ENVIRONMENTAL IMPACT ASSESSMENT STUDY REPORT

FOR THE PROPOSED INSTALLATION OF AN INCINERATOR FACILITY AT NACHU VILLAGE, NACHU SUB-LOCATION, KARAI LOCATION OF LUSIGETTI WARD IN KIAMBU COUNTY

CLIENT:		PREPARED BY
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JUNE 2020

CERTIFICATION

We, the under signed, hereby approve that all information given here in this report is accurate and true according to the best of our knowledge and understanding.

PRELIMINARY PROJECT DETAILS

Location of Project:	L. R. Karai/Lussigetti/1078 of Kiambu County
GPS Coordinates:	S01°16.735' E36° 36.188'
Neighbours:	Agricultural and Residential facilities
Nature of Activity:	Incinerator for Combustible Hazardous Waste including HCW
Project Proponent	Takataka Solutions Limited
Contact Person:	Norah Nyagah
Position of Contact Person:	Partnerships Manager
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Date of Audit:	June 2020

Signature……..……**Date** ……..……
For Project Proponent

ENVIRONMENTAL AND SOCIAL AUDIT EXPERTS

This EIA Study Report for the Proposed Installation of an Incinerator was prepared by Devlink Resources Consultants. Members of Devlink involved included the following:

- Patrick K. Kyalo (Lead Expert/ Lead Consultant)
- Timothy M. Kamau (Associate Expert/Data Collection/Reporting)
- Mr. Mike Nderitu (Lead Expert/ Data Collection/Reporting)
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- George K. Muthoka / Joyce Ngina Josiah (Community Development and Technical Advisor/ Sociologists and Occupational Health and Safety Expertise)
- Ms. Yvonne Khasandi (Associate Expert/Data Collection)
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- Ms. Charity Kita (Data Collection)

Signature: ……..…… DATE……..……
For Environmental Audit Experts

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ACRONYMS

asl	above sea level
CBD	Convention on Biological Diversity
CDE	County Director of Environment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO	Carbon Monoxide
COP	Conference of Parties
CSDS	Chemical Safety Data Sheets
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
EOSH	Environmental and Occupational Safety and Health
ESA	Environmental and Social Audit
ESIA	Environmental and Social Impact Assessments
ESMP	Environmental and Social Management Plan
GoK	Government of Kenya
HAIs	Health Care-Associated Infections
HBV	Hepatitis B Virus
HCW	Health Care Waste
HCWM	Health Care Waste Management
HFC	Hydrofluorocarbons
IESA	Initial Environmental and Social Audits
ILO	International Labour Organization
IPC	Infection Prevention and Control
MoH	Ministry of Health
MSDS	Material Safety Data Sheets
NCA	National Construction Authority
NEAP	National Environmental Action Plan
NEMA	National Environment Management Authority
NPEP	National Poverty Eradication Plan
OP	Operating Policy
OSH	Occupation Safety and Health
OSHA	Occupational Safety and Health Act
PCDDs	dioxins (polychlorinated dibenzo-para-dioxins
PCDFs	Polychlorinated Dibenzofurans
PFC	Perfluorinated Compounds
PHO	Public Health Officer
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
SDG's	Standard Development Goals
SOP	Standard Operations Procedures
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WRA	Water Resources Authority

EXECUTIVE SUMMARY

Takataka Solutions Limited is proposing to install a modern incinerator on its leased land where they are currently licensed to carryout waste sorting with the intention of incinerating all the combustible hazardous waste including Health Care based Wastes form the surrounding healthcare facilities in Nachu area such as Lussigetti Hospital.

According to the World Bank's Operating Policies (OP), the Environmental Management and Coordination (Amendment) Act of 2015, The Environmental Impact Assessment (EIA) and Environmental Audit Regulations as revised in 2016 as well as the Legal Notice Number 31 of 2019, such as project should be subjected to an EIA Study. EIA is a planning tool generally accepted as an integral component of sound decision-making. EIA is to give the environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activity before action is taken. Early identification and characterization of critical environmental impacts allow the public and the government to form a view about the environmental acceptability of a proposed developmental project and what conditions should apply to mitigate or reduce those risks and impacts. This particular EIA sought to review the potential overall environmental and social performance of the proposed incinerator in terms of regulatory compliance, incineration process, waste material management, emission compliance, safety and health management system, environmental management system and information disclosure. This is because an EIA is a tool for environmental conservation and has been identified as a key requirement for proposed projects such as the said incinerator, to ensure sustainable operations with respect to environmental resources and socio-economic activities in the neighbourhood of such projects.

This particular EIA involved meetings with representatives of Takataka Solutions Limited management, site visit/data collection, public consultation/questioning (for public participation), documentation and review, consolidation of findings, exit meeting and preparation of the EIA Study Report that includes an Environmental and Social Management Plan (ESMP).

The EIA established that the proposed incinerator has not yet been installed. But if installed and put into optimal use as per the manufacturers user guide and as per the expectations, its benefits will be immeasurable in terms of efficiency in disposing hazardous waste as well as Health Care Waste (HCW). But not to be forgotten is that some challenges that maybe encountered and are central to the incinerator could be lack of adequate fuel to support its operations. Other challenges could be related to Occupation Health and Safety (OSH) of the operators due to lack of adequate and appropriate Personal Protective Equipment (PPE. Other potential social and environmental impacts related to the implementation and operationalization of the proposed incinerator could include overall Environmental Management of the facility, proper waste segregation, proper functionality of the incinerator, fencing off the waste management site/the incinerator site, Noise Monitoring and Control, Air Quality Monitoring and Control, need for an Environmental Management System Set Up, Staff Awareness and Training; Community Health and Safety Issues, Adequacy of the Design of the Shelter, Emergency Response Procedures, Sanitation and Cleanliness of the Facility, Fire Outbreak Preparedness, Adequacy of the Design of the Shelter and Compliance to Environmental Standards.

But it should be noted that, addressing the identified potential challenges would result in numerous environmental and social benefits as far as the environment is concerned with regard to proper efficient disposal of combustible hazardous waste including HCW in Lussigeti and its environs. Given that the Takataka Solutions Limited management is committed to implementing all the recommendations made to ensure optimal operation of the incinerator, they could be licensed to install and operationalize the incinerator.

1. CHAPTER ONE: INTRODUCTION

1.1. Background Information

Takataka Solutions Limited are proposing to install a modern incinerator in one of their waste sorting and recycling sites located in Nachu area of Lussigeti ward. Takataka Solutions Limited is a company in collection of waste from households, businesses and factories. They take the waste to their decentralized sorting sites where it is sorted into more than 40 fractions. They then compost the organic waste into high quality compost; the other materials (paper, plastic, glass and metal) which they either recycle themselves or do so through their partners. This allows them to achieve one of the highest recycling rates in the country.

1.2. Project Objectives

The Project Development Objective is to improve waste management

1.3. Project Description

1.3.1 Features of the Incinerator

The proposed incinerator will entail various components that will complement each other to ensure that wastes a burnt as per the desired levels and as per the design of the incinerator. The incinerator will be sheltered in a permanent structure designed to ensure that there is adequate ventilation. The shelter will be made of the Walling-natural building blocks; the Roofing-metallic trusses, iron sheets; a Burglar proof metallic door; Metallic grills (for ventilation); and Cemented floor. The incinerator machine entails the following components:

- Manual loading door
- Main/Primary and Secondary combustion chambers
- After burning emission control chamber
- Gas Scrubber
- Discharge chimney
- Control panel
- Fuel storage

i. Manual Loading Door

This is the inlet where solid waste will be fed to the incinerator.

ii. Primary Chamber

This is where combustion of the solid wastes will take place. The chamber is cylindrical in shape and will horizontally be fitted along the floor of the incinerator shelter.

iii. Secondary Chamber

The products of combustion from the primary chamber exhaust into the secondary chamber to be located directly above the primary chamber for treatment. Within the secondary chamber additional heat and air will be added to promote combustion in the gaseous phase, thus ensuring complete combustion of the volatile and solid particulate.

iv. Gas Scrubber/Emission Control Chamber

Treated gases will exit the secondary chamber, directly into the emission control chamber, what is popularly known as scrubber. The gas scrubber/ washer are designed to suck all particulate matter from gases emanating from the burning chambers. Particulate matter from combustion process will be entrained within the spray of water which also will cool the gases to approximately 650°C.

v. Control Panel

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

vi. Fuel Storage

The fuel (diesel) used in burning the wastes will be stored in metallic tank raised above the main machine. The incinerator will be fed by a 400L diesel tank. The tank will be fitted with a level gauge, feeder and fill pipes and a breather.

1.3.2 Neighbors to the Facility

The proposed incinerator site is currently unmarked for waste sorting, recycling/composting and re-use. The site also neighbours quarry sites, farms and residential facilities.

Figure 1: A Google Earth Image showing the location of the project site in relation to its neighbors

1.3.3 Expected Operation Procedures of the Incinerator

The following are the expected operation procedures in the event of incinerating HCW.

1.3.3.1 Ash Removal

Startup of the incinerator begins with removal of the ash generated from the previous operating cycle. The following are guidelines for good operating practice:

- In general, allowing the incinerator to cool overnight is sufficient for the operator to remove the ash safely. This cooling can take as long as 8h.
- The operator should open the ash cleanout door slowly both to minimize the possibility of damage to the door stop and seal gasket and to prevent ash from becoming entrained.
- The operator should exercise caution since the refractory may still be hot and the ash may contain local hot spots, as well as sharp objects.
- The ash and combustion chamber should not be sprayed with water to cool the chamber because rapid cooling from water sprays can adversely affect the refractory.
- A flat blunt shovel, not sharp objects that can damage the refractory material, should be used for clean-up.
- Avoid pushing ash into the under fire air ports.
- Place the ash into a noncombustible heat resistant container, i.e., metal. Dampen the ash with water to cool and minimize fugitive emissions.
- Once the ash has been removed and prior to closing the ash cleanout door, the operator should inspect the door seal gasket for frayed or worn sections. Worn seal gaskets should be replaced.

- To prevent damage to the door seal gasket, the operator should close the ash cleanout door slowly and should not overtighten the door clamps.
- Overtightened door clamps may cause the seal gasket to permanently set and allow infiltration of outside air around the door face.

1.3.3.2 Waste Charging

The operator has the option of selecting which items are included in a particular charge. Waste properties which should be considered when the waste is segregated into charges include the heating value; the moisture content; the plastics content, and the amount of pathological wastes.

The heating value and moisture content of waste affects the performance of an incinerator. A charge of waste with a very high heating value may exceed the thermal capacity of the incinerator. The result is high combustion temperature, which can damage the refractory of the incinerator and can result in excessive emissions. Similarly, a charge of waste with very high moisture content will not provide sufficient thermal input, and the charge will require the use of more auxiliary fuel than usual. Plastic items are an example of materials with high heating values. Large quantities of plastic, which may contain polyvinyl chloride, should be distributed through many waste charges, not concentrated in one charge, if possible.

When sorting loads of waste to be incinerated, the operator should try to create a mixture of low, medium, and high heating value wastes in each charge, if possible, to match the design heat release rate of the incinerator. In general, lighter bags and boxes will contain high levels of low density plastics which burn very fast and very hot. Heavier containers may contain liquids (e.g., blood, urine, dialysis fluids) and surgical and operating room materials which will burn slowly. As a general rule for segregating waste into charges, the operator may mix light bags and heavy bags to balance the heating value of each charge. If several different types of waste, (i.e., red-bag, garbage and trash) are being charged to the incinerator, charging the incinerator with some of each waste type is better than charging it with all of one waste type. Special care should be taken to avoid overcharging the incinerator (beyond its intended use) with anatomical wastes. Prior to initiating charging, operation of the combustion air blowers and ignition and secondary burners should be checked following the manufacturers' recommendations. The proper operation of the primary and secondary burners is best achieved by observing the burner flame pattern through the view ports in the incinerator wall or in the burner itself as well as the control panel.

The incinerator is charged cold and because the waste units generally are small, they are usually loaded manually. The waste is loaded into the ignition/primary chamber, which is filled to the capacity recommended by the manufacturer. Typically, it is recommended to fill the incinerator completely, but not overstuffing the chamber. Overstuffing can result in blockage of the air-port to the combustion chamber and in premature ignition of the waste and poor performance (i.e., excess emissions) during startup. Overstuffing also can result in blockage of the ignition burner port and damage to the burner. After charging is completed, the charge door seal gasket is visually checked for irregularities. The door is then slowly closed and locked. The charge door seal gasket should then be inspected for any gaps that would allow air infiltration into the primary chamber. Once operation is initiated, no further charges should be made until the next operating cycle is initiated, i.e., after cooldown and ash removal.

1.3.3.3 Waste Ignition

Prior to ignition of the waste, the secondary combustion chamber should be preheated to a predetermined temperature by igniting the secondary burner. A minimum secondary chamber temperature of 980°C (1800°F) is recommended prior to ignition of the waste. After the secondary chamber is preheated, the secondary combustion air blower is turned on to provide excess air for mixing with the combustion gases from the primary chamber. The primary chamber burner is ignited to initiate waste combustion. When the primary chamber reaches a pre-set temperature, mostly 600°C (i.e., the minimum operating temperature for the primary chamber) and the waste

combustion is self-sustaining, the primary burner is shutdown. The primary combustion air and secondary combustion air are adjusted 'to maintain the desired primary and secondary chamber temperatures. (Typically this adjustment is automatic and can encompass switching from high to low settings or complete modulation over an operating range.) During operation, the primary burner is reignited if the ignition chamber temperature falls below a pre-set temperature. Similarly, the secondary burner is reduced to its lowest firing level if the secondary chamber rises above a pre-set high temperature setting. Again, control of the burners, like the combustion air, is typically automated.

1.3.3.4 Burndown

After the waste burns down and all volatiles have been released, the primary chamber combustion air level is increased to facilitate complete combustion of the fixed carbon remaining in the ash. The temperature in the primary chamber will continue to decrease indicating combustion is complete. During the burndown period, the primary burner is used to maintain the primary chamber temperature at the predetermined minimum level of the operating range. The length of time required for the burndown period depends on the incinerator design, waste characteristics, and degree of burnout desired. A typical burndown period is 2 to 4h. When combustion is complete, the primary and secondary burners are shutdown. Shutdown of the secondary burner which initiates the cooldown period usually is automatically determined by a pre-set length of time into the cycle. The combustion air blowers are left operating to cool the chambers prior to subsequent ash removal. The blowers are shutdown when the chambers are completely cooled or prior to opening the ash door for ash removal. Cooldown typically lasts 5 to 8h.

The final step in the cycle is examination of ash burnout quality. Inspection of the ash is one tool the operator has for evaluating incinerator performance. The operator should look for fine gray ash with the consistency of ash found in the fireplace at home or in the barbeque grill. Ash containing large pieces of unburned material (other than materials which are not combustible, such as cans) shows that incinerator performance is poor. It may be necessary to return these large pieces of material to the incinerator to be re-burned. Ash color also is an indicator of ash quality. White or gray ash indicates that a low percentage of carbon remains in the ash. Black ash indicates higher carbon percentages remaining. Although carbon remaining in the ash indicates that available fuel has not been used and combustion has not been complete, the fact that carbon remains in the ash is not in itself an environmental concern or an indicator that the ash is not sterile. Nonetheless, ash color can be used to assist the operator in evaluating burnout and incinerator performance.

1.3.3.5 Special Considerations

If pathological waste is being burned, the ignition burner should be set to remain on until the waste is completely burned. Further, the volume of waste charged needs to be significantly reduced. The time required to burn an equivalent volume of such waste will be extended, since the waste contains high moisture and low volatile content. To destroy pathological waste efficiently, the waste must be directly exposed to the burner flame; consequently piling pathological waste in a deep pile (e.g., filling the entire chamber) results in inefficient combustion.

1.4 Justification for Preparation of Safeguards Instruments/EIA

According to the World Bank, the proposed project can be assigned environmental category B and the safeguards policy triggered for the project is Environmental Assessment (OP/BP 4.01) and Indigenous People (OP/BP 4.10). This means that before implementation, the project proponent, Taktaka Solutions Limited, should subject the proposed incinerator project to an ESIA. The same is required by the EMCA 2015, the EIA and Audit Regulations as Amended in 2016 as well as the provisions of the Legal Notice Number 31 of 2019. The ESIA/IEA is meant to ensure that there is due diligence in the application of environmental and social safeguards during installation and to plan for mitigating and/or addressing any potential adverse risks in operation of the incinerator.

The ESIA is required for systematic documentation, objective determination and evaluation of the environmental and social liabilities of the incinerator installation, commissioning and operations to ascertain if they are in full compliance with the World Bank Safeguard policies/ the EMCA 2015, the EIA and Audit Regulations as Amended in 2016 as well as the provisions of the Legal Notice Number 31 of 2019 including the recommended Waste Management Plan (WMP). The ESIA indicates compliance with environmental, health and safety guidelines with the objective of protecting the health of workers and the general public living in the area as well as to protect the biophysical environment. It has also generated an ESMP that describes in detail the mitigation measures to be carried out, the costing, scheduling and responsibility of such measures.

1.4.1 Definition and Purpose of the ESIA/EIA

ESIA/EIA is a systematic analysis of projects, policies, plans or programmes to determine their actual and potential environmental impacts, the significance of such impacts and to propose measures to mitigate the negative ones, *(NEMA, 2002).* ESIA is mainly used at the level of specific developments and projects such as the mentioned proposed incinerator *(IIED, 1998).* They are site specific, i.e. for specific and definable projects, in specific areas; hence each project must have its own ESIA report. The underlying key principles of ESIA are that every person is entitled to a clean and healthy environment and that every person has a duty to enhance and safeguard the environment.

ESIA is both a planning and decision-making tool. As a planning tool, ESIA presents methodologies and techniques for identifying, predicting and evaluating actual and potential environmental impacts of projects, policies, plans and programmes in the project cycle (planning, implementation, operation and decommissioning phases). As a decision making tool, the ESIA process presents decision-makers with the information necessary to determine whether or not a project should be fully implemented (if still under implementation or not yet implemented), its operations continued or not (if up and running), and if it should, then under what conditions (*NEMA, 2002*). Thus, this ESIA is intended to identify the impacts-actual and potential (both beneficial and adverse-environmental (biophysical) social and economic) of the proposed incinerator project implementation and operation activities.

1.4.2 The ESIA Scope

The scope of the ESIA covered all the civil works and installation related activities of the incinerator, as well as the operationalization of the whole project. The scope of activities included the following:

- Determining how far the activities that relate to the installation of the incinerator as well as its operation can be made to comply with sound environmental health and safety (EHS) management practices.
- Identifying any mitigation to improve its implementation and operation effectiveness.
- Identifying gaps in environmental management measures and to prepare an action plan that will be implemented during the rest of the project period
- Preparing this environmental study report on the potential environmental consequences on the environment, and socio-economic impact of the operationalization of the incinerator if any.

1.4.3 Methodology Applied for the ESIA

There are many different plans and processes for carrying out ESIAs. Different circumstances require different approaches and plan frameworks. But for this particular ESIA, we applied the following process:

a. **Pre-ESIA Activities** which included:
    i. Selection of EIA team;
    ii. Via the guide/contact person from the project proponent, reached out to the area administration and
    iii. There was planning of the ESIA.

b. Site Activities: which were divided into 5 steps as follows:

i. Understanding and Assessment of planned environmental controls;
ii. Gathering of ESIA evidence;
iii. Evaluation of ESIA findings; and

Under this section, there was also environmental scoping that provided the key environmental issues being addressed in this report. It involved the following activities:

i. Desktop studies and interviews;
ii. Public consultation;
iii. Physical inspection of the project site and surrounding areas; and

c. Post ESIA Activities that include:

i. Production of draft ESIA Study report that included draft ESMP;
ii. Review of the draft ESIA Study report by the client;
iii. Production of a final ESIA Study report; and

The above process was married with the following activities:

- Preparation of an ESIA framework and checklist;
- Review of relevant documents such as the existing environmental laws and regulations, World Bank standards, OSH standards, good EHS management practices, the client's own environmental and social management plans etc. and existing environmental and occupational safety and health (EOSH) legislations and standards, environmental safeguard policies and guidelines of the World Bank and the Government of Kenya;
- Site visits to where the incinerator will be installed. This included physical inspection of the proposed facility site and its surroundings, carrying out interviews and discussions with project management and staff, and holding meetings and consultations with key stakeholders and the surrounding communities;
- Verification of procedures, instructions and equipment in place designed to help the facility apply and adhere to existing environmental laws, regulations, World Bank standards/policies, OSH standards, good environmental and safety management practices
- Evaluation of findings, developing a prioritized list of concerns related to past and ongoing activities at the facility site, making recommendations (including the Expert's opinion of the facility's overall environmental/social performance with respect to regulatory, World Bank corporate environmental requirements, cost estimates for the implementation of remediation action plan deemed necessary to comply with World Bank's Safeguard Policies and those provided for by the EMCA, 2015 etc.);
- Review of safeguards instruments including WMP for the safe and effective management of the incinerator by incorporating appropriate remediation measures; and
- Compiling the findings / report writing

CHAPTER TWO: BASELINE INFORMATION

This chapter provides the main features of the baseline biophysical and socio-economic information of the project area. Environmental description, also known as baseline studies, is intended to establish the present state of the environment, taking into account changes resulting from natural events and from other human activities (Glasson, 1994; Canning et al., 2003). If an environmental description is flawed, this will reduce the accuracy of subsequent predictions and mitigation measures (Canning et al., 2003).

2.1 Location of the Project

The proposed incinerator is to be installed within a compound located at Nachu Village, Nachu Sub-Location, Karai Location on Lussigetti area of Kiambu County. As earlier indicated, the site is surrounded by quarry sites, agricultural farms as well as residential facilities.

Figure 2: The Proposed Project Site as at the EIA Scoping phase

2.2 Kiambu County

Kiambu County is one of the 47 counties in the Republic of Kenya. It is located in the central region and covers a total area of 2,543.5Km^2 with 476.3Km^2 under forest cover according to the 2009 Kenya Population and Housing Census. Kiambu County 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 360 31'and 370 15'East.

2.2.1 Physical and Topographic features

Kiambu County is divided into four broad topographical zones; Upper Highland, Lower Highland, Upper Midland and Lower Midland Zone. The Upper Highland Zone is found in Lari constituency and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550metres above sea level (asl). It is dominated by highly dissected ranges and it is very wet, steep and important as a water catchment area. The lower highland zone is mostly found in Limuru and some parts of Gatundu North, Gatundu South, Githunguri and Kabete constituencies. The area is characterized

by hills, plateaus, and high-elevation plains. The area lies between 1,500-1,800metres asl and is generally a tea and dairy zone though some activities like maize, horticultural crops and sheep farming are also practiced.

The upper midland zone lies between 1,300-1,500metres asl and it covers mostly parts of Juja and other constituencies with the exception of Lari. The landscape comprises of volcanic middle level uplands. The lower midland zone partly covers Thika Town (Gatuanyaga), Limuru and Kikuyu constituencies. The area lies between 1,200-1,360metres asl. The soils in the midland zone are dissected and are easily eroded. Other physical features include steep slopes and valleys, which are unsuitable for cultivation. Some parts are also covered by forests.

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. Their fertility is 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. These soils are found in the highlands, mostly in Gatundu South, Gatundu North, Githunguri, Kiambu, Kiambaa, Lari, Kikuyu, Kabete and Limuru Constituencies. 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 can support drought resistant crops such as soya beans and sunflower as well as ranching. These soils are mostly found in parts of Juja, Thika Town, Ruiru, Kabete, Limuru, Gatundu North and Gatundu South Constituencies.

Most parts of the county are covered by soils from volcanic footbridges. These are well drained with moderate fertility. They are red to dark brown friable clays, which are suited for cash crops like coffee, tea and pyrethrum. 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. However, these areas are suitable for ranching and growth of drought resistant crops

2.2.2 Ecological Conditions

Water in the county is from two principal sources-surface and sub-surface. The county is divided into several sub-catchments 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

2.2.3 Climatic Conditions

The county experiences bi-modal type of rainfall. The long rains fall between Mid-March to May followed by a cold season usually 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 of Thika Town constituency 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 highlands areas of Limuru and some parts of Gatundu North, Gatundu South, Githunguri and Kabete constituencies, to 34°C in the lower midland zone found partly in Thika Town constituency (Gatuanyaga), Kikuyu, Limuru and Kabete constituencies (Ndeiya and Karai). July and August are the months during which the lowest temperatures are experienced, whereas January to

March is the hottest months. The county's average relative humidity ranges from 54 percent in the dry months and 300 percent in the wet months of March up to August

2.2.4 Environment and Climate Change

i. Major Degraded Areas / Hotspots And Major Contributions To Environmental Degradation

Over the years there has been an increase in environmental deterioration through depletion of resources, destruction of ecosystem, habitat and extinction of wildlife. Kiambu County is not exceptional from the increased environmental degradation. The major degraded areas in Kiambu County are forests and Rivers. Kinale and Kieni forests have faced major deforestation due to population demand for shelter and fuel and encroachment for farming demand. In addition rivers like Athi River have experienced much pollution through dumping of waste which comprises of effluents, agricultural chemicals and industrial waste.

ii. Environmental Threats

The major contributors to environmental degradation are; increased population leading to massive deforestation and encroachment of water catchment areas. In addition, industries have emissions that have led to lot of air and water pollution. Farming has also led to pollution due to the release of various agrochemicals in the water sources.

iii. High Spatial And Temporal Variability Of Rainfall

The county experiences bi-modal type of rainfall. The long rains fall between Mid-March to May followed by a cold season usually 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 of Thika Town constituency 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 highlands areas of Limuru and some parts of Gatundu North, Gatundu South, Githunguri and Kabete constituencies, to 34°C in the lower midland zone found partly in Thika Town constituency (Gatuanyaga), Kikuyu, Limuru and Kabete constituencies (Ndeiya and Karai).

iv. Change In Water Levels Or Glacier

There are various areas that act as reservoir for biodiversity in Kiambu County which are prone to destruction be it through natural means or by human being interference. This has been brought about by overgrazing, encroachment and poor agricultural practices, high population pressure, high cases of fire outbreaks, pollution through dumping of waste (effluent, agricultural chemicals and industrial waste), lack of law enforcement and policy implementation and increased quarrying. These areas include: Manguo, Ruromo and Ondiri swamps, Sulmac in Kamae area which is a source of River Karimenu, Kijabe- Escarpment forest strip, catchment of River Bathi and Gatamaiyu in Kinale, Muguga gully, Limuru (Kwambira), Kiracha and Riu Nderi wetland and Shauri quarry.

This in turn has led to loss of habitat that act as a breeding ground for various water birds, interference with water discharge system resulting to reduced volumes of rivers, high cost of water treatment, eutrofication effects on water quality and quantity, land degradation, soil erosion, landslides during rainy seasons and increased incidences of waterborne diseases(typhoid).

v. Solid Waste Management Facilities

The main solid waste management facilities in Kiambu County include landfills, dumpsites, incinerators, recycling facilities and bio-decomposers. These solid waste management facilities are spread across the county as follows: 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 Takataka Solutions (sorting, recycling and composting facilities) in Kiambaa Sub County and three Alternative Energy

Solutions Limited (AESL) - Prolysis plants in Thika Sub County. There is also a bio decomposer in Kangoki composting facility which is a pilot project in Thika.

2.2.5 Water and Sanitation

a) **Water Resources**

Kiambu County is endowed with both surface and ground water resources. The county has sixteen permanent rivers originating from Aberdare Ranges, which is the main water tower for the county. The major rivers that meet the county water demand are; Ndarugũ, Thiririka, Ruiru, Kamiti and Kiu, all of which eventually drain into Athi River, and five major wetlands are; Kikuyu, Lari, Theta, Kiganjo and Gacii wetlands. The eastern part of the county that includes Thika, Gatundu, Ruiru and Juja is well endowed with surface water from Chania, Thika, Karimenu, Ruabora, Ndarugu, Thiririka, Theta, Mukuyu, Ruiru rivers. The western part of the county that includes Limuru, Kikuyu, Kiambu, Karuri, Lari and Githunguri areas has limited surface sources, hence rely on underground water sources mainly boreholes. However, some areas of ground water sources have high fluoride levels which cause negative effects to both people and livestock, and residue effects in crops.

i. Ground Water

Kiambu County is in a sub catchment that has two main aquifers; the Nairobi Suite and Basement Athi Suite. Most of the ground water exploitation is from the Nairobi Suite which is predominantly volcanic. Kiambu County falls within the Upper Athi Catchment Area, which covers seven Sub-Catchments as shown below:

- 3BA (Nairobi)
- 3BB (Kamiti, Riara, Kiu),
- 3BC (Ruiru, Mukuyu, Gatamaiyu),
- 3BD (Thiririka& Theta),
- 3CB (Ndarugu, Ruabora)
- 4CA (Chania)
- 3DA (Athi River)

b) Water Supply Schemes

Kiambu County has a total of eight main licensed water management institutions. Table 16 shows the area coverage and the percentage sustainable water usage by every company.

Table 1: Water companies area coverage and water usage

	Water company	Area coverage in KM^2	Percentage of sustainable use
1.	Limuru Water And Sewerage Company	108	80
2.	Kikuyu Water Company	41	80
3.	Kiambu Water And Sewerage Company	32	80
4.	Karuri Water And Sanitation Company	18	60
5.	Githuguri Water And Sanitation Company	98	87
6.	Ruiru Juja Water And Sewerage Company	175	76
7.	Gatundu Water And Sanitation Company	150	80
8.	Thika Water And Sewerage Company	254	65

In the county, 46% of the populations are not currently served by Water Service Providers (WSPs). These areas are served by Community Based Organizations (CBOs), private water operators and direct abstraction from surface and ground water sources.

c) Water Sources And Access

Access to clean and safe water is foundational to the development of any community. The county is endowed with 16 permanent rivers; the distance covered to access water from the nearest water accessibility point differs from one

Sub County to another. The shortest distance covered is less than a kilometer while the largest in about 2.5 kilometers. 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 kilometer. In Kiambu and Kabete sub counties the distance is approximately 1.5 kilometers while Kikuyu records the longest distance of about 2.5 kilometers.

d) Water Management

To achieve sustainable development goal six: Ensure availability and sustainable management of water and sanitation for all. The county is using the following policy measures in water management:

- Enactment of the Kiambu Water and Sanitation Services Act, 2015
- Setting up of monitoring and evaluation unit
- Establishment of county WASH club
- Working with GIZ IWaSP to stimulate the formation of a water stewardship platform to implement water resources management activities in Kiambu catchment area. The multi-stakeholder platform has representatives from public, private and civil society organizations.
- Strengthening reporting systems by WSPs
- Increasing investment in human resources for the sector
- Develop and implement a water resource mobilization strategy.
- Ensure and ring fence water sector revenues
- Promote bottom-up budget preparation
- Lobbying for more budgetary allocation in water resources management
- Create and institutionalize a county water sector fund
- Leverage additional resources from the private sector, civil society organizations and other stakeholders to promote sector investment
- Increase private sector participation in decision making

e) Sanitation

Kiambu County is considered as 60% urban with numerous peri-urban centres mushrooming rapidly due to land use changes. There are twelve main urban centres within the county out which five, namely, Thika, Kiambu, Limuru, Ruiru and Juja urban centres have convectional sewer treatment system. Apart from Ruiru and Juja treatment works the rest of the treatment works are old and currently treating beyond their design limits. Kiambu sewer treatment works was constructed in 1974 with a design capacity of 1,000m3/day. It's currently receiving 2,200m3/day; Limuru was commissioned in 1984 with a design capacity of 540m3. It's currently receiving 2000m3/day; Thika was constructed 1978 with a design capacity of 6,100m3/day. The treatment facility is currently receiving 8,000m3/day. In order to address the shortfalls, Thika treatment works is currently undergoing improvement through donors funding. The capacity of the treatment system is expected increase by 6500m3/day when the on-going improvements works are completed. The following improvement is on-going in Thika and Juja

- Construction of 77km of trunk and reticulation sewers in Juja and Thika towns
- Construction of 12No. Thika ponds (6,522m³/day).
- Modification of existing Thika ponds.

Ruiru and Juja convectional treatment sewer works are work in progress. Upon completion Ruiru is design to treat 10,000m/day and total length of 57, 440m of trunk and subsidiary sewer line installed. Juja upon competition will treat 10,000m3/day and total 7700m lengths of trunk sewers line installed. 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

5persons/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.

An engineered semi aerobic landfill (Fukuoka method) has been constructed at Kangoki in Thika Sub County, the first of its kind in Kenya and Africa which will handle solid waste from sub-counties after commissioning. The new technology will be accompanied by a modern waste segregation unit and composting facility. A pylorisis plant for recycling plastic waste is in place at Thika Sub County. Public sanitation facilities in Kiambu county are spread in the various sub counties as follows: 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.

2.2.6 Vegetation Resources

The area and its environs are characterized by the presence of mostly exotic tree species and food crops such as maize and beans and grass cover.

Figure 3: A photo showing some of the vegetation within and around the project site

2.2.7 Land Use Compatibility

The proposed development is located in an environment that does not present a challenge to land use planning considering that there are quarrying sites which in the future could be put into sanitary landfill use.

2.2.8 Service Activities

2.2.8.1 Sewerage Services

There is no trunk sewer line near the project site; hence the project will make use of septic tank system.

2.2.8.2 Electricity Supply

The national electricity grid passes near the project site; hence the proposed project site will be connected to the main line. But to be noted is that the project proponent plans to have the area transformer upgraded to a larger one or having an extra one installed within the project site.

2.2.8.3 Water Supply

The proposed project plans to install roof water harvesting facilities adequate enough to provide water for its use.

Figure 4: Some of the large roof surfaces to be utilized for rain water harvesting

2.2.8.4 Solid Waste Management

To be noted is that the whole project site as well as the proposed project is meant for sustainable solid waste management.

CHAPTER THREE: REVIEW OF T HE APPLICABLE ENVIRONMENTAL LEGISLATION IN KENYA

3.1 Introduction

The desire for continued improvement on our ways of life comes with associated impacts on the environment. Environmental and social impacts can either be positive, negative, small scale, large scale, temporary, permanent, reversible or irreversible depending on the nature of the activities/ operations being undertaken. In the face of continued development and the resultant impacts, a lot of legislative tools have been developed to guide development, safeguard environmental and social concerns and offer probable mitigation interventions. Kenya has a policy, legal and administrative framework for environmental and social management. Under the framework, NEMA is responsible for ensuring ESIAs on proposed facilities as per the provisions of EMCA and other International regulations.

ESIAs are carried out in order to identify positive and negative (actual and potential) impacts associated with proposed projects such as the proposed incinerator, with a view to taking advantage of the positive impacts and developing mitigation measures for the negative ones. The guidelines on ESIAs are contained in sections 58 to 67 of EMCA. Hence, ESIA is a tool for environmental conservation and has been identified as a key requirement for proposed projects to ensure sustainable operations with respect to environmental resources and socio-economic activities in the neighborhood of such project sites. The government has established guidelines to facilitate the process on ESIAs that are contained in the Kenya Gazette Supplement No. 56, legislative supplement No. 31, Legal Notice No. 101 of 13th June 2003 and which was revised in 2016 not forgetting the Legal Notice Number 31 of 2019. In order to ensure that the incinerator implementation and operations conform to existing policies and laws, a number of key statutes were reviewed. These included the following:

- Environmental Management Principles and Guidelines
    - The Principle of Waste Management
    - The Principle of Environmental and Social Assessment
    - Sustainability
    - Principle of Intergenerational Equity
    - Principle of Prevention
    - Precautionary Principle
    - Polluter Pays Principle
    - Principle of Public Participation
- The Kenya National Environmental Action Plan (NEAP, 2009-2013)
- Policy Framework
    - Environmental Policy Framework
    - National Injection Safety and Medical Waste Management Policy 2007
    - Infection Prevention and Control Policy and Guidelines 2011
    - The National Poverty Eradication Plan (NPEP), 1999-2015
- Legal Framework
    - Environment Management Coordination Act (Amendment) 2015.
    - Physical Planning Act, (Revised Edition, 2012).
    - The Environmental (Impact Assessment and Audit) Regulations, 2003 (revised in 2016).
    - County Government Act, 2012 (Amended in 2014)
    - EMCA (Waste Management) Regulations, 2006 Legal Notice No.12.
    - Environmental Management and Co-ordination (Fossil Fuel Emission Control) Regulations, 2006
    - Environmental Management and Co-ordination (Air Quality) Regulations, 2014

- The Public Health Act, Cap 242.
- Occupational Safety and Health Act (OSHA) 2007.
- Noise and Excessive Vibrations Pollution Control Regulations 2009.
- Way leave Act, 2010.
- Water Act of 2016

- The Constitution of Kenya, 2010
- International Conventions and Treaties
  - Sustainable Development Goals (SDG's)
  - United Nations Framework Convention on Climate Change (UNFCCC)
  - Kyoto Protocol
- Safeguard Policies for World Bank
  - Environmental Assessment Operational Policy OP/BP 4.01
  - Indigenous people OP/BP 4.10
  - World Bank Group Environmental, Health and safety guidelines

3.2 Environmental Management Principles and Guidelines

The project proponent is expected under law and best practice to consider and exercise all the principles and tenets of sustainable environmental and socio-economic management. Some of these principles are as discussed below:

3.2.1 The Principle of Health Care Waste Management/Waste Management

Provision of health care services is core at the mandate of every government in the world; a healthy population is a productive nation/ state. Whereas provision of affordable and quality healthcare is the desire of every government; there are challenges in management of wastes generated by health care providing facilities both private and public. It is against this background the MoH in Kenya has formulated policies to guide in management of HCW. The ministry has gone further and formulated strategic plans to implement HCW management over a specific period of time; currently the "Health Care Waste Management Plan 2016–2021" is being implemented. HCW entails all the waste generated within health-care facilities, research centres and laboratories related to medical procedures (WHO, 2014). In addition, it includes the same types of waste originating from minor and scattered sources, including waste produced in the course of health care undertaken in the home (e.g. home dialysis, self-administration of insulin, recuperative care) (WHO, 2014). For purposes of HCWM in Kenya, the wastes are classified into categories such as Infectious; Highly Infectious; Non-Infectious/ non-hazardous (non-clinical); Chemical and Pharmaceutical; Sharps; and Radioactive waste. The waste categories should be segregated at source and packed in colour coded packaging materials as indicated in the table below.

Table 2: Colour Codes system used in Kenya

Type of Waste	Colour of container and markings	Type of Container.
Sharps	Yellow (Marked 'Sharps')	Puncture proof
Infectious	Yellow	Strong leak proof plastic bag with biohazard symbol
Highly Infectious	Red (Marked Highly Infectious)	Containers capable of being autoclaved
Non-Infectious/ non-hazardous (non-clinical)	Black	Plastic Bag or container.
Chemical and Pharmaceutical	Brown	Plastic bag or Container
Radioactive waste	Yellow with black radio-active symbol	Lead Box

Such wastes should be disposed based on the type of wastes and the likely impact on the environment. Given that the proposed will be managing HCW, it is upon the project proponent to adhere to the said HCWM policies without fail.

3.2.2 The Principle of Environmental and Social Assessment

Environmental Assessment /ESIA just like financial audit strive to assess practices and operations in the use of resources and are defined as "systematic, documented, periodic and objective process in assessing an organization's activities and services". ESIAs are undertaken for various reasons and the major objectives of undertaking ESIAs are:

i) Promoting good environmental management;
ii) Facilitating management control of environmental practices;
iii) Assessing compliance with relevant statutory and internal requirements;
iv) Maintaining credibility with the public (local communities and relevant stakeholders);
v) Raising staff awareness and enforcing commitment to departmental environmental policy as stipulated in Standard Operations Procedures (SOP) or guidelines;
vi) Establishing the performance baseline for developing an Environmental Management.
vii) Exploring improvement/mitigation opportunities

Conducting an ESIA is no longer an option but a sound precaution and a proactive measure in today's heavily regulated environment in the wake of acknowledged importance of sound environmental management. Indeed, evidence suggests that ESIA has a valuable role to play, encouraging systematic incorporation of environmental perspectives into many aspects of an organisation's overall operation, helping to trigger new awareness and new priorities in policies and practices. The proponent should take all practical measures to ensure the implementation of the Environmental and Social Management Plan (ESMP) of either the approved ESIA (such as the one carried out for the incinerator leading to the production of this report) by carrying out environmental auditing (EA) on a regular basis. It is worth noting at this juncture that this ESIA was undertaken prior to construction and commissioning of the incinerator; in view of this the ESIA exercise identified all the potential and actual environmental and social impacts thereby developing an ESMP that will ensure sustainability in the use of the facility. The ESMP will also serve as the baseline in the future management and auditing of the facility.

3.2.3 Sustainability

The principle of sustainability requires that natural resources should be utilized in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. It strives for equity in the allocation of the benefits of development and decries short-term resource exploitation which does not consider the long-term costs of such exploitation.

3.2.4 Principle of Intergenerational Equity

The principle of sustainability should be examined together with that of intergenerational equity, which focuses on future generations as a rightful beneficiary of environmental protection. Essentially, the principle of intergenerational equity advocates fairness, so that present generations do not leave future generations worse off by the choices they make today regarding development. Its implementation requires the utilization of natural resources in a sustainable manner while avoiding irreversible environmental damage.

3.2.5 Principle of Prevention

The principle of prevention states that protection of the environment is best achieved by preventing environmental harm in the first place rather than relying on remedies or compensation for such harm after it has occurred. The reasoning behind this principle is that prevention is less costly than allowing environmental damage to occur and then taking mitigation measures.

3.2.6 Precautionary Principle

The precautionary principle recognizes the limitations of science, as it is not always able to accurately predict the likely environmental impacts of resource utilization. It calls for precaution in the making of environmental decisions where there is scientific uncertainty. Accordingly, it is closely related to the principle of prevention and can be viewed as the application of the principle of prevention where the scientific understanding of a specific environmental threat is not complete. The precautionary principle thus requires that all reasonable measures must be taken to prevent the possible deleterious environmental consequences of development activities. Further, it demands that scientific uncertainty should not be used as a reason for not taking cost effective measures to prevent environmental harm.

3.2.7 Polluter Pays Principle

The polluter pays principle requires that polluters of natural resources should bear the full environmental and social costs of their activities. It seeks to internalize environmental externalities by ensuring that the full environmental and social costs of resource utilization are reflected in the ultimate market price for the products of such utilization. Since environmentally harmful products will tend to cost more, this principle promotes efficient and sustainable resource allocation as consumers are likely to prefer to the cheaper less polluting substitutes of such products.

3.2.8 Principle of Public Participation

The principle of public participation seeks to ensure environmental democracy and requires that the public, especially local communities should participate in the environment and development decisions that affect their lives. It requires that the public should have appropriate access to information concerning the environment that is held by public authorities and should be given an opportunity to participate in decision-making processes. Hence this was fulfilled via consultation of some of the people living around the proposed project site.

3.3 National Environmental Action Plan

The National Environment Action Plan (NEAP) was first published in 1994, and the most recent document was revisited in 2007 with a scope from 2009 - 2013. The NEAP provides a framework for the implementation of the Environment Policy and realization of the Standard Development Goals and Vision 2030. The plan outlines measures to combat climate change including mitigation and adaptation, improving inter-sectoral coordination, mainstreaming sustainable land management into national planning, policy and legal frameworks and undertake research on impact of climate change on environmental, social and economic sector.

The plan also aims to increase the country's forest cover and adopt economic incentives for management of forest products. It is upon the project's proponent to ensure that the activities and components of the project are geared towards attaining the gist of the NEAP

3.4 Policy Framework

3.4.1 Environmental Policy Framework (2014)

The Kenya Government's Environmental Policy of 2014 is geared towards sound environmental management for sustainable development. This is envisaged in the principle of prudent use, which requires that the present day usage should not "compromise the needs of the future generations". Incinerator operations should be done within acceptable environmental management framework. The policy emphasis is on environmental protection such as avoiding air pollution in order to ensure sufficient supplies for the present and future generations. The policy envisages the use of the "polluter pays principle", where one is expected to make good any damage made to the environment. The Policy aims at integrating environmental aspects into development plans.

3.4.2 National Injection Safety and Medical Waste Management Policy 2007

This policy advocates for the importance of safeguarding patients, health workers and the community at large from risks associated with unnecessary and unsafe injections as well as improper disposal of health care wastes. The overall objective of the Policy is to ensure safe injection practices and proper management of medical waste, in order to safeguard the patient, health care provider, community and the environment. Given that the proposed project will be handling some medical wastes, it is upon the project proponent to ensure that they acquaint themselves with this policy.

3.4.3 Infection Prevention and Control Policy and Guidelines 2011

The guidelines are specifically designed for the healthcare workers to understand and practice evidence-based infection prevention and control (IPC) practices that will protect patients, clients, and health care workers from Healthcare-Associated Infections (HAIs). HAIs include urinary tract infections, surgical-site infections, bloodstream infections, and pneumonia.

3.4.4 Health Care Waste Management Plans

The GoK through the MOH has developed HCWM guidelines that are effected through management plans and are reviewed from time to time. This ensures that HCWM in Kenyan HCF is responsive to the dynamics of HCWM strategies, hence the HCWM Plan of 2016-2021. The national HCWM Plan of 2016-2021 is dedicated to management of HCW in the period stated (2016-2021). The Strategic planning for HCWM covers not only the technical aspects related to waste management such as waste handling, storage, transportation, treatment, and disposal, but also capacity-building and awareness creation. The plan provides viable technical and management options as well as a roadmap for the domestication of the National HCWM Strategic Plan 2015 - 2020 in Kenya for five years.

3.5 Legal Framework

3.5.1 Environment Management and Coordination Act (Amendment) 2015

EMCA is an Act of parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for related matters. NEMA is a body established under the Act, and has the legal authority to exercise general supervision and co-ordination over all matters relating to the environment, and is the principal arm of the Government charged with the implementation of all policies relating to the environment. Part II of EMCA states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. It is worth noting that the entitlement to a clean and healthy environment carries a collective duty. Hence, there is not only the entitlement to a clean and healthy environment, but also the duty to ensure that the environment is not degraded in order to facilitate one's own as well as other persons' enjoyment of the environment. According to Section 58 of the Act, ESAs need to be carried out on all proposed projects. All ESIA reports are submitted to NEMA for review and necessary advice thereafter. The law is based upon the principle that everybody is entitled to a healthy and clean environment. Section 42, pertinent to the continued running of this project deals with *Discretionary approvals required:* The Act requires that projects acquire environmental approval before their commencement. NEMA approves and issues an environmental license after an EIA report depending on whether the project assessment and report satisfies it. This is also in compliance with the requirements of EMCA Part VI section 58 (1) and (2) which states that:

> *"Notwithstanding any approval, permit or license granted under this Act or any other law in force in Kenya, any person, being a proponent of a project, shall, before financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeded with, carried out, executed or conducted by another person any undertaking specified in the Second Schedule to this Act, submit a project report to the authority in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee" The proponent of the project shall undertake or cause to be undertaken at his own*

expense an EIA/EA study and prepare a report thereof where the Authority, being satisfied, after studying the report submitted under Subsection (1), that the intended project may or is likely to or will have a significant impact on the environment, so directs".

Carrying out this ESIA is part of complying with the provisions of EMCA.

3.5.2 ESIA and EIA/ EA Guidelines (2003, Revised in 2016)

The ESIA and EA/ ESA guidelines require that ESIAs and EAs/ ESAs be conducted in accordance with the issues and general guidelines spelt out in the second and third schedules of the regulations. These include coverage of the issues on schedule 2 (ecological, social, landscape, land use and water considerations) and general guidelines on schedule 3 (impacts and their sources, project details, national legislation, mitigation measures, a management plan and environmental auditing schedules and procedures. Carrying out this ESIA is part of complying with the provisions of EMCA as well as complying with the provisions of EIA/EA Guidelines of 2003 (as revised in 2016).

3.5.3 The Water Act 2016

The 2016 Act repealed the water Act 2002. The enactment of this law aimed at aligning national water management and water services provision with the requirements of the Constitution of Kenya 2010 particularly on the clauses devolving water and sanitation services to the county governments. Consequently, the Act retained some and established other new institutional arrangements including, Ministry of Water and Irrigation as the sector coordinator, Water Services Regulatory Board (WASREB) for regulation of water services' providers, Water Resources Regulatory Authority (WRA formerly WRMA) for water resource use regulation, National Water Harvesting and Storage Authority for major water infrastructural development, Water Tribunal for dispute resolution, Water Sector Trust Fund for water services development towards the un-served and poor segments of the society in peri-urban and rural areas, Water Works Development Agencies to replace the Water Service Boards, and Basin Water Resources Committees to replace Catchment Advisory Committees (CAACs).

The Act vests provision of water and sanitation services with the county governments through Water Services Providers (WSPs) whose operations must be in accordance with a Service Agreement entered between each WSP and WASREB. It provides for national monitoring and information systems on water resources and it allows the WRA to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by the project proponent and the information thereof furnished to the authority. This may include periodic water analysis records for borehole water or even for harvested rain water.

3.5.4 Public Health Act Cap 242 (2012)

The Public Health Act protects human health, prevents and guards against introduction of infectious diseases into Kenya from outside, to promote public health and the prevention, limitation or suppression of infectious, communicable or preventable diseases within Kenya, to advice and direct local authorities in regard to matters affecting the public health to promote or carry out researches and investigations in connection with the prevention or treatment of human diseases.

This Act provides the impetus for a healthy environment and gives regulations to waste management, pollution and human health and the project proponent must follow it to the latter by avoiding open burning of any wastes as well as exposing animals to the access of wastes.

3.5.5 Physical Planning Act Cap 286 (2010)

This Act provides for the preparation and implementation of physical development plans for connected purposes. It establishes the responsibility for the physical planning at various levels of Government in order to remove uncertainty regarding the responsibility for regional planning. It provides for a hierarchy of plans in which guidelines are laid down for the future physical development of areas referred to in a specific plan. The ostensible intention is that the three-tier order plans, the national development plan, regional development plan, and the local physical development plan should concentrate on broad policy issues. Thus, it is upon the project proponent to ensure that the proposed project conforms to the County's Physical Plans.

3.5.6 Laws Governing Environmental Health

The health of the environment is a broad issue that should apply to any activity occasioning environmental degradation. However, what we have in Kenya is construed rather narrowly to apply only to environmental problems, which affect the human body, but not including diseases.

3.5.6.1 Public Health

Under this section the review is confined to the provision of the Public Health Act (Cap 242 of 2012), the Traffic Act (Cap 403 of 2013), the Local Government Act (Cap 265 of 1998), the Penal Code (Cap 63 of 1948) and the Factories Act (Cap. 514 of 1977). Within the Public Health Act, the sections on housing and prevention of mosquitoes are directly pertinent. On sanitation, the Act borrows from the common law doctrine of nuisance, which makes it an offence for any landowner or occupier to allow nuisance or any other condition liable to be injurious or dangerous to health to prevail on his land. A medical health officer, once satisfied of the danger, may issue an order requiring the owner or occupier of the land to remove the nuisance. Fighting malaria is also a critical environmental task dealt under the Act. Part XII makes it an offence to leave on one's land or premises, any collection of water, sewage, rubbish, well, pool, gutter, channel cesspit, latrine, urinal or dump pit where mosquitoes may breed. Such a situation constitutes a nuisance. Any person who fails to clear such a nuisance is guilty of an offence under the Act.

The project proponent should not allow the collection of water, sewage, rubbish, well, pool, gutter, channel cesspit, latrine, urinal where mosquitoes may breed in relation to the operation of the incinerator that could trigger this law hence becoming a threat to public health. This is because not using it as intended could mean the burning of waste in the open as well as allowing the piling of waste in the open leading to its access by animals such as dogs, cats and birds.

3.5.6.2 The Working Environment

The two statues relevant to this subject are the Factories Act (Cap 514 of 1977, replaced by the Occupational Safety and Health Act of 2007)) and the Mining Act (Cap 306). The primary environmental requirements under the Factories Act are that each factory (working place) must observe as high standards of cleanliness as are possible for the respective operations; avoid overcrowding, construct and maintain adequate ventilation, provide and maintain suitable natural or artificial lighting, as appropriate, provide drainage of floors and construct and maintain clean sanitary conveniences. This should be provided for in the construction of the shelter for the incinerator.

3.5.6.3 The Factories and other Places of Work (Fire Risk Reduction) Rules, 2007

These Rules were published in the Kenya Gazette Supplement No. 46, Legislative Supplement No. 28, Legal Notice No. 59 of 4th May, 2007 being a supplementary legislation to the Factories and other places of work act, Cap 514 which was repealed. The Occupational Safety and Health Act (OSHA) 2007 (replacement of Cap 514) recommends the implementation of this subsidiary legislation. The rules provide for fire safety measures with specific focus on the following critical requirements:

i. Safe handling and storage of flammable substances
ii. Provision of fire escape exits
iii. Formation of firefighting team
iv. Functions of a firefighting team
v. Fire safety training
vi. Conducting fire drills
vii. Installation, maintenance, inspection and testing of fire equipment
viii. Documentation of a fire safety policy and
ix. Annual fire safety audits

The operation of the proposed incinerator should comply with the provisions of this law. Thus, in line with the Fire Risk Reduction, rules 2007, the project proponent is required to:

i. Provide and maintain suitable and adequate number of firefighting equipment
ii. Establish a firefighting team
iii. Organize training for firefighting team
iv. Conduct annual fire drill
v. Conduct annual fire audit

3.5.6.4 Management of Hazardous Waste

In the foregoing section, we saw that work environment protection focuses largely on protection of human beings against injury by such wastes or radiations. The Public Health Act is also concerned with the protection of human health. Section 75 of the Constitution whose purpose is protection from the deprivation of property, empowers the government to acquire property "in circumstances where it is necessary to do so because that property is in a dangerous state or injurious to the health of human beings or animals or plants." This is the closest reference to the protection of the environment and its resources. In relation to the operation of the incinerator, the handling of diesel should be done with a lot of care to avoid any spillage because hydrocarbons are classified as being hazardous by NEMA in Kenya.

3.5.6.5 Environmental Management &Coordination Act (Waste Management) Regulations (2006)

These Regulations apply to all categories of waste as is provided for. According to the regulations, no person should dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. Any person whose activities generate waste should collect, segregate and dispose or cause to be disposed off of such waste in the manner provided for under these Regulations. Any person whose activities generates waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose of such waste in a designated waste disposal facility. Any person, whose activities generate waste, should segregate such waste by separating hazardous waste from non-hazardous waste and shall dispose of such wastes in such facility as is provided for by the relevant Local Authority. Any person who owns or controls a facility or premises which generates waste should minimize the waste generated.

Every trade or industrial undertaking should install at its premises anti-pollution technology for the treatment of waste emanating from such trade or industrial undertaking. No owner or operator of a trade or industrial undertaking should discharge or dispose of any waste in any state into the environment, unless the waste has been treated in a treatment facility and in a manner prescribed by the Authority in consultation with the relevant lead agency. Third Schedule comprehensively deals with all requirements for operating such a facility (Incinerator) in Kenya. The schedule provides the following information:

i. Standard for treatment and disposal of Wastes;
ii. Standards, guidelines, criteria, procedure for installing/operating incinerators

Further to that the operator should comply with Part IV of the regulation that deals with hazardous wastes (Regulation 22 through to 32); Part VI that deals with Biomedical Wastes (Regulations 36 through 47). The facility management must observe this law strictly in the management of its waste water and sewage as well as in its operation of the incinerator by applying for the necessary licenses as provided for *(For more information, see attached EMCA (Waste Management) Regulations 2006)*.

3.5.6.6 Environmental Management and Coordination Act (Noise) Regulations (2009)

The noise regulations in the country clearly state that any person who contravenes their provisions commits an offence. The provisions are as per the following table:

Table 3: First Schedule of the Regulation Provides for the Following Permissible Noise Levels

Zone			**Sound Level Limits dB(A) (Length-14hours)**	**Noise Rating Level (NR) (Length-14 hours)**
			Day	Night
A.	Silent Zone		40	35
B	Places of worship		40	35
C.	Residential	Indoor	45	35
		Outdoor	50	35
D.	Mixed residential (with commercial some and Places of entertainment)		55	35
E.	Commercial		60	35
Time Frame				
Day	6.01 a.m. – 8.00 p.m. (Length-14 hours)			
Night:	8.01am. – 6.00 a.m. (Length-10hours)			

To avoid contravention of this law, all bottles should be opened before being put into the incinerator so as to avoid their explosions.

3.5.6.7 Fossil Fuel Emission Control Regulations 2006

These regulations are described in Legal Notice No. 131 of the Kenya Gazette Supplement no. 74, October 2006. The regulations include internal combustion engine emission standards, emission inspections, the power of emission inspectors, fuel catalysts, licensing to treat fuel, cost of clearing pollution and partnerships to control fossil fuel emissions. The fossil fuels considered are petrol, diesel, fuel oils and kerosene. To comply with this regulation, the proponent should make sure that the incinerator machine is functioning optimally as well as avoiding adulated diesel hence the need to source diesel from reputable sources such as Shell, Total, National Oil, Delta and *Kenol Kobil* Petrol Stations to mention but a few.

3.5.6.8 Environmental Management and Co-ordination (Air Quality) Regulations, 2009

The objective of these Regulations (which were revised in 2014) 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 required and 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 should observe policy and regulatory requirements and implement the mitigation measures proposed in this document, in an effort to comply with the provisions of these Regulations, on the abatement of air pollution more so as a precautionary measure *(see attached air quality regulations, 2014).*

Under the general prohibitions (Part II), section 5 states that no person should act in a way that directly or indirectly causes immediate or subsequent air pollution. Among the prohibitions are priority air pollutants (as listed under schedule 2 of the regulations) that include general pollutants, mobile sources and greenhouse gases. Odours are also prohibited under section 9 of the regulations (offensive emissions). Emissions into controlled areas such as schools, hospitals, residential areas and populated urban centers are also prohibited. By practicing open air waste burning is leading to contravention of this law in that it is leading to production of foul odour as well as polluting the atmosphere. Hence, it is upon the project proponent to ensure that no open waste burning within the incinerator site at any time.

3.5.6.9 The Occupational Safety and Health Act, (2007)

This is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. The key areas addressed by the Act include:

i) General duties including duties of occupiers, self-employed persons and employees;
ii) Enforcement of the Act including powers of an occupational safety and health officer;
iii) Registration of workplaces (hence the proponent needs to register the workplace of this project);
iv) Health General Provisions including cleanliness, ventilation, lighting and sanitary conveniences;
v) Machinery safety including safe handling of transmission machinery, hand held and portable power tools, self-acting machines, hoists and lifts, chains, ropes & lifting tackle, cranes and other lifting machines, steam boilers, air receivers, refrigeration plants and compressed air receiver;
vi) Safety General Provisions including safe storage and handling of dangerous liquids, fire safety, evacuation procedures, precautions with respect to explosives or inflammable dust or gas;
vii) Chemical safety including the use of material safety data sheets, control of air pollution, noise and vibration, the handling, transportation and disposal of chemicals and other hazardous substances materials; and
viii) Welfare general provisions including supply of drinking water, washing facilities, and first aid kits and Offences, penalties and legal proceedings

Under Section 6 of this Act, every occupier is obliged to ensure safety, health and welfare of all persons in his workplace. The occupier shall achieve this objective by preparing and as often as may be appropriate, revising a written statement of his general policy with respect to the safety and health at work of his employees and the organization and arrangements for the time being in force for carrying out that policy (Section 7). He is also required to establish a safety and health committee at the workplace in a situation where the number of employees exceeds twenty (section 9) and to cause a thorough safety and health audit of his workplace to be carried out at least once in every period of twelve months by a registered safety and health Advisor (Section 11). In addition, any accident, dangerous occurrence, or occupational poisoning which has occurred at the workplace needs to be reported to the occupational safety and health officer of the respective area by an employer or self-employed person (section 21). According to section 44, potential occupiers or users of any premises as work places are required to apply for registration to the Director for all premises intended for use as workplaces. Such places shall be maintained in a clean state during the operation phase (section 47). In relation to fire safety, section 78 (3) requires spillage or leaks of any flammable liquid to be contained or immediately drained off to a suitable container or to a safe place, or otherwise treated to make it safe.

Furthermore, a clear and bold notice indicating that smoking is prohibited should be conspicuously displayed in any place in which explosive, highly flammable or highly combustible substances, are manufactured, used, handled or stored- section 78 (5). In addition, necessary precautions for dealing with fire incidents should be implemented including provision of means for extinguishing fire and means for

escape, in case of fire, for the persons employed in any workplace or workroom – section 81. As far as disaster preparedness and emergency response program is concerned, section 82 (1) makes it a mandatory requirement for every occupier of a workplace to design evacuation procedures to be used during any emergency situation and to have them tested at regular intervals. To promote health and safety of employees who are at risk of being exposed to chemical substances, section 84 (3) and 85 (4) requires every employer to maintain at the workplace Material Safety Data Sheets (MSDS) and Chemical Safety Data Sheets (CSDS) respectively for all chemicals and other hazardous substances in use and ensure that they are easily available to the employees. The employers' positive contribution towards the welfare of the employees include provision and maintenance of adequate supply of wholesome drinking water - section 91 and a first aid box or cupboard of the prescribed standard – section 95 at suitable point (s) conveniently accessible to all employees.

Other precautionary measures include: issuance of a permit to work to any employee, likely to be exposed to hazardous work processes or hazardous working environment, including such work processes as the maintenance and repair of boilers, dock work, confined spaces, and the maintenance of machinery and equipment, electrical energy installations, indicating the necessary precautions to be taken – section 96 (1); provision and maintenance for the use of employees, adequate, effective and suitable PPE and clothing including suitable gloves, footwear goggle and head coverings in any workplace where employees are likely to be exposed to wet, injurious or offensive substance – section 101 (1). In relation to this Act, the project proponent should provide appropriate PPE to the incinerator operators as well as provide first aid kits. It will be prudent for the project proponent to develop a fire management means or a health and safety committee be put in place. The project management should pay attention to the firefighting aspect and put in place the necessary measures needed in firefighting; this will entail but will not be limited to the following:

i. Installing fire suppression system; and
ii. Training incinerator personnel on firefighting;

3.5.7 Employment Act (2007)

a) General Principal

The Act constitutes minimum terms and conditions of employment of an employee and any agreement to relinquish vary or amend the terms set shall be null and void. The Act stipulates that no person shall use or assist any other person, in using forced labour. Clause 5 of the Act states that its shall be the duty of the Cabinet Secretary/ Minister, Labour officer, the National Labour Court and the subordinate labour courts to; Promote equality of opportunity in employment in order to eliminate discrimination in employment Promote and guarantee equality of opportunity for a person who, is a migrant worker or a member of the family of the migrant worker lawfully within Kenya. No employer shall discriminate directly or indirectly, against an employee or prospective employee or harass an employee or prospective employee on the following grounds; race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability, pregnancy, mental status or HIV status. An employer should pay his employees equal remuneration for work of equal value.

b) Part IV Rights and Duties of Employment

The provisions of this part and part VI constitute basic minimum and conditions of contract of service. The employer shall regulate the hours of work of each employee in accordance with provisions of this Act and any other written law. Subsection (2) of section 27 states that an employee shall be entitled to at least one rest day in every period of seven days. An employee shall be entitled to not less than twenty-one working days of leave after every twelve consecutive months. The incinerator operators should be allowed to be off duty during the weekends where possible.

c) Maternity Leave

Section 29 of the Act stipulates that a female employee shall be entitled to two months maternity leave with full pay and an employer who has paid a female employee wages for two months during her maternity leave shall be reimbursed by the National Social Security Fund, the equivalent of wages paid by the employer during maternity leave or a lesser amount as may be determined by the minister in rules made by the minister for that purpose. Subsection 8 of section 29 further states that no female employee should forfeit her annual leave entitlement on account of having taken her maternity leave.

3.5.8 Work Injuries Benefits Act (2007)

i. Obligations of Employers

Section 7 of the Work Injuries Benefits Act (WIBA) stipulates that every employer shall obtain and maintain an insurance policy, in respect of any liability that the employer may incur under this Act to any of his employees. Hence the project proponent is advised that it obeys the provisions of WIBA in relation to the operation of the incinerator.

ii. Employer to Keep Records (Section 9)

Section 9 states that an employer shall keep a register or other record of the earnings and other prescribed particulars of all employees and produce the same on demand by the director for inspection. Such records should be retained for at least six years after the date of last entry. Thus all records in relation to the operation of the facility should be well kept and maintained.

iii. Reporting of Accidents

A written or verbal notice of any accident shall be given by or on behalf of the employee concerned to the employer and a copy to the Director of Occupational Health and Safety within twenty-four hours of its occurrence in case of fatal accident. In case of any accidents, the rules should be applied to the latter. And that is why the incinerator operators under the supervision of the incinerator manager should keep proper records including those of any incidents.

3.5.9 National Construction Authority Act, 2011

Section 5 of the Act stipulates the mandate of the National Construction Authority (NCA) which is to oversee the construction industry and coordinate its development. Section 5 subsection 2 part (f) states that the authority shall provide consultancy and advisory services with respect to the construction industry; part (g) promote and ensure quality assurance in the construction industry; part (k) accredit and register contractors and regulate their professional undertakings; (l) accredit and certify skilled construction workers and construction site supervisors; (m) develop and publish a code of conduct for the construction industry; and (n) do all other things that may be necessary for the better carrying out of its functions under the Act. Hence it is upon the project proponent to ensure that the construction of the incinerator shelter is registered with NCA and supervised by the NCA during its construction so as adhere to the provisions of the Act.

3.6 Treaties

A treaty is a binding agreement under International Law concluded by subjects of International Law, namely states and international organizations. Treaties can be called by many names including; International Agreements, Protocols, Covenants, Conventions, Exchanges of Letters, Exchanges of Notes, etc. However, all of these are equally treaties and the rules are the same regardless of what the treaty is called. Treaties can be loosely compared to contracts; both are means of willing parties assuming obligations among themselves, and a party to either that fails to live up to their obligations can be held legally liable for that breach. The central principle of treaty law is expressed in the maxim *pacta sunt servanda,* translated as "pacts must be respected." Kenya has ratified the following Project-relevant international conventions:

3.6.1 United Nations Framework Convention on Climate Change

The UNFCCC sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 191 countries having ratified. Under the Convention, governments:

- ✓ Gather and share information on greenhouse gas emissions, national policies and best practices;
- ✓ Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
- ✓ Cooperate in preparing for adaptation to the impacts of climate change.

The Convention entered into force on 21 March 1994. Kenya signed the UNFCCC on 12th July 1992, ratified it on 30th August 1994 and started enforcing it on 28th November 1994. The project proponent should observe the above convention in all its operations throughout the project cycle and especially reducing the releasing of greenhouse gases by avoiding open burning of waste by fully operationalizing the incinerator.

3.6.2 Kyoto Protocol

According to a press release from the United Nations Environment Programme (UNEP):

> *"The Kyoto Protocol is an agreement under which industrialized countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that were expected by 2010 without the Protocol, this target represents a 29% cut). The goal was to lower overall emissions of six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, HFCs, and PFCs - calculated as an average over the five-year period of 2008- 12." (http://en.wikipedia.org/wiki/kyoto_protocol)*

Compliance with this convention will largely inform the technical and environmental evaluation of the project if any additional funding may be required in future. There is thus a necessity that proper adherence to minimal emission levels of greenhouse gases be ensured during the operational phases of the project, which could be achieved if the project proponent fully operationalizes the incinerator, avoids operating the incinerator when its faulty and repairing it fast enough to avoid open burning of wastes.

3.7 World Bank Safeguard Policies Triggered by the Project

The WB's environmental and social safeguard policies are a cornerstone of its support to sustainable poverty reduction. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for Bank and borrower staffs in the identification, preparation, and implementation of programs and projects. The Safeguard policies also provide a platform for the participation of stakeholders in project design and have been an important instrument for building a sense of ownership among local populations. In essence, the safeguards ensure that environmental and social issues are evaluated in decision making, help reduce and manage the risks associated with a project or program, and provide a mechanism for consultation and disclosure of information. The WB has 10 key operational policies although for the Kenya Health Sector Support project only 2 policies were triggered that is OP/BP 4.01 on Environmental assessments and OP/BP 4.10 on Indigenous People.

3.7.1 Environmental Assessment Operational Policy OP 4.01

Environmental Assessment (EA) is used in the WB to identify, avoid, and mitigate the potential and actual negative environmental impacts associated with Bank lending operations. In WB operations, the purpose of EA is to improve decision making, to ensure that project options under consideration are sound and sustainable, and that potentially affected people have been properly consulted. It helps ensure the environmental and social soundness and sustainability of investment projects as well as support integration of environmental and social

aspects of projects in the decision-making process. As indicated at the beginning of this report, the proposed incinerator project was assigned environmental category B hence implementation of the incinerator project triggered the Environmental Assessment Operational Policy OP 4.01. This means that before implementation, the incinerator project should be subjected to an ESIA as is the case with this report. The ESIA is meant to ensure that due diligence in the application of safeguards during installation and to plan for mitigating and/or addressing of any potential and actual adverse risks during the operational phase of the incinerator project. As per the ESIA, the incinerator has minimal negative impacts to the environment and people, which can be mitigated successfully as **it is categorized under category B under WB Categorization criteria**. But the incinerator project proponent is adhering to this OP by subjecting the incinerator project to ESIA, disclosure will be done in due course, that review will be done as per the provisions of EMCA (Amendment) 2015 and that the proponent will implement the ESMP as contained in this ESIA report and as advised by NEMA.

3.7.2 OP/BP 4.10 (Indigenous Peoples)

This policy contributes to the Bank's mission of poverty and sustainable development by ensuring that the development process fully respects the dignity, human rights, economies and cultures of indigenous peoples. For all projects that are proposed for Bank financing and affect indigenous peoples, the Bank requires the borrower to engage in a process of free, prior, and informed consultation. The broad support of the project by the affected Indigenous Peoples such as Bank-financed projects includes;

(i) Preventive measures to adverse effects to the indigenous cultures and practices
(ii) Avoiding potential and actual adverse effects on the Indigenous Peoples' communities
(iii) When avoidance is not feasible, minimize, mitigate, or compensate for such effects.

Bank-financed projects are also designed to ensure that the Indigenous peoples receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive. The objective of this policy is to design and implement projects in a way that fosters full respect for Indigenous Peoples' dignity human rights and cultural uniqueness and so that they receive culturally compatible social and economic benefits and do not suffer adverse effects during the development process. Via consultation of members of the public living around the incinerator site, it was established that the incinerator implementation is expected to create various job opportunities to the locals while it's expected that the project proponent will be involved in grading the roads leading the project site regularly.

3.7.3 World Bank's Environmental, Health and Safety Guidelines

Under its "General EHS Guidelines (April 30, 2007)", the WB has several guidelines that include the following:

i) EHS Guidelines - Air Emissions and Ambient Air Quality
ii) EHS Guidelines - Waste Management
iii) EHS Guidelines - Health Care Facilities
iv) EHS Guidelines - Hazardous Materials Management
v) EHS Guidelines - Construction and Decommissioning

The WB EHS "Air Emissions and Ambient Air Quality" guidelines require projects with "significant" sources of air emissions, and potential for significant impacts to ambient air quality to prevent or minimize impacts by ensuring that emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards (or in their absence, the current WHO Air Quality Guidelines, or other internationally recognized sources). Kenya currently has the 2014 national air quality regulations applicable to this incinerator project. The standards, however, make no mention of dioxins which are potent cancer-inducing, expected in incineration emissions. But to be noted is that, the proposed incineration unit is a "no significant" source since it is not expected to have the capacity to generate high levels of air

pollutants if well maintained and properly managed as per the operation procedures given in this report. The WB EHS "Waste Management" guidelines apply to both non-hazardous and hazardous waste. They advocate for waste management planning where waste should be characterized according to: composition, source, types, and generation rates. This is essential for the project proponent in relation to operation of the incinerator project since there is a need to segregate the different categories of waste to be handled by the incinerator. These guidelines call for implementation of a waste management hierarchy that comprises prevention, recycling/reuse; treatment and disposal. The guidelines require segregation of conventional waste from hazardous waste streams and if generation of hazardous waste cannot be prevented (as is the case in hospitals); its management should focus on prevention of harm to health, safety and environment. The Guidelines recommend monitoring to include:

i) Regular visual inspection of all waste storage, collection and storage areas for evidence of accidental releases and to verify that wastes are properly labelled and stored.
ii) Regular audits of waste segregation and collection practices.
iii) Tracking of waste generation trends by type & amounts, preferably by facility departments.
iv) Keeping manifests or other records that document the amount of waste generated and its origin.
v) Periodic auditing of third party treatment and disposal services including re-use and recycling facilities/processes when significant quantities of hazardous wastes are managed by third parties. Whenever possible, audits should include site visits to the treatment, storage and disposal location.

3.8 The Constitution of Kenya, 2010

The provision for legal and institutional mechanisms is one of the basic conceptual tools for environmental management. Further, considering that the environment supports life, it requires protection that is stable and can only be changed, if necessary, by a special and substantial majority. These Constitutional provisions for environmental management are not new, and already exist in other countries. Environmental provisions were outlined, albeit superficially, in the previous constitution of Kenya. The current constitution's innovation is the presentation, in greater detail, of obligations in respect of specific natural resources, as well as the human aspects of environmental management. Environmental provisions are included in Chapter Four, under 'Rights and Fundamental Freedoms', Chapter Five, under 'Environment and Natural Resources', and Chapter Ten, under 'Judicial Authority and Legal System'. The Fourth Schedule also includes environmental provisions under 'Distribution of functions between National and County Governments' and the Fifth Schedule titled 'Legislation to be enacted by Parliament'.

In relation to the incinerator project, it can be taken as the right step in constructing and operationalizing it because its operationalization is likely to lead to the conservation of our natural resources such as water bodies and land/soil as well as ensuring a clean environment for all. This is because proper incineration of especially hazardous waste means that it doesn't find its way into water bodies or even agricultural land hence not polluting them. It should also be noted that proper incineration of waste leads to reduced atmospheric pollution that can arise from open burning of waste.

3.8.1 Compliance with Prudent Environmental Management

An analysis of the various environmental laws in Kenya shows that, at disposal to the project proponent are clear laws providing guidance on the best way to manage the environment and its resources. By not adhering to any cannot be an excuse of causing environmental degradation. It should be noted that, ignorance is no defense in a court of law. Hence, the project proponent is advised to acquaint itself with the provisions of all laws that may touch on its operations and specifically operation of the incinerator, one of them being the application for license from NEMA to operate the incinerator as per the provision so the Waste Management Regulations of 2006.

CHAPTER FOUR: PROJECT ALTERNATIVES

4.1 Introduction

This chapter analyses the project alternative in terms of site and non-implementation. The purpose of including alternatives in the ESIA is to identify and evaluate alternate actions that accomplish similar goals and promote sustainable development (Anderson et al., 2003). Alternatives should be economically feasible with minimal adverse environmental impacts and time delays. Diverse alternatives to the proposed action must be included in the ESIA. Alternatives may include both design and location options (Steinneman, 2000). In most case, the ESIA process often occurs too late in the decision-making process to consider a full range of alternatives. This can undermine ESIA goals to encourage more environmentally sound and publicly acceptable solutions. Allowing new alternatives and objectives to evolve in relation to environmental conditions and public preferences may be a solution to most of the environmental and socio-economic problems associated with the implementation of new projects (Anderson et al., 2003).

4.2 No-Action Alternative

The '*no-action/project'* alternative, which serves as a baseline for comparative analysis, must be included where the environmental impact of taking the proposed action is too high compared to the impact of not taking the proposed action. The *"No project"* alternative option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. Under *"No project"* option, the proponent's proposal would not receive necessary approvals from Authorities. The proposed construction and installation of an incinerator would not be implemented. This option would however, involve several losses both to the proponent and the community as a whole. The *"No Project"* alternative option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- The economic status of Kenyans would remain unchanged
- The local skills would remain underutilized (in terms of labor provision)
- Increased poverty and crime in Kenya due to lack of job opportunities
- The waste management sector would continue to suffer due to lack of adequate sustainable waste management facilities in the country.

4.3 Relocation Option

Relocation of the proposed project of is one of the alternatives in ensuring the environmental and social status of the area is not affected. But, it is quite clear that as per the current situation, the proposed project cannot be relocated. The reason behind this is that the proponent currently owns the proposed site of development, hence getting an alternative site could be a very expensive venture. It should also be noted the proposed project site is utilized as a waste sorting site. Thus, installing an incinerator would only compliment the current activity by assisting in the proper disposal of those waste materials that cannot be re-used, recycled or composited. It should also be noted that health care facilities in the area such as Lusiggeti Hospital have already signed a working relation with the project proponent hence it would be inconveniencing to relocate the proposed project.

4.4 Waste Water/Sewage Management Alternatives

The available technologies that can be considered as alternatives include Use of constructed/artificial wetland; Use of septic tank and/or bio-digesters; Use of stabilization ponds/lagoons; Use of waste treatment plants such a Bio-box or the Vex-P system; Connection to the municipal council sewage system; Use of conservancy tanks, partial treatment and pumping to a municipal council sewage system. The available and feasible alternative to sewage and waste water management is the construction of a septic system given that its amounts are not expected to be high.

4.5 Alternatives to Achieving Green Building

The areas of concern may be categorised broadly as proper and efficient use of resources. These include power, water and other sources of energy; Reducing waste and pollution and improving occupant health. Green building can take on various forms. From the basic housing level to the national level, efforts are being put to reduce reliance on the costly fossil fuels. Some of the methods that can be adopted in this include:

i. The Use of Renewable Energy

More projects are powering up using solar panels. The availability of the technology and ease of setting up the panels have gone a long way in encouraging its adoption. The use of biomass (popularly known as biogas) is also gaining a significant foot hold in many homes. This is more so in rural areas, where animal waste is enhanced to produce gas used in powering up. Waste (such as papers, plastics, and so forth) is also being used in an ingenious pilot project in areas of Nairobi to produce heat energy. This has been embraced in these communities as it provides an affordable way to cook and heat water. The proponent is advised to explore the use of renewable sources of energy such as solar and wind for lighting or even providing the electricity to run the incinerator.

ii. Adoption of Water Harvesting, Treatment and Re-Use

Projects with large roof surfaces such as the proposed one, should adopt rain water harvesting. Methods include tanks and also water pans in areas having space. Trenches in gardens are also dug up with the sole intention of trapping run-off water. Hence, the proposed project should entail rain water harvesting without failure.

iii. The Use of Plants or Vegetation

Plants can be used as water towers to aid in replenishing ground water. Homes in hot areas are advised to adopt plants to keep the temperatures down. The project proponent is also advised to establish a vegetation cover around the development.

iv. Adoption of Natural Lighting and Ventilation

Strategic building of windows and porches goes a long way in enhancing natural lighting. Sun roofs are also becoming a common feature in many homes, allowing much sunlight into the rooms. These are just some of the few methods that could be adopted in going green in building the proposed project.

CHAPTER FIVE: CONSULTATIONS AND PUBLIC PARTICIPATION AND SOCIAL IMPACT ASSESSMENT

5.1 Introduction

The integration of public participation/involvement of stakeholders in the ESIA process is very important in terms of its implication for sound decision making and the sustainability of development activities. In this regard, the Kenya ESIA Procedures provide for the involvement of stakeholders and the public in the assessment and review of proposed undertakings. This is achieved through a number of mechanisms, including the administration of questionnaires, which this particular project adopted.

Public participation is a key component of an ESIA and is used to integrate citizens into the environmental decision-making process. Traditional decision-making approaches such as closed-door discussions between politicians and experts are no longer appropriate (Barrington et al., 2003). Public participation, if it is to be democratic, must foster trusting relationships through open and honest negotiations between proponents and the public (Barrington et al., 2003).

But it should be evident, when necessary, that a plan for public involvement was developed early in the process. The public should be provided with sufficient information about the proposed project and properly understand the project and issues to be able to give informed comments and participate fully in the process (Huang et al., 2003). For this particular project, those consulted were taken through the project concept. It is also important that there is evidence that all public comments are considered in the formulation of the list of concerns. All public comments should be recorded without judgment or prioritizing in the initial stages of the process (UNEP, 2002; Huang et al., 2003). The public must be involved early in the process (Barrington et al., 2003). The public must not be placed in a reactive position. Decisions must not be evaluated after they have been made but rather participants must be involved at all stages of the ESIA process. The public must be given sufficient time to digest information and prepare its comments, while keeping the whole procedure within a reasonable time frame. Public and Stakeholders' involvement in the ESIA process is essential and may lead to enormous benefits for the proponent, stakeholders and the nation. Where this is ignored, conflicts and problems may be created for project implementation and sustainability. Not only does the involvement of the public in the SEIA process often strengthen the project, but public participation is required by EMCA.

The participation of beneficiaries and partners and the public in general has been identified as an essential component in ensuring sustainable development. To accomplish the mission of getting the public's opinion on the proposed project, questionnaires were administered to the neighborhood to gather the public opinions on the proposed project. The respondents included business people and individual neighboring residents of the region as well as via public consultation meetings. The findings during public consultations with stakeholders indicated that the general public is in support of the project as long as they are involved; it is transparent; their livelihoods are taken care of; and they are fully sensitized on what the project involves.

5.2 Some Social Concerns Raised by the Participants

a. Livelihood Value of the Facility

Most of the respondents are eager to see the project implemented. Due to high rates of unemployment in Kenya, they believe that during construction, skilled and non-skilled workers will be contracted and after completion, it will create employment opportunities for several people as security personnel, incinerator operators, cleaners and waste sorters or loaders. The would-be staff of the project will also create market to the small businesses surrounding the development site such as restaurants not forgetting diesel providers.

b. Gains in the Local and National Economy

Respondents are expecting gains in the local and national economy through payment of relevant taxes, rates

and fees by the project proponent to the government and the local authority. As well, in the implementation of the project, the proponent will purchase massive loads of construction materials with a high multiplier effect.

c. Risks of Accidents and Injuries to Workers and the Public

Respondents fear that because of the intensive construction activities including erection and fastening of roofing materials, metal grinding and cutting, concrete work, steel erection and welding among others, construction workers will be exposed to risks of accidents and injuries. Such injuries can result from accidental falls from high elevations, injuries from hand tools and construction equipment and cuts from sharp edges of metals and metal sheets among others. The proponent is expected to provide appropriate Personal Protective Equipment (PPE) to the workers as well as providing or setting up a first aid corner at the construction site to handle emergency cases. The public could also be exposed to accidents such as falling debris. This will be avoided by scaffolding the site. The public could also be exposed to accidents such as being hit by vehicles getting into or out of the project site. This could be avoided by erecting appropriate warning signs, erecting bumps along the area roads so as to co troll the speed of vehicles.

d. Increased Traffic In The Area

Those operating from the surrounding areas of the site were of the opinion that traffic will be high especially during the construction period, and this may inconvenience them. To counter this fear, it has been advised that transportation of construction materials and carting away of waste materials be done during off peak hours of the day.

e. Support for the Incinerator

During the Public Consultation, it came out that all the respondents were in support for the project to be implemented. The information given by the public against and in relation waste management is related open burning of the waste or and lack of secure fence around the site.

5.3 Environmental Concerns Raised by the Respondents

a) Noise Pollution

Respondents feared the possibility of high levels of noise in the project site as a result of construction. Causes of noise will include cutting equipment, construction machinery, metal grinding, large trucks carrying construction materials to the site. To ameliorate against this, the proponent is expected to ensure good maintenance of the equipment in the construction as well as providing the workers with protective equipment (noise muffles). Construction is also not expected to be undertaken earlier than 6am and not later than 6pm.

b) Dust Emissions and Foul Odours

Respondents expressed concern over dust emissions within the development site and the surrounding areas, especially during the construction period. Dust emissions from building materials such as cement and sand could affect the people working or residing in the neighborhood and workers health as it causes allergies, respiratory diseases, eye problems and visibility problem. To minimize dust levels the proponent should ensure trucks carrying building materials such as soil and sand are covered and sprinkle the construction site and the access road leading to the site with water to keep dust down as much as possible.

It was also noted if wastes (both liquid and solid) are not properly managed, there could emanate foul smell from the project site. Hence, the project proponent was encouraged to take all necessary steps toward ensuring that no foul smell is produced from the project site. One of the recommended ways of ensuring that there is no release of foul smell is by installing ventilators on the roof of the incinerator shelter (recommended not being less than 10ft above the roof). Any organic waste will also be removed on a daily basis for composting in well-constructed compost pits which shall be covered with canvas to ensure fast decomposing and to contain any

smell that may emanate from the composting pits. It is upon the project proponent to ensure optimum functioning of the incinerator so as to avoid production of obnoxious gases during its operations by following all laid down waste incineration procedures as well not operating a faulty incinerator.

c) Increased Water Demand

Respondents fear that large quantities of water will also be used for construction in the mixing processes. They also raised concerns that after completion of the project, there will be an increase in population of the area leading to a strain on water resources. The proponent is expected to initiate roof water harvesting (as part of green building) to ensure there is sufficient water for domestic uses for the project Also the proponent is expected to ensure that he fixes automatic water taps to help conserve water. It is upon the project proponent to seek for alternative water source, especially during the construction period such as use of water bowsers or sinking a borehole at the project site.

d) Solid Waste Generation

Respondents said that there is a possibility of large quantities of solid waste to be generated and considering that the project is itself going to be involved handling waste. During construction, empty cartons, empty paint and solvent containers and broken glasses left lying at the construction site will affect the aesthetic value surrounding environs as they are non-biodegradable. Sharp metals at the site might cause accidents to the workers and the general public. The project operations will likely lead to wastes being scattered in the area. Therefore there is a need for the proponent to provide waste containment within the project site.

e) Liquid Waste Generation

Respondents said that there is a possibility of large quantities of liquid waste to be generated especially during the operational stage of the project. They requested that the proponent constructs an adequate sewage management system such as a septic tank. They also requested that the proponent ensures provisions for sanitation facilities for the construction workers. It was specifically recommended that the septic tank should not be constructed close to the neighboring properties but towards the frontage/access road. This is to avoid leakage of sewage into the neighboring properties incase of poor workmanship.

f) Generation of Exhaust Emissions

Respondents expressed fear of generation of exhaust emissions from the trucks transporting the building materials to the construction site. Emissions containing carbon dioxide and other gases may have an impact on the health of the workers and people in the neighborhood. The proponent is supposed to ensure that vehicle engines are switched off when not in use, equipment to be properly maintained as well as ensuring that non-leaded fuel is used. The proponent is also in agreement to utilize electric run machines during the construction phase to reduce on gas emissions.

g) Scavenging Animals and Public Health

It is a common occurrence for dogs to scavenge on the open dump sites. The neighbouring community is concerned about contracting diseases from waste brought to their homesteads by their dogs following scavenging at the waste management site. It should also not be lost that some wastes can lead to the death of the scavenging animals. This can be discouraging to the community living around the project site from keeping pet animals. Such incidents do not directly relate to the operations and performance of the proposed incinerator, but it is worth noting that by putting into full use the incinerator and properly fencing it off, such incidences would most likely not be experienced *(for more information, see attached sample forms of public consultations as well as copies of minutes of a public meeting held at the project site together with an attendance list).*

CHAPTER SIX: ENVIRONMENTAL AND SOCIAL AUDIT FINDINGS

6.1 Introduction

The ESIA sought to find out the environmental compatibility and performance of the proposed incinerator. In assessing the facility in relation to the environment and socio-economic aspects, the ESIA delved into various parameters that define environmental performance of such a facility in the face of delicate environmental resources use. The parameters were divided into *hard* and *soft* issues based on the effect of implementing and operating such a facility to the environment.

Through the EIA, the experts endeavored to ensure that applying the aims and objectives incorporated in the following statements optimizes the development potential of the proposed project. These statements include: -

- To maximize the social, economic and ecological benefits of the project,
- To minimize the social economic and ecological costs of the project,
- To ensure that the functioning of vital ecosystems or critical habitats is not irreversibly disrupted,
- To ensure that where damages or costs occur, every reasonable measure is taken to ameliorate or compensate for such damages or costs.

To achieve the aims and objectives, the environmental experts applied the principles of integrated environmental management. The overall evaluation of the impacts associated with the project has been carried out using the principals of efficiency, equality, safety and sustainability.

6.2 Potential Construction Phase Impacts

The Construction phase is also associated with various positive and negative impacts. The potential negative impacts are as discussed below:

6.2.1 Potential Effect to Air Quality

Vehicular/equipment engine exhaust emissions are a potential source of impacts to air quality, though they will be minor and temporary during construction. Air quality impacts will be temporary during construction. The project will generate moderately significant vehicle trips to the area. Vehicular and equipment exhaust emissions during project operations will, thus, have a minor incremental/cumulative impact locally and regionally. Particulate matter (dust particles) would be generated by grading, excavation and the movement of construction vehicles. It is not possible to accurately estimate the particulate concentration that might occur at the site because it is dependent on meteorological conditions and soil moisture. But all the same, mitigation measures need to be put into place. Proposed mitigation measures include:

- Vehicle speeds in and around the construction area will be limited to minimize dust in the area.
- Discourage idling of vehicles i.e. vehicle and equipment engines will be turned off when not in direct use to reduce exhaust emissions.
- Regular maintenance of construction plant and equipment
- The management will sensitize the employees on sound environmental management.
- Provide Personal Protective Equipments (PPE) such as nose masks to the workers on site
- The construction contractor will water the site with exposed soil surfaces twice each day during dry weather.

6.2.2 Increased Water Demand

Water is a major concern especially in construction sites. The proposed development will most likely cause strain to the existing water supply in the area, which will have a direct impact to the main water supply especially if the supply remains constant. This calls for proper mitigation measures to be put into place. Hence proposed mitigation measures include the following:

- Avoid wasting the water supplied to the site.
- Encourage water reuse/recycling during both construction and operational phases.
- In order to encourage water conservation during operational phase the proponent should install water conserving taps that turn off automatically when water is not in use.
- Encourage proper water management systems.

6.2.3 Potential Effects due to Increased Power Demand

It is expected that there will be high power consumption especially during occupation phase. The proposed development will be connected to the existing power line and this might strain this resource. However the contractor, construction workers and the eventual occupants will be encouraged to conserve energy and to use energy conserving appliances as much as possible. Energy conservation involves proper use of electrical appliances, lighting systems and other electrical gadgets utilized for different purposes. Thus, the proposed mitigation measures are as stated below:

- All electrical appliances should be switched off when not in use.
- Put off all lights when not in use.
- Use energy conserving electric lamps for general lighting.
- Utilize natural light inside buildings to avoid using electricity for lighting during the day.
- Explore the use of solar and wind energy especially for site security lighting during the night
- Create awareness among workers by use of stickers on the need to conserve energy

6.2.4 Potential Impacts due to Effluent Generation

Effluent generation and its management is another challenge related to implementation of the proposed project. It is common for developers to begin construction of projects without planning on how effluent will be disposed appropriately; hence waste water (raw sewage) is either channelled to a river, or disposed carelessly. Some are poorly constructed, are of inadequate capacity, make use of low quality structural materials which leads to leakage of sewage to the underground water hence posing a dangerous health risk to the living organism including man. However, the proposed project deviates from this norm and hence, has integrated effective waste water handling system in to its designs. It is also recommend that:

- All liquid wastes to be disposed of properly by connecting to the septic tank sewer system to be constructed
- Construction of the drainage system to be under the supervision of the structural engineer
- Provide mobile toilets to construction workforce

6.2.5 Potential Impacts in Relation to Occupational Health and Safety

The immediate neighbours and workforce involved would be more subjected to these environmental hazards such as falling debris or materials, dust, vehicle accidents, falling from high areas, open pits etc. Food for the construction workforce is usually provided by mobile individuals who usually operate without licenses. This can compromise health of the workers especially if foodstuffs are prepared in unhygienic conditions. To ameliorate against the above, the proposed mitigation measures include:

- All workers should be provided with full protective gear. These include working boots, overalls, helmets, goggles, earmuffs, masks and gloves.
- Construction crew at the site to be sensitized on social issues such as drugs, alcohol and diseases.
- A first aid kit should be provided within the site. This should be fully equipped at all times and should be managed by qualified person.
- The contractor should have workmen's compensation cover. It should comply with workmen's compensation Act, as well as ordinances, Regulations and Union Agreements.
- Adequate sanitary facilities should be provided and standard cleanliness maintained.
- Food handlers preparing food for the workers at the site should be controlled and monitored to ensure that

food is hygienically prepared.

- The construction site should be well scaffolded to take care of falling materials
- Control the speed of vehicles in and around the project site

6.2.6 Impacts in Relation to Surface Drainage

Good drainage system is used to prevent land near human settlement from becoming saturated with water which collects or accumulate/flood after a downpour or from other sources. Poor drainage causes dampness to building structures as well as water stagnation. Dampness is influenced by poor drainage, in the presence of warmth and darkness, breeding grounds for malaria and other diseases can be directly traced to it. Hence, proper drainage of the general property/premise comes in handy to enhance effective flow of the much anticipated surface run-off emanating from the roof catchments and other newly pave areas within the site. To prevent bad effects of poor drainage, the following mitigation measures are proposed for this project:

- During construction, the design of the drainage system should ensure that surface flow is drained suitably into the public drains provided to control flooding within the site.
- Drainage channels should be installed in all areas that generate or receive surface water such as drive ways and along the building block-edges of the roofs.
- Channels should be covered by approved materials to prevent occurrence of accidents and entry of dirt that would compromise flow of run-off.
- Drainage channels should ensure safe disposal of run-off/surface water &should be self-cleaning.
- Paving of the side walkways, driveways and other open area should be done using pervious materials to encourage recharge and thus reducing water run-off volume.
- All rain water from the roofs should be harvested so as to reduce on amount of run-off

6.2.7 Potential Impacts due to Solid Waste Generations

Solid waste will be generated both during construction and operation phases of the project. This will include metal cuttings, rejected materials, excavated materials, paper bags, empty cartons, broken glass among other materials from a construction site. Solid wastes if not well managed have a potential of causing disease outbreaks due to the creation of suitable breeding conditions from various pathogens. To avoid occurrence of such effects, recommended mitigation measures include:

- The contractor or the proponent should be ready to facilitate proper waste management and disposal from the site. The resulting debris could be collected, transported and disposed off at suitably NEMA approved dumpsites.
- It is recommended that land excavation and construction waste be recycled or reused to ensure materials that should be disposed off as waste are diverted for productive use. In this regard the proponent is committed to ensuring that construction materials left over at the end of construction should be recovered for refurbishing and use in other projects. Such measures should involve the sale or donation of such recyclable/reusable materials to construction companies, local community and residents.
- Any disposal should be by a NEMA licensed person/company at a NEMA approved site

6.2.8 Potential Noise Pollution

Activities related to the project implementation can lead to noise, which is the unwanted/undesirable sound that can affect job performance, safety and health, of especially those residing around the project site. This can lead to psychologically related effects of noise that include annoyance and disruption of concentration. Physical effects may include loss of hearing, pain, nausea and interference with communications if the exposure is severe. The proposed project is expected to generate noise during construction period. Since the proposed site is located within a residential area though sparsely populated, there should be a clear guideline on the working hours whereby construction work should be carried out strictly during the day. Other proposed mitigation

measures include:

- Construction works should be carried out only during the specified time of 0800-1700hrs.
- Machineries should be maintained regularly to reduce noise resulting from friction.
- There should not be unnecessary horning of the involved machinery
- Provision of bill boards at the construction site notifying of the construction activity and timings
- Sensitize drivers of construction machinery on effects of noise.
- Billboards will be suitably erected on the start of the project to psychologically prepare the people in the vicinity.
- Workers in the vicinity of high-level noise to wear safety and protective gears.
- Provide barriers such as walls around site boundaries to provide some buffer against noise propagation.
- The proponent should comply with the **Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.**

6.2.9 Potential Increased Run Off

Construction works and paved roads could result in additional run off through creation of impervious areas and compaction of soils. Impervious areas and compacted soils generally have higher runoff coefficients than natural areas and increased flood peaks are a common occurrence in developed areas. Increased runoff from paved grounds and expansive roofs causing extreme flooding and overflows of drainage system shall be mitigated via the following:

- Surface runoff and roof water shall be harvested and stored in an underground reservoir for reuse or shall be directly channeled to storm water drains.
- A storm water management plan that minimizes impervious area infiltration by use of recharge area & use of detention and /or retention with graduated outlet control structures will be designed.
- All rain water from the roofs should be harvested so as to reduce on amount of run-off

6.2.10 Summary of Construction Phase Impacts and Mitigation

Potential construction impacts would include: stress on infrastructure as a result of increased population/vehicle traffic, possible soil erosion, possible surface & ground water hydrology changes and water quality degradation, solid waste generation, noise pollution, dust emissions, generation of exhaust emissions, increased water demand, increased energy consumption, increased use of building materials, likely accidents; and diseases. To ameliorate against the potential negative effects, measures such as the following should be taken:

- Awareness creation & education of the project area communities regarding HIV/AIDS &other diseases.
- The contractor will ensure that all machines are well tuned and maintained to reduce amount of exhaust emission
- All materials will be ordered as per need to avoid over piling on site which leads to destruction of materials and unnecessary obstruction.
- The construction will be done in design that will allow for natural ventilation and lighting as well as both vertical and horizontal ventilation. The incorporation of natural ventilation and lighting will contribute to the reduction of the amount of energy consumed in artificial ventilation and lighting. Landscaping and greening of the buildings will be a contribution to the ongoing beautification and greening of our urban centers, a factor that will subsequently be beneficial to carbon sequestration.
- To save on water, the construction could also incorporate water saving designs such as waterless urinals, self-timing taps and low volume water closets. Water harvesting from the roof will be implemented to provide water for cleaning, landscaping and use in the toilets. Roof water harvesting will also lead to the reduction of the amount of runoff within the area hence controlling the flooding that afflicts itself during the rainy seasons.
- Emergency escape routes will also be incorporated during this stage

- Waste containment facilities will also be constructed during this stage.
- To protect the health of workers on the site, they should be provided with protective gears and the contractor ensures that they make full use of them. Workers should not be forced or allowed to lift heavy loads.
- All materials on site should not be piled to heights that are prone to accidental falls.
- First Aid kits and emergency numbers should be conspicuously displayed. This means that someone trained in administering first aid should be present at the construction site all the time of the work.
- An insurance cover by the contractor should be acquired to compensate for any unforeseen medical emergencies and injuries or destructions
- Provisions should be included during the construction period to allow for greening of public places.
- Provisions for disabled friendly toilets with support bars in them should be implemented during the construction period to avoid unnecessary modifications later during the life of the project.

On the other hand the anticipated positive impacts include: creation of alternative employment opportunities, improving growth of the economy, improved living standards, provision of the much needed sustainable waste management facilities and provision of market for supply of construction materials and other services.

6.3 Operation Phase

The activities to be carried out during the operation phase of the proposed project include receiving waste, storage, incineration and disposal of the ashes. All activities will be done with high standards of operation observing all required standards of hygiene, safety and waste disposal.

6.3.1 Overall Environmental Management

It was realized that the construction and installation of the incinerator is likely to help much in overall management of the environment in Lusigetti and the environs assuming that the incinerator will be operated to the optimum. However, despite the place being a waste sorting site, what should not be allowed is heaping of waste materials in the open to the extent of rotting and producing foul odours neither should there be allowed open burning of waste regardless of their types/category within the project site

6.3.2 Healthcare Waste Management

It should not be lost that Health Care Waste from hospitals will be finding its way into the facility for incineration. The Ministry of Health of Kenya has put in place guidelines that offer directions on management of HCW in Kenya. It is upon the project proponent to acquaint oneself with these guidelines for better implementation. It should be noted that mixing wastes (infectious and no-infectious) complicates waste management, since mixing sharps and other infectious waste with non-infectious waste increases the amount of waste that is considered infectious (WHO 2014). Studies have demonstrated that poorly disposed HCW can be sources of new infections to humans and pose a danger to animals scavenging such waste. It is imperative for the project proponent to note that with maximized use of the incinerator facility, such nuisances will not be experienced and should not be experienced anyway.

6.3.3 Noise Monitoring and Control

The project proponent should ensure that noise monitoring is carried out with regard to the incinerator operations. There are regulations that set the permissible levels of noise that should be observed when operating various machines. The levels are set out in (***Noise and Excessive Vibration Pollution) (Control) Regulations, 2009***. In section 5, the regulations provide permissible noise levels and states that:

> *No person shall make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.*

Table 4: First Schedule of the Regulation Provides for the Following Permissible Noise Levels

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

Time Frame	
Day	6.01 a.m. – 8.00 p.m. (Length-14 hours)
Night:	8.01 .m. – 6.00 a.m. (Length-10hours)

It is expected that the incinerator will be designed in a manner that does not allow noise pollution even from the explosion of bottles during incineration. But, whenever possible, let bottles to be incinerator be open to avoid noise pollution from the explosion of bottles as well as avoiding open burning of the waste.

6.3.4 Air Quality Monitoring and Control

It is likely that the emissions from the incinerator impact on air quality within the influence of the incinerator. It is only fair and just to the environment that air quality monitoring around the incinerator (a radius of 1km) is undertaken on regular basis. The government in its wisdom has formulated air quality regulations that would ensure air quality is maintained at acceptable levels within the jurisdiction of Kenyan borders. To be noted is that air pollution will not be avoided if open burning of waste is allowed. Non-optimal operationalization of the incinerator can also lead to atmospheric air pollution, something that can lead to conflicts with the surrounding community. It should be noted that open burning of waste produces toxic emissions such as carbon monoxide (CO), dioxins (polychlorinated dibenzo-para-dioxins or PCDDs), and furans (polychlorinated dibenzofurans or PCDFs). CO is produced by poor and incomplete combustion. These emissions could be reduced by good incinerator operating procedures. Dioxin and furan emissions occur through burning of chlorine-containing wastes, e.g., PVC and other plastics, hence it is advisable to avoid unnecessary plastics in the wastes to be incinerated.

In general, the emissions from incinerators should not be allowed to blow across cultivated land because exposure to dioxins and furans is mostly through food intake (WHO 2001). Such emissions would be minimized by good waste segregation practices to eliminate inclusion of unnecessary PVC waste, and appropriate practices for high-temperature incineration. It is also advisable to have the chimney not less than 10m high from the ground level. To reduce on emissions, it is advisable to stop open burning of waste as well as adhering to the following practices:

- ✓ Ensure that the incinerator is functioning properly, and the chimney is clear of excessive soot.
- ✓ Rigorously segregate waste so that no unnecessary PVC (IVs, etc.) waste is incinerated
- ✓ Ensure that the incinerator is preheated adequately and that supplementary fuel is added whenever necessary to maintain the burning temperature above 600^0C.
- ✓ Load the incinerator according to the recommended “Best Practices”.
- ✓ Adopt rigid quality control measures.

6.3.5 Environmental Management System Set Up, Suitability and Performance

Management of environmental concerns at the project site will largely be guided by the national guidelines provided by the ministry with regard to public health and environment. The project proponent should be aware

and informed about the expected standards with respect to environmental concerns. However, the impact of the guidelines can be defeated by poor management of environmental matters within the project site. A classic example is where the waste is well segregated at source, but lumped together when its being picked up for disposal, thus mixing up of hazardous materials such as medical wastes with none-hazardous wastes such as food remains. Therefore, the project proponent should fully be dedicated in environmental management and especially management of HCW.

6.3.6 Staff Awareness and Training

It is imperative that staff awareness and training with respect to environmental management is adequately done especially on management of HCW as stipulated in various guidelines offered by the MoH.

6.3.7 Compliance to Environmental Standards

Compliance of environmental standards is a must for the project proponent owing to the many facets of the project that affects the environment. Central to this is HCW that require stringent disposal measures. In line with EMCA, there are compliance levels that have been set for operations of an incinerator as indicated in the Environmental Management and Coordination Act, Waste Management Regulations (2006). Third Schedule of the said regulations comprehensively deals with all requirements for operating such a facility (Incinerator) in Kenya. The schedule has the following provisions:

iii. Standard for treatment and disposal of Wastes;
iv. Standards, guidelines, criteria, procedure for installing and operating incinerators

Further to that the project proponent should comply with Part IV of the regulation that deals with hazardous wastes (Regulation 22 through to 32); Part VI that deals with Biomedical Wastes (Regulations 36 through 47) by acquiring all the set environmental licenses and carrying out any required environmental assessments, and especially during the operation phase by carrying out annual ESA. The project management should strive to comply with all set environmental standards. Under the waste management regulations (regulation 12) all existing solid waste disposal sites are required to undergo environmental audits in order to ensure compliance with the set conditions thereof in terms of the provisions under Part V which states that the report compiled under the regulations shall include among others:

- ✓ The past and present impacts of the waste disposal site/apparatus;
- ✓ The responsibility and proficiency of the operators of the waste disposal site;
- ✓ Existing strategies to mitigate environmental impacts of solid waste disposal activities;
- ✓ Health and safety concerns of the waste disposal site;
- ✓ Legislative and policy frameworks relevant to the waste stream and disposal site management;
- ✓ Existing environmental awareness and sensitization measures including environmental standards and regulations, law and policy for the managerial personnel;
- ✓ Identification, documentation and analysis of all negative environmental impacts associated with the existing solid waste and disposal site management;
- ✓ An analysis of environmental performance of the disposal site in the light of environmental impacts;
- ✓ Development of an environmental management plan and action plan for the waste streams and sites;
- ✓ Public consultations on the impact of the continued existence of the disposal site within the area; and Preparation of an ESA report

The existing waste disposal sites are subject to environmental monitoring and control audits by NEMA inspectors (Section 117 of EMCA, 2015) in conjunction with other government lead agencies such as the OSH Department and in the manner prescribed under regulation 35 (3a-f).

6.4 Community Health and Safety Issues

6.4.1 Operational Effectiveness of the Incinerator

It is our advice that the project proponent enters into a maintenance contract so as to ensure proper regular servicing and maintenance so as to have the incinerator in very good operating status all through.

6.4.2 Water Resources Management

It is expected that the project proponent will find an alternative water source so as not to strain the local source.

It should not be forgotten that underground water resources are prone to pollution from hazardous materials seeping from the surface especially during the rainy season and thus poor handling and disposal of especially hazardous wastes, is a potential source of contamination of underground water resources. Hence, the project proponent should ensure at all times that the quality of underground water in the area is above board as stipulated in the Environmental Management and Co-ordination (Water Quality) Regulations, 2006 schedule 1. This can only be ascertained by carrying out regular water analysis from underground water sources in the area. This calls for the project proponent to fully operationalize the incinerator to ensure that all hazardous wastes are incinerated. They should also ensure a waste reduction system by exercising waste recycling for some wastes such as the organic materials and re-using others such as paper/cartons, plastic packaging materials and glass bottles not contaminated with hazardous substances.

Table 5: Recommended Quality Standards for Sources of Domestic Water

Parameter	**Guide Value (max allowable)**
pH	6.5 – 8.5
Suspended solids	30 (mg/L)
Nitrate-NO_3	10 (mg/L)
Ammonia–NH_3	0.5 (mg/L)
Nitrite –NO_2	3 (mg/L)
Total Dissolved Solids	1200 (mg/L)
Scientific name*(E.coli)*	Nil/100ml
Fluoride	1.5 (mg/L)
Phenols	Nil (mg/L)
Arsenic	0.01 (mg/L)
Cadmium	0.01 (mg/L)
Lead	0.05 (mg/L)
Selenium	0.01 (mg/L)
Copper	0.05 (mg/L)
Zinc	1.5 (mg/L)
Alkyl benzyl sulphonates	0.5 (mg/L)
Permanganate value (PV)	1.0 (mg/L)

6.4.3 Structural Safety of Project Infrastructure

It should be noted that the smoke chimney is should not be exposed for easily vandalization not forgetting that kids could climb on it with danger of getting burnt. It is advisable that a secure fence is established around the incinerator area with a lockable entrance. The chimney and any parts of the incinerator that can get hot should also be insulated.

Construction of the incinerator should include an ash pit as the standard for new incinerators so as to avoid disposal of the ashes from the waste incineration being disposed in the open. This is noting that the incineration process produces two types of ash. Bottom ash comes from the furnace (primary burning chamber) and is mixed with slag, while fly ash comes from the stack (secondary burning chamber) and contains components

that are more hazardous. In most waste incinerators, bottom ash is approximately 10% by volume and approximately 20 to 35% by weight of the solid waste input. Fly ash quantities are much lower, generally only a few percent of input. Emissions from incinerators can include heavy metals, dioxins and furans, which may be present in the waste gases, water or ash. Plastic and metals are the major source of the calorific value of the waste. The combustion of plastics, like polyvinyl chloride (PVC) gives rise to these highly toxic pollutants.

Toxics are created at various stages of such thermal technologies, and not only at the end of the stack. These can be created during the process, in the stack pipes, as residues in ash, scrubber water and filters, and in fact even in air plumes which leave the stack. There are no safe ways of avoiding their production or destroying them, and at best they can be trapped at extreme cost in sophisticated filters or in the ash. The ultimate release is unavoidable, and if trapped in ash or filters, these become hazardous wastes themselves. The pollutants which are created, even if trapped, reside in filters and ash, which need proper disposal otherwise we disperse the incinerator ash throughout the environment which could subsequently enter our food chain. Thus, it is advisable that an ash pit is constructed during the incinerator installation.

The ash pit should be large enough to store incinerated residues for at least 10 years without being emptied. A pit of 3.25m^3 stores ash from the burning of approximately 300 safety boxes per month, over a period of 12years. The ash pit would have access trap doors to allow the pile of ash to be redistributed from time-to-time. For such a design and volume to be done accurately, the incinerator operations should be recorded on a daily basis, i.e. how much waste is received per day (in weight), how much waste is completely incinerated per day, how much ash is produced per day against waste incinerated. Therefore, accurate and proper records are vital in optimum operation of the incinerator.

6.5 Occupation Safety and Health Management

OSH is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment or operating/occupying a certain premises. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment.

Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995. The definition reads: "Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job." The reasons for establishing good OSH standards are frequently identified as:

- ✓ **Moral**-An employee should not have to risk injury at work, nor should others associated with the work environment.
- ✓ **Economic**-many governments realize that poor occupational safety and health performance results in cost to the State (e.g. through social security payments to the incapacitated, costs for medical treatment, and the loss of the "employability" of the worker). Employing organizations also sustain costs in the event of an incident at work (such as legal fees, fines, compensatory damages, investigation time, lost production, lost goodwill from the workforce, from customers and from the wider community).

- ✓ **Lega**l-Occupational safety and health requirements may be reinforced in civil law and/or criminal law; it is accepted that without the extra "encouragement" of potential regulatory action or litigation, many organizations would not act upon their implied moral obligations.

With regard to operation of the proposed incinerator, the ESIA dwelt on the following parameters that may greatly define OHS during operation of the facility.

6.5.1 Adequacy of the Design of the Shelter

The design and construction of the shelter should include vital facilities such as the following and which should be provided for at the facility:

i. **A defined Office space** - there should be provision for a fully equipped office with furniture and office accessories so as to assist in proper record keeping of the incinerator operations and activities;
ii. **Washing rooms** - there should be bathrooms (separate for male and females) with functioning shower head and adequate supply of water
iii. **A Toilet** -there should be a toilet for the incinerator operators to avoid their having to share one with other staff and clients;
iv. **Supplies/ material Store**-the shelter should have a store where consumables like fuel, records, PPEs and other supplies can be stored.
v. **Waste Store**- the shelter should have a dedicated waste store to avoid the wastes being stored outside promoting scavenging by animals such as dogs and cats. The operators should be provided with waste boxes to store wastes awaiting incineration or a waste store that should have the capacity to stock at least 200 neatly-stacked safety boxes.

The incinerator shelter should be designed to enable the trained operators to safely process and dispose of infectious waste. Other than the above singled fundamentals, it should encompass other several elements, housed within the sheltered enclosure. These elements are:

i. **A storage box** to keep tools, protective clothing and records.
ii. An enclosure with a lockable door to prevent access by children and unauthorized persons, as well as scavenging animals and birds.
iii. An access hatch through a wire-mesh wall of the incinerator to allow waste to be deposited when the incinerator shelter is locked and the operator is not present. This hatch should open into a safety-box deposit which should provide a protected area where the waste boxes and containers can be deposited temporarily.

6.5.2 Operator's Tasks and Responsibilities

It is good that the incinerator operators have a regular routine to burn the waste as well as a formal way for reporting of achievements or problems associated with the operation of the incinerator. It is highly recommended that the incinerator operators in conjunction with the management establish a regular routine to burn the waste, work towards minimizing personal risk, as well as risk to other workers and the local community by not operating a faulty incinerator as well as initiate a way of reporting achievements and problems to the supervisor for necessary actions.

6.5.3 Receiving Health-Care Waste at the Incinerator

There should be established a formal way of receiving wastes at the incinerator facility. The following procedures are recommended to be observed for a better operation of the incinerator once it is fully operationalized:

i. When Operator is Present at the Incinerator

When waste is deposited at the Incinerator, the operator should:

a) Receive the waste, record the required details in the Waste-Deposit Record.
b) Verify that any waste received is appropriately packaged -that is: Sharps in safety boxes; other waste in plastic bags, and Needles in needle-cutter containers.

ii. When the Operator Is Not Present At the Incinerator

If the operator is not present at the incinerator site, the person delivering the waste should:

- Make sure that the safety boxes and plastic bags are properly closed.
- Deposit the safety boxes and plastic bags through the access hatch that is clearly labeled and designed for this purpose. The waste deposited here drops into the safety box deposit that is accessible only to authorized persons.

On returning to the incinerator site, the operator should arrange the safety boxes or plastic bags of waste which have been deposited through the waste store access hatch in the waste store. The operator should also complete the Waste-Deposit Record for the newly arrived waste.

6.5.4 Security of the Facility

The facility should not be highly exposed to avoid easy access for anyone with ill intention of vandalizing the facility. Such lack of proper securing of the incinerator area is also what can enable the access to waste by stray dogs and cats as well as enabling anybody to dispose their waste into the incinerator area indiscriminately.

6.5.5 Personal Protection Equipment

Lack of appropriate PPE for use during operation of the incinerator should not be allowed considering that there will be handling of potentially hazardous or infectious wastes all the time. This can expose the operators to infections from especially HCW waste. Waste incineration systems produce a wide variety of pollutants which are detrimental to human health. Such systems are expensive and do not eliminate or adequately control the toxic emissions from chemically complex solid waste such as the HCW. Even new incinerators release some toxic metals, dioxins, and acidic gases. Far from eliminating the need for a landfill, waste incinerator systems produce toxic ash and other residues. Dioxins are the most lethal Persistent Organic Pollutants (POPs) which have irreparable environmental health consequences. The affected populace includes those living near the incinerator as well as those living in the broader region. People are exposed to toxic compounds in several ways:

- By breathing the air which affects both workers in the plant and people who live nearby;
- By eating locally produced foods or water that have been contaminated by air pollutants from the incinerator; or
- By eating fish or wildlife that have been contaminated by the air emissions.

Dioxin is a highly toxic compound which may cause cancer and neurological damage, and disrupt reproductive systems, thyroid systems, respiratory systems etc. Considering this, it is worthwhile to ensure optimum functioning of the incinerator, attaining complete combustion and the scrubber functioning to its fullest so as to minimize the amount of gases finding their way onto the atmosphere. It is also imperative that the project proponent provides the incinerator attendants with the appropriate PPE at all times. Safety of the incinerator operators can be assured by following the instructions below:

i. Wearing the proper PPE provided to all operators at all times when operating the incinerator.

ii. Washing hands regularly, hence why a washroom and a hand wash basin is needed within the incinerator shelter.
iii. Being vaccinated against Hepatitis B Virus (HBV).
iv. Having regular medical checkups (every six months).

6.5.6 Fire Outbreak Preparedness

Given that the facility will be disposing wastes by combustion, it should have the right category of firefighting equipment such as carbon and powder fire extinguishers as well as buckets of dry sand inside the facility too to help fight electric fires. The management should also ensure that contacts for emergency service providers are well displayed in and around the facility as well as an emergency alarm system. The incinerator attendants should be trained by reputable firms such as St. Johns Ambulance on fire emergencies as well as be subjected to regular fire grills.

6.5.7 First Aid Kits

The project proponent should make the necessary arrangements to ensure the incinerator attendants are trained in first aid administration, emergency preparedness and response as well as making sure that the facility is provided with adequate easily accessible first aid kits.

6.5.8 Sanitation and Cleanliness of the Facility

Poor housekeeping within the incinerator shelter with waste bags and other boxes being left lying all over the floor is not an option. This is dangerous as it can lead to accidental slips and falls within the incinerator shelter. Hence, it is recommended that all what is not related to the operation of the incinerator be removed from the shelter, and that the project proponent acquires waste holding containers for proper containment of the waste within the shelter as it awaits incineration. Further, it is imperative to have washrooms and disinfection supplies within the incinerator for the operators not to expose them to carrying infections to their homes because for lack of a place to change their clothes to PPE and vise-versa before and after operating the incinerator.

6.5.9 Emergency Response Procedures

The project proponent should have had a dedicated emergency response team. Operators of the incinerator should be well trained in emergency response procedures to ensure that they are ready to deal with any emergency cases at the incinerator facility.

6.5.10 The Project Management and the Incinerator Operations

Central to efficient operation of the incinerator is the project management. The incinerator can poorly be operated due to the following highlighted challenges:

a) Lack of Adequate Supply of Fuel (Diesel)

This can lead to the incinerator attendants resulting to open burning of waste. The inadequate supply of diesel also leads to incomplete combustion of waste by the incinerator leading to the production and release of noxious gases such as carbon monoxide into the atmosphere. Lack of complete combustion of the HCW means that its volume is not reduced as per the standards. This means that, with lack of reducing the waste volumes, if an ash pit is constructed, it will get filled up very fast, which is not economical.

b) The Incinerator Operators

The incinerator should have a dedicated operator so as to avoid a situation whereby the attendants are not able to organize and keep track of what goes around the incinerator. Some assessments of waste management practices and incinerator performance carried out highlight incinerator project management and incinerator

operator constraints as critical factors in good waste management and optimal performance of incinerators. Major constraints identified are inadequate operator training and motivation. The following operator-related measures should be adopted to ensure good incinerator performance:

i. Only a trained, qualified and equipped operator should operate the incinerator.
ii. The operator must be on-site while the incinerator is functioning.
iii. The operator must be motivated to follow "Best Practices."
iv. The incinerator should be operated according to Best Practices to minimize emissions and other risks.
v. The operator must have long-term contracts or be permanent hires.

Long-term or permanent operator contracts are often the most difficult of the above points to address. Incinerator operation is usually not a full-time job, and frequently incinerators are operated by casual labor responsible for grounds maintenance. This approach is strongly discouraged since training efficient operators is time-consuming and expensive; and operator knowledge and commitment are essential for good incineration practices. The incinerator operators should be contracted for long terms or be on permanent payrolls so as to be able to develop a technical profile, consistently maintain records and be able to recognize maintenance needs. It is therefore advisable that the project management dedicates at least two full time operators to the incinerator and who should possibly be permanently employed. This would ensure that tracking of the performance of the incinerator is done and efficiency is attained with regard to disposal of various categories of waste.

c) Supervision

Even if the incinerator operator would be well-trained, supervision is essential. Supervision would provide quality control and recourse to improve other aspects of waste management, in particular segregation and disposal practices. Most countries have a collaborative mechanism for developing a regulatory framework for especially, such as the National Policy on Injection and Medical Waste Management and the National Health Care Waste Management Strategic Plan (2016 – 2021) that underpin national policies for handling, processing and destruction of infectious waste at all health facilities, including primary health facilities. As per the policy and the plan, this project proponent included, there should be a designated an HCWM supervisor, with operational linkages (directly or indirectly) to a Waste Management Committee. The responsibilities of the HCWM supervisor at the facility should include but not be limited to:

i. Ensuring good waste segregation practices;
ii. Coordination and supervision of waste transportation, packaging, storage and handling;
iii. Monitoring of waste handling at the incinerator and other appropriate locations
iv. Supervision of the incinerator operator; and Reporting.

6.5.11 Best Practices in Waste Incineration

a. Appropriate Conditions for Incinerating Waste

It is advisable to use the incinerator to burn waste only if:

- Twelve or more safety boxes of waste have been deposited at the site for disposal.
- No large groups of people are present in the immediate area.
- The safety precautions are adequate.
- The incinerator is in good working order.

b. For Safety Precautions to be Termed Adequate, the Following Conditions must be Met

- The appropriate PPE should be available and in good condition.
- A container full of sand is available at the incinerator site.
- The appropriate tools are available to operate the incinerator.

c. For the Incinerator to be considered in Good Working Condition, the Following Conditions must be met:

- The ash door and the loading door close correctly, i.e. they must not be broken.
- The strainer cables to the chimney should be tight, and there should be no risk that the chimney will fall down.
- The metal parts (front door, loading door, spigot, chimney, etc.) should not be badly corroded and/or likely to break.
- The masonry should not be badly cracked and/or likely to cause injury.

d. Preparation and Loading the HCW

Prior to start-up:

- Make sure that the HCW is dry. If it is wet, place it in a well ventilated spot inside the incinerator to dry.
- Ensure that all tools and equipment are in working order.
- Wear protective clothes (gloves, goggles, overalls and masks).
- Remove the ash from the incinerator and place it in the ash pit.
- Clean the area around the incinerator.
- Weigh the medical waste to be incinerated and count the boxes and/or packages. Record these quantities in the Waste-Disposal Record
- After starting the incinerator, observe the primary burning chamber temperature gauge until the temperature stabilizes (approximately 5 minutes) at around 600°C .
- Load only HCW that has been weighed and recorded in the operator's record for burning.
- Endeavor to load a mixture of safety boxes bags of waste so as to assist maintain the temperature at or above 600°C.
- If the temperature drops below 600°C, do not load waste till rises again.
- Do not load very wet HCW. Place them in a dry, well-ventilated, warm place to dry (e.g. next to the top of the incinerator).
- As a general rule: burn more of safety boxes in order to increase temperatures in the incinerator, and more bags of other waste in order to reduce temperatures in the incinerator.

e. Burn Down/Cool Down

When all the available HCW has been burned and the temperature indicated on the temperature gauge falls below 600°C, proceed to burn down/cool down. After the waste has burned down, leave sufficient time for the fire to die down and the embers to cool. This allows the "fixed carbon" in the waste bed to burn, reducing toxic emissions and ensuring that all the waste is totally destroyed.

i. It is advisable the operator does not leave the incinerator site until the temperature on the gauge falls below 400°C (if there is no temperature gauge, wait until the fire is reduced to a bed of red embers) to avoid any possible accidents.
ii. Allow the incinerator to cool down for at least three hours after use before removing the ash.

f. Cleaning – Including Ash Removal

When burning is complete a residue is left, the HCW incineration ash. It is important to dispose of this ash carefully since it is toxic and it may contain sharp objects. If the load of health-care waste has been burned in accordance with "best practices", the volume and weight of the ash should be minimal compared to the HCW incinerated. When carrying out the cleaning and ash removal, the operator should observe the instructions below:

i. Always wear gloves and a face mask when removing the ash.

ii. Never handle the ash or other solids with bare hands. Always wear protective clothing, including gloves. Use a rake (should be provided as part of the incinerator tool kit) to rake the ash and other non-burnable waste directly into the ash transport trolley and take it directly into the ash pit without storing it first.
iii. If the incinerator is operated every day, remove the ashes and other non-burnable waste the following day, prior to operating the incinerator again.
iv. If the incinerator is not used every day, remove all the ash on the same day after several hours or remove it the following morning. Do not leave ash in the incinerator for long periods of time.
v. Carefully sweep the area around the incinerator to ensure that all the needles and non-combustible waste are placed in the ash pit.
vi. Always close the trap door of the ash pit to avoid accidents.

g. Record-Keeping and Reporting

The incinerator activities should be recorded on a daily basis on different forms:

i. The **Waste-Deposit Record** shows the source, amount and type of waste deposited at the incinerator when the operator is present, and provides a monthly record of the waste burnt.

The purpose of the Waste-Deposit Record is to trace the quantities and origins of waste deposited. This record may not provide complete information since the waste deposited during the operator's absence may not be recorded. However, to avoid this, the operator is advised to develop a timetable of waste delivery at the incinerator site so as to avoid cases of people delivering waste in his absentia. The table below shows a sample Waste-Deposit Record that should be completed for every delivery of waste deposited at the incinerator and if possible getting the signature of the person who deposits the waste for the record.

Table 6: Example of waste deposit record

Health facility:				*Month/year:*		
Type of Incinerator:			*Name of incinerator operator:*			
Waste deposited						
Date	*Sharps (kg)*	*Other (kg)*	*Origin of waste*	*Means of transport to incinerator*	*Name of person depositing waste*	*Signature of person depositing waste*

ii. The **Waste-Disposal Record** shows the amount of waste destroyed and the amount of incineration ash produced at each burn session

Table 7: Example of waste Disposal Record

Health facility:			*Month/year:*	
Type of Incinerator:		*Name of incinerator operator:*		
Waste disposed/Incinerated				
Date	*Amount of HCW Incinerated (Sharps& Other types of HCW) in kg*	*Amount of Incineration Ash realized*	*Amount of Fuel (Diesel) Consumed*	*Number of Electricity Units consumed*

iii. The **fuel and energy record** should show amount of fuel (diesel) and number of electricity units consumed each burn session

iv. The **Tools and Equipment Record** lists the equipment available and its condition, as well as problems and defects encountered with any of the elements of the incinerator.

Table 8: Sample Tools and Equipment Record for use by the incinerator operator

Health facility:		Month:	
Type of incinerator:		Name of incinerator operator:	
Tools and equipment			
Category	**Item**	**Available**	**Condition**
Tools	Hand brush/dustpan		
	Hard broom		
	Ash rake		
	Shovel		
	Chimney cleaning brush and cord		
Safety	Sand bucket		
	Fire retardant gloves		
	Eye protection/face mask		
	Overalls or suitable clothing to cover the upper body, including the lower arms		
	Lock for incinerator door		
	Safety first aid kit		
Records & measurement	Weighing scale		
	Incinerator records for recording incineration activities		
Problems:			
Packaging or segregation of deposited waste			
Fuel and consumables for operating incinerator			
Other			
Incinerator defects			
Date	Description	Present status	

The operator should be responsible for maintaining these records in accordance with the steps below:

i. Submitting each record monthly to the waste-management supervisor.
ii. Keeping a carbon copy of all records at the incinerator site. These records must always be available for inspection at the site.
iii. Preparation of monthly/quarterly reports of the waste-management activity on the basis of the information in the daily records.

h. Operator's Maintenance Responsibilities

The operator should observe maintenance of the incinerator by carrying out the following activities:

- Keeping the area around the incinerator clean; not allowing it to become littered.
- Storing safety boxes & other medical waste in an orderly manner in the incinerator waste boxes and store.
- Storing fuel stocks in the incinerator fuel store or tank.
- Keeping the concrete slabs on either side of the incinerator clean; not using them as permanent storage zones. However, there could be temporarily storage of the HCW that is being dried prior to burning.
- Keeping tools, records and protective clothing in the storage box/office provided in the incinerator shelter.
- Handling tools and protective clothing carefully and keeping them clean.
- Immediately reporting to the waste-management supervisor any damage to the incinerator that affects operation or performance.
- Performing simple repairs but avoiding makeshift solutions.
- Systematically completing and submitting monthly reports for all records.
- Keeping the incinerator site locked at all times.
- Not allowing unauthorized persons to enter the incinerator area during periods of incineration.
- Ensuring that the waste-management supervisor has a key to the incinerator.
- Immediately reporting any vandalism, theft or unauthorized entry to the waste management supervisor.

6.5.12 Staff (Operators) Welfare

The welfare of the operators and other staff directly involved in waste management in the facility should be well taken care of to avoid incidences of low morale and go slows that would affect waste management with harmful ramifications on the surrounding environment as well as the social welfare of the local community.

7. CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

An ESMP shows the necessary actions to be undertaken to improve environmental and social management and compliance. This is geared towards maximizing on use of resources while at the same time identifying areas that would require improvements.

Table 9: Environmental Monitoring/Management plans for the construction phase

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Estimated Cost (Kshs.)
High Demand of Raw materials	**1.** Source building materials from local suppliers who use environmentally friendly processes in their operations.	Civil Engineer, Architect, Project Manager & Contractor	Throughout construction period	Part of the main budget
	2. Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered.			
	3. Ensure that damage or loss of materials at the construction site is kept minimal through proper storage.			
	4. Use of some recycled/refurbished or salvaged materials to reduce the use of raw materials and divert material from landfills.			
	2. Specify locations for trailers and equipment, and areas of the site which should be kept free of traffic, equipment, and storage.		1 month	200, 000.00
	3. Designate access routes and parking within the site.		1 month	
	4. Introduction of more vegetation (trees, shrubs and grass) on open spaces and their maintenance.	Architect, Project Manager & Landscape specialist	Monthly to Annually	
	5. Design and implement an appropriate landscaping program to help in re-vegetation of part of the project area after construction.		beginning of the project	
Increased storm water, runoff and soil erosion	1. Roof water to be harvested and stored in underground reservoirs for use in general cleaning and in the toilets. The tanks should have a capacity of at least 100, 000litres.	Civil Engineer, Mechanical Engineer, Project Manager & Contractor	During the beginning phase of the project	500, 000.00
	2. A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structure should be designed.		1 month	100, 000.00
	3. Apply soil erosion control measures such as leveling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil.			50, 000.00
	4. Ensure that construction vehicles are restricted to existing roads to avoid soil compaction within and around the project site.		Construction period	
	5. Ensure that any compacted areas are ripped to reduce run-off.		2 months	
	6. Site excavation works to be planned such that a section is completed and rehabilitated before another section begins.	Project Manager	Throughout construction period	200, 000.00
	7. Construction of soil-galleys on sloppy sections.	Project Manager		
	8. Open drains all interconnected will be provided on site.	Civil Engineer		
	9. Roof catchments will be used to collect the storm water for some uses e.g. washing of floors and cars	Civil Engineer		

Increased solid waste generation	**1.** Use of an integrated solid waste management system i.e. through a hierarchy of options: reduction, sorting, re-use, recycling and proper disposal	Project Manager & Contractor	Throughout construction period	200, 000.00
	2. Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed, rather than cutting them to size, or having large quantities of residual materials.		One-off	
	3. Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed of.			
	4. Ensure that damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects			
	5. Donate recyclable/reusable or residual materials to local community groups, institutions and individual local residents or home owners.			
	6. Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time		Throughout construction period	
	7. Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure.		One-off	
	8. Purchase of perishable construction materials such as paints should be done incrementally to ensure reduced spoilage of unused materials		Throughout construction period	
	9. Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste			
	10. Use construction materials containing recycled content when possible and in accordance with accepted standards.			
	11. Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at the site			
	12. Dispose waste more responsibly by dumping at designated dumping sites or landfills only.	Project Manager, Mechanical Engineer & Contractor	Throughout construction period	
	13. Waste collection bins to be provided at designated points			
	14. Running educational campaigns amongst workers, e.g. through use of posters, to encourage reuse or recycling of the solid waste			
Dust emission	**1.** Ensure strict enforcement of on-site speed limit regulations	Project Manager & Contractor	Throughout construction period	100, 000.00
	2. Avoid excavation works in extremely dry weathers if/and when possible			
	3. Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles			
	4. Personal Protective equipment to be worn			
Exhaust emission	**1.** Vehicle idling time shall be minimized	Project Manager & Contractor	Throughout construction period	50, 000.00
	2. Alternatively fueled construction equipment shall be used where feasible; equipment shall be properly tuned and maintained			

	3. Sensitize truck drivers to avoid unnecessary racing of vehicle engines at loading/offloading points and parking areas, and to switch off engines at these points			
Noise and vibration	**1**. Sensitize construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Resident Project Manager & Contractor	Throughout construction period	50, 000.00
	2. Sensitize construction drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals			
	3. Ensure that construction machinery are kept in good condition to reduce noise generation			
	4. Ensure that all generators & heavy duty equipment are insulated / placed in enclosures to minimize ambient noise levels.			
	5. Trees around the site will provide some buffer against noise propagation			
	6. The noisy construction works will entirely be planned to be during day time when most of the neighbors will be at work.			
Increased energy consumption	**1.** Ensure electrical equipment, appliances and lights are switched off when not being used	Project Manager & Contractor	Throughout construction period	Part of the main budget
	2. Install energy saving fluorescent tubes at all lighting points instead of bulbs which consume higher electric energy			
	3. Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts			
	4. Monitor energy use during construction and set targets for reduction of energy use.			
	5. Have provision for the installation of solar panels as per the provisions of the 2012 and the Energy (Solar Photovoltaic Systems) Regulations			
High Water Demand	**1**. Harness rainwater for some domestic uses such as general cleaning, in the toilets & gardening (roof catchment), hence the need for a dual water distribution system within the building	Mechanical Eng., proponent &Project Manager	Throughout construction period	100, 000.00
	2. Install water conserving taps that turn-off automatically when water is not in use as well as low flush toilets & waterless urinals	Manager, proponent & Contractor	One-off	
	3. Promote recycling and reuse of water as much as possible (need for a dual water distribution system within the building)	Project Manager & Contractor	Construction period	
	4. Install a discharge meter at water outlets to determine and monitor total water usage		One-off	
	5. Promptly detect and repair water pipe and tank leaks		Throughout construction period	
	6. Sensitize tenants to conserve water by avoiding unnecessary toilet flushing etc.			
	7. Ensuring taps are not running when not in use			
Generation of wastewater	**1.** Provision of means for handling sewage generated by construction workers such as mobile toilets	Mechanical Engineer & Project Manager	One-off	Part of the main budget
	2. Conduct regular checks for sewage pipe blockages or damages since such vices can lead to release of the effluent into the land and water bodies		Throughout construction period	
	3. Monitor effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated			

Incidents, accidents and dangerous occurrences.	**1.** Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place.	Project Manager, Developer, Contractor and Site Safety Officer	Continuous	100, 000.00
	2. Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition to safety education and training shall be emphasized.		Continuous	
	3. Ensure that the premises are insured as per statutory requirements (third party and workman's compensation)		Annually	
	4. Develop, document and display prominently an appropriate SHE policy for construction works		One-off	
	5. Provisions must be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented		One-off	
	6. Ensure that Suitable, efficient, clean, well-lit and adequate sanitary conveniences have been provided for construction workers		One-off	
	7. Ensure that materials are stored or stacked in such manner as to ensure their stability and prevent any fall or collapse		Continuous	
	8. Ensure that items are not stored/stacked against weak walls and partitions		Continuous	
	9 All floors, steps, stairs and passages of the premises must be of sound construction and properly maintained		Continuous	
	10. Securely fence or cover all openings in floors		One-off	
	11 Ensure that construction workers are not locked up such that they would not escape in case of an emergency		Continuous	
	12. All ladders used in construction works must be of good construction and sound material of adequate strength and be properly maintained		One-off for the design/ regularly for documentation	
	13. Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency. Such procedures must be tested at regular intervals			
	14. Ensure that adequate provisions are in place to immediately stop any operations where there is an imminent and serious danger to health and safety and to evacuate workers	Project Manager & Contractor	One-off	
	15. Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site			
	16. Provide measures to deal with emergencies and accidents including adequate first aid arrangements		Continuous	
Machinery/ equipment safety	**1.** Arrangements must be in place for the medical examination of all construction employees before, during and after termination of employment	Project Manager, Developer & Contractor	Continuous	50, 000.00
	2. Ensure that machinery, equipment, PPP, appliances and hand tools used in construction do comply with the prescribed safety and health standards and be appropriately installed maintained and safeguarded		One-off	
	3. Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain		Continuous	

	4. All machines and other moving parts of equipment must be enclosed or guarded to protect all workers from injury	Project Manager	One-off	
	5. Arrangements must be in place to train and supervise inexperienced workers regarding construction machinery use and other procedures/operations	Project Manager	Continuous	
	6. Equipment such as fire extinguishers must be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued	Project Manager	Continuous	
	7. Reports of such examinations must be presented in prescribed forms, signed by the examiner and attached to the general register	Project Manager	Continuous	
Occupational health and safety risks during construction period and occupational phase	**1.** Well stocked first aid box which is easily available and accessible should be provided within the premises	Project Manager, Developer & Contractor	One-off	100, 000.00
	2. Provision must be made for persons to be trained in first aid, with a certificate issued by a recognized body.		One-off	
	3. Firefighting equipment such as fire extinguishers and hydrant systems should be provided at strategic locations such as stores and construction areas.		One-off	
	4. Regular inspection and servicing of the equipment must be undertaken by a reputable service provider and records of such inspections maintained		Every 3 months	
	5. Signs such as "NO SMOKING" must be prominently displayed within the flat, especially in parts where inflammable materials are stored		One-off	
	6. Enough space must be provided within the premises to allow for adequate natural ventilation through circulation of fresh air	Project Manager & proponent/ residents/ contractor	One-off	
	7. There must be adequate provision for artificial or natural lighting in all parts the premises in which persons are working or passing		One-off	
	8. Circuits must not be overloaded		Continuous	
	9. Distribution board switches must be clearly marked to indicate respective circuits and pumps		One-off	
	10. There should be no live exposed connections		Continuous	
	11. Electrical fittings near all potential sources of ignition should be flame proof		One-off	
	12. All electrical equipment must be earthed		One-off	
	13. Develop a suitable system for the safe collection, recycling and disposal of chemical wastes, obsolete chemicals and empty chemical containers to avoid their reuse for other purposes and to eliminate or minimize the risks to safety, health and environment		One-off	
	14. Ensure that all chemicals used in construction are appropriately labeled or marked and that material safety data sheets containing essential information regarding their identity, suppliers classification of hazards, safety precautions and emergency procedures are provided and are made available to employees and their representatives		One-off	
	15. Keep a record of all hazardous chemicals used at the premises, cross-referenced to the appropriate chemical safety data sheets		Continuous	

	16. There should be no eating or drinking in areas where chemicals are stored or used		Continuous	
	17. Provide workers in areas with elevated noise and vibration levels, with suitable ear protection equipment such as ear muffs		One-off	
	18. Ensure that construction workers are provided with an adequate supply of wholesome drinking water which should be maintained at suitable and accessible points.	Project Manager & Contractor	One-off	
	19. Ensure that conveniently accessible, clean, orderly, adequate and suitable washing facilities are provided and maintained in within the site			
	20. Provision for repairing and maintaining of hand tools must be in place			
	21. Hand tools must be of appropriate size and shape for easy and safe use			
	22. Height of equipment, controls or work surfaces should be positioned to reduce bending posture for standing workers			
Safety and security	**1**. Ensure general safety and security at all times by providing day and night security guards and adequate lighting within and around the construction site.	Project Manager & Contractor	Continuous	10, 000.00 per month
Oil Spills	**1.** A designated garage section of the site fitted with oil trapping equipments to be planned for changes. Such an area will be well protected from contaminating the soil			5, 000.00n per month
Increased Food Supply/demand	**1.** Construction workers will be given breaks to go for lunch	Project Manager & Contractor	Continuous	50, 000.00
	2. Onsite canteen to supply food if possible			
Hydrology and Water Quality Degradation	**1.** Hazardous substance control and emergency response plan that will include preparations for quick and safe cleanup of accidental spills.	Mechanical Engineer, Project Manager, Contractor & the Developer	Continuous	Part of erosion control
	2. Hazardous-materials handling procedures to reduce the potential for a spill during construction			
	3. Identify areas where vehicle maintenance activities and storage of hazardous materials, if any, will be permitted			
Vector / Water Borne Diseases	1. Complete refuse collection and handling service to be provided	Mechanical Engineer	Continuous	50, 000.00
Exposure to Diseases	**1.** Shall be mitigated by occupational health and safety standards enforcement	Contractor & all foremen	Continuous	
Increased Pressure on Infrastructure	**1.** Coordinate with other planning goals and objectives for region	Architect, Project Manager, Contactor and the Developer	Continuous	
	2. Upgrade existing infrastructure and services, if and where feasible.			
Insecurity	**1.** Appoint security personnel operating 24 hours	Security Officer, Resident Project Manager & Police	Continuous	Part of general safety
	2. Body-search the workers on entry, to avoid getting weapons on site, and leaving site to ensure nothing is stolen.			
	3. Ensure only authorized personnel get to the site			
Air Pollution	**1.** Suitable wet suppression techniques need to be utilized in all exposed areas	The Contractor & Site Safety Officer	Continuous	Part of dust control
	2. All unnecessary traffic must be strictly limited on site; speed controls are to be enforced			

Emergence of new environmental concerns	1. Due to the magnitude of the project, the Firm of experts should carry out monitoring and evaluation. More so an initial environmental audit should also be carried within a period of 12 months after commencement of the operations	Firm of Experts.	Continuous	200, 000.00

Table 10: General Operational Environmental and Social Management Plan

Facility/ Environment Concern	Observations Made	Proposed Intervention Actions	Responsibility	Monitoring Means	Duration	Potential cost (Ksh)
Overall Environmental Management	▪ The incinerator installation and operationalization should be geared to help much in overall management of the environment in Lusigetti and the environs in terms of especially hazardous waste management ▪ There should not be allowed any open burning of waste or piling of it in the open, hence making it accessible by animals such as dogs, cats and birds and probably children. Thus this has been a nuisance and an eyesore to the neighbouring community	▪ Ensure full operationalization of the incinerator ▪ Avoid piling waste where it can be accessed by animals ▪ Avoid open burning of waste	▪ Project management/ Project Proponent	▪ Full & efficient operation of the incinerator ▪ Lack of waste piled outside the incinerator ▪ Lack of open burning of waste ▪ No animals accessing the waste	▪ Throughout	▪ 500, 000
	▪ Have in place well documented environmental management strategies that would inform organized environmental management system. ▪ Develop an Institutional Environmental Policy Statement thus procedures and schedules for reviewing the Environmental Policy; records of overall environmental performance review meetings and departmental environmental management structure.	▪ The project proponent is advised to put in place structural mechanisms that will ensure efficient environmental management strategies are adopted and reviewed from time to time to promote sustainable management of the environment ▪ In consultation with environmental experts and relevant lead agencies, the proponent to develop its own environmental policy, if none exists	▪ Project management/ Project Proponent ▪ Environmental Experts	▪ Initial ESA ▪ Team dedicated to Environmental management	▪ Can be initiated immediately but endeavor to complete the process in 12months	▪ 150, 000 one off
	Healthcare Waste Management					
	▪ Segregation of waste all the way from point of generation through to the final	▪ Ensure full operationalization of the incinerator always	▪ Project management/	▪ Full and efficient operation of the	▪ In the next three months	▪ -

	disposal of the segregated wastes. ▪ Acquire the HCW in force (2016-2021) ▪ No heaping together all wastes for open burning thereby increasing the risk of infection from HCW ▪ HCW should not be left outside at the incinerator area for a long period hence being accessed by animals. ▪ Acquire a waste disposal/incinerator operating license ▪ Construct pits for disposing ashes and another pit for compositing organic wastes. These pits should be well attended and fenced off to reduce risk to the general population.	▪ Avoid piling HCW where it can be accessed by animals ▪ The project proponent should know that the incinerator works best on well sorted waste ▪ The project proponent should ensure that all guidelines provided by the MOH on HCWM are followed to eliminate incidences of poor HCW management like the evident mix-ups. ▪ It is important for the project proponent to train and retrain the staff involved in HCWM urgently ▪ Apply from NEMA for a waste disposal/ incinerator operating license ▪ Develop a schedule that will ensure that HCW brought to the incinerator for disposal is never left outside the incinerator shelter ▪ Fence the incinerator area tightly so as to keep off some stray animals such as dogs ▪ Empty the organic waste compositing pit and fence it off	Project Proponent	incinerator ▪ Lack of waste piled outside the incinerator ▪ Lack of open burning of waste ▪ No animals accessing the waste ▪ Proper following of all guidelines provided by the MOH on HCWM ▪ Training and retraining reports ▪ Tight fence around the incinerator ▪ Regularly emptied and fenced off organic waste pit	▪	▪
	Noise Monitoring and Control					
	▪ There must be noise monitoring carried out with regard to the incinerator operations ▪ Check that bottles are opened being incinerated to avoid noise pollution from explosions	▪ Initiate full operationalization of the incinerator immediately by providing adequate diesel ▪ Avoid open burning of to reduce on noise pollution from explosions	▪ Project management/ Project Proponent	▪ Reduced or lack of complaints from the public ▪ Full and efficient operation of the incinerator ▪ Lack of open burning of waste	▪ Keep the incinerator operating	▪ -
	Air Quality Monitoring and Control					
	▪ The proponent should avoid air pollution around the area, either from the incinerator operations or from open burning of waste	To reduce on emissions, it is advisable adhering to the following practices: ▪ Firstly, initiate full operationalization of the incinerator always by providing adequate diesel and avoid open burning of waste	▪ Project management/ Project Proponent	▪ Air monitoring data ▪ Reduced or lack of complaints from the public	▪ Every six months ▪ Keep the incinerator operating	▪ 100, 000 one off to purchase the necessary equipment or

		▪ Secondly, ensure that the incinerator is functioning properly, and the chimney is clear of excessive soot. ▪ Rigorously segregate waste so that no unnecessary PVC (IVs, etc.) waste is incinerated ▪ Ensure that the incinerator is preheated adequately and that supplementary fuel is added whenever necessary to maintain the burning temperature above 600C. ▪ Load the incinerator according to the recommended "Best Practices". ▪ Adopt rigid quality control measures.		▪ Full and efficient operation of the incinerator ▪ Lack of open burning of waste		50,000/yr
	Staff Awareness and Training					
	▪ Staff awareness and training with respect to environmental management as stipulated in various guidelines offered by the MOH and NEMA	▪ There should be training and frequent retraining of all the project staff with respect to environmental management	▪ Project management/ Project Proponent	▪ Training reports	▪ Should be done every six months there after	▪ 50, 000 per training
	Environmental Management System Set Up, Suitability and Performance					
	▪ The project proponent should have in place a documented environmental management policy	▪ Formulate an environmental policy for the incinerator	▪ Management/ Project Proponent	▪ Environmental policy in place	▪ Up to 12 months	▪ 50, 000
	Compliance to Environmental Standards					
	▪ It is upon the project proponent to ensure that the project is compliant to the set environmental standards.	▪ Comply with all set environmental standards such as applying for an ETP license and an Incinerator operation license as well. ▪ They should carry out an environmental audit for the project annually	▪ Project management/ Project Proponent	▪ ETP and an Incinerator operation licenses	▪ Every to 12 months	▪ 100, 000 per annum
Community Health and Safety Issues	**Operational Effectiveness of the Incinerator**					
	▪ The incinerator should be undergoing regular servicing and maintenance	▪ Ensure thorough sorting of waste to avoid organic wastes finding their way into the incinerator once full operationalization is done ▪ Ensure regular servicing once full operationalization has been initiated ▪ Evidence of a servicing contract	▪ Project management/ Project Proponent	▪ Lack of organic wastes at the incinerator site ▪ Lack of complaints from the public	▪ Throughout the operation of the incinerator	▪ Part of full operationalization of the incinerator

	Structural Safety of Project Infrastructure					
	▪ The chimney should not be highly exposed to avoid easy be vandalization not forgetting that kids could climb on it with danger of getting burnt.	▪ Install guards around the chimney to ensure that nothing can reach it	▪ Project management/ Project Proponent	▪ Insulated/ well-guarded chimney	▪ Should be done during the construction phase	▪ 20, 000
	Ash Pit					
	▪ The incinerator should have a functional ash pit as should be the standard for incinerators to avoid the dispose of the ash from the incinerator in the open	▪ There is need to construct a standard ash pit with a lockable cover. The ash pit should be large enough to store incinerated residues for at least 10 years without being emptied. A pit of 3.25m^3 stores ash from the burning of approximately 300 safety boxes per month, over a period of 12years.	▪ Project management/ Project Proponent	▪ A standard ash pit complete with lockable cover	▪ Its construction should be done together with the incinerator shelter	▪ 60, 000
Occupation Safety and Health Management	**Adequacy of the Design of the Shelter**					
	The design of the shelter should be up to standard to include: ▪ A defined Office space ▪ A Supplies/ material Store ▪ A Toilet ▪ Washing rooms ▪ The shelter to have a store where consumables like fuel, records, PPEs and other supplies can be stored	▪ There should be provision for a fully equipped office with furniture and office accessories so as to assist in proper record keeping of the incinerator operations and activities ▪ There should be a bathroom with functioning shower head and adequate supply of water ▪ There should be a toilet for the incinerator operators to avoid their having to share the mortuary pit latrine with mortuary attendants and clients; ▪ A store should be provided for within the incinerator Other than the above singled fundamentals, it should encompass other several elements, housed within the sheltered enclosure. These elements are: ▪ A storage box to keep tools, protective clothing and records. ▪ An enclosure with a lockable door to prevent access by children and	▪ Project management/ Project Proponent	▪ Fully equipped office with furniture and office accessories ▪ A bathroom with functioning shower head and adequate supply of water ▪ A toilet for the incinerator operators ▪ A store within the incinerator ▪ A storage box to keep tools, protective clothing &records ▪ An enclosure with a lockable door to prevent access by children and	▪ These installations and modifications should be done during the project design phase	▪1, 000, 000 the needful modifications

		unauthorized persons, as well as scavenging animals and birds. ▪ An access hatch through a wire-mesh wall of the incinerator to allow waste to be deposited when the incinerator shelter is locked and the operator is not present. This hatch should open into a safety-box deposit which should provide a protected area where the safety boxes (and containers from needle-cutters) can be deposited temporarily.		unauthorized persons, as well as scavenging animals & birds. ▪ An access hatch through a wire-mesh wall of the incinerator		
	Operator's Tasks and Responsibilities					
	▪ The incinerator operators should have a regular routine to burn the waste ▪ Prompt reporting of achievements or problems associated with the operation of the incinerator	▪ Initiate full operationalization of the incinerator by always providing adequate diesel ▪ Avoid open burning of waste ▪ The incinerator operators in conjunction with the management should establish a regular routine to burn the waste ▪ Work towards minimizing personal risk, as well as risk to other workers and the local community by not operating a faulty incinerator ▪ Initiate a way of reporting achievements and problems to the supervisor for necessary actions	▪ Project management/ Project Proponent	▪ A regular routine to burn the HCW in place ▪ Reports on achievements and problems associated with the operation of the incinerator and solutions taken	▪ In the first month of full operationalization of the incinerator	▪ -
	Receiving Health-Care Waste at the Incinerator					
	▪ There should be a well-developed formal way of receiving wastes at the incinerator facility	In the event of full operationalization of the incinerator and in the presence of the operator at the incinerator and waste is deposited at the incinerator, the operator should: ▪ Receive the waste, record the required details in the Waste-Deposit Record. ▪ Verify that any waste received is appropriately packaged -that is: Sharps in safety boxes; other waste in plastic bags, and needles in needle-cutter containers.	▪ Project management/ Project Proponent ▪ Incinerator operator	▪ Incinerator operating reports	▪ A continuous activity	▪ -

		▪ And that there are no organic wastes brought to the incinerator When the operator is not present at the incinerator, the person delivering the waste should: ▪ Make sure that the safety boxes and plastic bags are properly closed. ▪ Deposit the safety boxes and plastic bags through the access hatch that is clearly labeled and designed for this purpose. The waste deposited here drops into the safety box deposit that is accessible only to authorized persons. At locations where a needle-cutter is used, deposit the needle containers through the access hatch that is used for the safety boxes and plastic bags. Thus this calls for the modification of the door to allow deposit of waste into the shelter even when the operator is not within the incinerator shelter. ▪ On returning to the incinerator site, the operator should arrange the safety boxes or plastic bags of waste which have been deposited through the waste hatch in the waste store. ▪ The operator should also complete the Waste-Deposit Record for the newly arrived waste once he returns to the facility				
	Security of the Facility					
	▪ Lack of proper securing of the incinerator area is what can enable the access to waste by stray dogs and cats as well as enabling anybody to dispose their waste into the incinerator area indiscriminately.	▪ Security of the facility should be enhanced by ensuring that it is well fenced off to make sure that strangers do not access the incinerator area nor do dogs access waste ▪ Dispatch a 24hour watchman to the incinerator area	▪ Project management/ Project Proponent	▪ Proper fence around the incinerator facility ▪ A 24hour watchman at the incinerator area	▪ Fencing can be done during construction while a watchman can be deployed immediately	▪ 50, 000 for fencing
	Personal Protection Equipment and Safety of the Incinerator Operator					

	▪ The incinerator attendants should have appropriate PPE for use during operation of the incinerator	Supply of at least two sets of PPE of the right quality is recommended. The set of the right PPE should include at minimum the following: ▪ Eye Goggles (medical grade); ▪ Dust Mask-appropriate grade; ▪ Gumboots-appropriate grade; ▪ Hand glove-appropriate grade; ▪ Face Mask-appropriate grade; and ▪ Overall- covering the body and the head. Exercising the following measures will ensure that the operator is safe: ▪ Wearing the proper PPE at all times when operating the incinerator; ▪ Washing hands regularly, hence why a hand wash basin with running water is needed within the incinerator shelter; ▪ Being vaccinated against Hepatitis B Virus (HBV); and ▪ Having regular medical checkups (every six months).	▪ Project management/ Project Proponent	▪ Availablility of adequate PPE of the right quality	- within a month	20, 000 to purchase adequate PPE
	Fire Extinguishers					
	▪ Installed adequate fire suppression equipment/ system at the incinerator shelter	▪ The management should install fire suppression system before operationalization of the incinerator which should be serviced regularly to keep it effective at all times ▪ The incinerator operators should be trained on how to operate the fire extinguishing system to be installed and fire drills should be undertaken from time to time	▪ Project management/ Project Proponent ▪ Incinerator operators	▪ Availability of fire extinguishing equipment ▪ Training reports of the incinerator operator on fire emergencies	▪ Should be achieved within the next three months	▪ 100, 000
	First Aid Kits					
	▪ The incinerator should have adequate well equipped first aid related equipment.	▪ It is important that the facility is equipped with well-stocked first aid kits as well as training the incinerator operators on first aid administering from reputable first aid trainers such as St. Johns Ambulance.	▪ Project management/ Project Proponent	▪ Availability of adequate first aid kits ▪ Training reports of the operator on first	▪ Should be achieved within the next three months	▪ Can be part of the fire emergency cost

				aid administration		
	Sanitation and Cleanliness					
	▪ As earlier noted, the incinerator should have adequate sanitation facilities; ▪ There should be piped water of good pressure ▪ The shelter should be well arranged and clean at all times. ▪ The sanitation and cleanliness of the facility should not be compromised by waste being deposited outside the shelter. This exposes the wastes to access by scavenging animals such as dogs.	▪ The operators are encouraged to observe and maintain the highest levels of cleanliness possible. ▪ Measures should be put in place to ensure that wastes delivered when the operator is not in are not deposited outside the incinerator shelter. This should be done by creating safe boxes that would allow safe depositing of HCW when the operator is not within the incinerator area. ▪ Make a point of providing a sanitation facility to serve the incinerator alone	▪ Project management/ Project Proponent	▪ No waste kept outside the incinerator shelter ▪ Availability of safe waste disposal boxes ▪ Piped water connected to the facility ▪ Toilet & bathroom constructed to serve the facility	▪ Should be achieved within the next three months	▪ 200, 000
	Emergency Response Procedures					
	▪ Have a well-documented emergency plan for the incinerator facility. ▪ Have a well-functioning Emergency alarm at the incinerator ▪ Have the operator trained on emergency response. ▪ Have an emergency committee in place	▪ It is recommended that the project proponent develops an emergency plan as well as constitute an Emergency Response Committee (ERC) that will entail staff from all departments. The members of the committee should be trained on emergency preparedness and response; the trained staff should in return be trainers of trainees to ensure that eventually all staff in all departments will be equipped with the necessary skills in emergency preparedness and response.	▪ Project management/ Project Proponent ▪ Department of Public Health and Department of Occupational Safety and Health	▪ Emergency alarms in place ▪ Training reports on emergency management ▪ Emergency management committee in place	▪ Can be done together with the training on fire/first aid management	▪ Can be part of the fire emergency cost
	Work Injuries Benefit Cover					
	▪ A Work Injuries Benefit Cover insurance cover should be in place	▪ The management to have the Work Injuries Benefit (WIBA) Cover insurance cover put in place	▪ Proponent ▪ Department of Occupational Safety and Health	▪ Work Injuries Benefit Cover insurance cover put in place	▪ Can be achieved with the next six months	▪ 50, 000
	The Management in Relation to the Incinerator Facility					
	The Incinerator Operators ▪ The facility should always be supplied with adequate fuel so as to remain	▪ The operators should always be subjected to retraining to improve their skills and know how especially the basics like	▪ Department of Public Health and Department of	▪ Re-training report of the operators ▪ Two motivated	▪ Can be achieved by commercializing	Can be part of full operationalization of the incinerator

	operational always so as to avoid open burning of wastes not forgetting that inadequate supply of diesel also leads to incomplete combustion of the waste by the incinerator leading to the production and release of noxious gases	loading of wastes, minor maintenance procedures that go a long way in defining the health of the facility in the long run ▪ The management should ensure there are at least two dedicated operators with long term contracts to inspire their morale. The operators should be subjected to regular retraining until they are well equipped with skills to navigate challenges likely to occur in the operations of the incinerator ▪ Ensure adequate supply of fuel to the incinerator as well as ensuring full operationalization of the incinerator Further to the above, the following operator-related measures should be adopted to ensure good incinerator performance once full operationalization is initiated: ▪ Only a trained, qualified and equipped operator should operate the incinerator. ▪ The operator must be on-site while the incinerator is functioning. ▪ The operator must be motivated to follow "Best Practices." ▪ The incinerator should be operated according to Best Practices to minimize emissions and other risks. ▪ The operator must have long-term contracts or be permanent hires.	Occupational Safety and Health ▪ Project management/ Project Proponent	incinerator operators in place ▪ Adequate supply of diesel to enable optimum operation of the incinerator	the incinerator activities	
	Supervision ▪ Supervision is another area that needs to be addressed seriously so as to a mix up of waste delivered at the incinerator	▪ Mixed up waste delivered at the incinerator could be identified with better supervision at the point of waste generation and at the incinerator site. The responsibilities of the supervisor at the facility could include but not be limited to: ▪ Ensuring good waste segregation practices;	▪ Project management/ Project Proponent	▪ Supervision reports ▪ Strict sorting of HCW at source	▪ Throughout	▪ -

		▪ Coordination and supervision of waste transportation, packaging, storage and handling; ▪ Monitoring of waste handling at the incinerator and other appropriate locations ▪ Supervision of the incinerator operator; and Reporting.				
	Motivation ▪ One of the key barriers to good waste management is the absence of motivated operators and waste management supervisors and the lack of effort to motivate them	▪ One way of motivating the personnel is through schemes offering financial incentives for good performance. ▪ Good training and creating awareness among all project staff on the importance of good waste management (thorough sorting at source) can also improve motivation levels. ▪ As well, confirming permanent employment to the trained incinerator, giving them the appropriate PPE as well as providing for their own office and washroom would highly motivate to delivering the best in waste management and incinerator operation.	▪ Project management/ Project Proponent	▪ Motivational schemes of the incinerators such as permanent or long term employment terms ▪ Training reports ▪ Provision of appropriate PPE to the operators ▪ Provision for office space, washroom and toilet to the incinerator operators	▪	▪
	Incinerator Records ▪ There should be proper records at the incinerator indicating the type and quantity of wastes disposed.	▪ In the event of full operationalization of the incinerator, records should be kept and they would help in evaluating the performance of the incinerator.	▪ Project management/ Project Proponent	▪ Copy of proper records	▪ Throughout	▪ -
	Best Practices in Waste Incineration once the incinerator is fully operationalized					
	Appropriate Conditions for Incinerating Waste would include the following ➢ Observing appropriate conditions for incinerating the waste	It is advisable to use the incinerator to burn HCW only if: ➢ Twelve or more safety boxes of waste have been deposited at the site for disposal. ➢ No large groups of people are present in the immediate area. ➢ The safety precautions are adequate. ➢ The incinerator is in good working order.	▪ Project management/ Project Proponent ▪	▪ Efficient incineration process ▪ Monitoring reports	▪ This is immediate and then maintained throughout	-

	➢ In relation to Safety Precautions, there should be provision of appropriate PPE	For Safety Precautions to be Termed Adequate, the Following Conditions must be Met ➢ The appropriate PPE should be available and in good condition. ➢ Buckets full of sand are available at the incinerator site. ➢ The appropriate tools are available to operate the incinerator.	▪ Project management/ Project Proponent ▪	▪ PPE available all the time and being used appropriately ▪ Availability of sand buckets	▪ This is immediate and then maintained throughout	-
	➢ Making sure that the incinerator is in Good Working Condition due to the presence of a correctly closing loading door; the metal parts (front door, loading door, and chimney) not badly corroded and/or likely to break	For the Incinerator to be considered in Good Working Condition, the Following Conditions must be met: ➢ The ash door and the loading door close correctly, i.e. they must not be broken. ➢ The strainer cables to the chimney should be tight, and there should be no risk that the chimney will fall down. ➢ The metal parts (front door, loading door, spigot, chimney, etc.) should not be badly corroded and/or likely to break. ➢ The masonry should not be badly cracked and/or likely to cause injury. ➢ The incinerator should never be operated if faulty	▪ Project management/ Project Proponent ▪	Well maintained incinerator in optimal operating status	Can be achieved throughout	Running cost of the incinerator
	➢ Preparation and Loading the waste before start-up should follow the procedure below: - Making sure that the waste is dry - Ensuring that all tools and equipment are in working order. - Wearing of complete and of best quality PPE. - Consistence in removing the ash from the incinerator and placing it in the ash pit immediately. - Weighing of the waste to be	In the preparation and loading of the HCW and before starting-up the incinerator, one should: ➢ Make sure that the HCW is dry. If it is wet, place it in a well ventilated spot inside the incinerator to dry. ➢ Ensure that all tools and equipment are in working order. ➢ Wear proper PPE (gloves, goggles, overalls and masks). ➢ Remove the ash from the incinerator and place it in the ash pit immediately. ➢ Clean the area around the incinerator. ➢ Weigh the medical waste to be	▪ Project management/ Project Proponent ▪ Incinerator operators	▪ Incinerator operating records ▪ Efficient operation of the incinerator	▪ This is immediate and then maintained throughout	-

	incinerated and counting of the boxes and/or packages hence a record of these quantities	incinerated and count the boxes and/or packages. Record these quantities in a Waste-Disposal Record (WDR) ➢ After starting the incinerator, observe the primary burning chamber temperature gauge until the temperature stabilizes (approximately 5 minutes) at around 600°C. ➢ Load only HCW that has been weighed and recorded in the operator's record for burning. ➢ Endeavor to load a mixture of safety boxes bags of waste so as to assist maintain the temperature at or above 600°C. ➢ If the temperature drops below 600°C, do not load waste till it rises again. ➢ Do not load very wet HCW. Place them in a dry, well-ventilated, warm place to dry (e.g. next to the top of the incinerator). ➢ As a general rule: burn more of safety boxes in order to increase temperatures in the incinerator, and more bags of other waste in order to reduce temperatures in the incinerator.				
	➢ Burn Down/Cool Down- for at least 3hours following a waste incineration session.	➢ When all the available waste has been burned and the temperature indicated on the temperature gauge falls below 600°C, proceed to burn down/cool down. ➢ After the waste has burned down, leave sufficient time for the fire to die down and the embers to cool. ➢ It is advisable that the operator does not leave the incinerator site until the temperature on the gauge falls below 400°C.	▪ Project management/ Project Proponent ▪ Incinerator operators	▪ Incinerator operating records ▪ Efficient operation of the incinerator	▪ This is immediate and then maintained throughout	-

		➢ Allow the incinerator to cool down for at least 3hrs after use before removing the ash.				
	➢ Cleaning – Including Ash Removal: when wearing the appropriate gloves and a face mask.	When carrying out the cleaning and ash removal, the operator should observe the instructions below: ➢ Always wear gloves and a face mask when removing the ash. ➢ Never handle the ash or other solids with bare hands. Always wear protective clothing, including heavy duty gloves. Use a rake (should be provided as part of the incinerator tool kit) to rake the ash and other non-burnable waste directly into a ash transport trolley and take it directly into the ash pit without storing it first-you can wet it to avoid being spread by wind. ➢ If the incinerator is operated every day, remove the ashes and other non-burnable waste the following day, prior to operating the incinerator again. ➢ If the incinerator is not used every day, remove all the ash on the same day after several hours or remove it the following morning. Do not leave ash in the incinerator for long periods of time. ➢ Carefully sweep the area around the incinerator to ensure that all the non-burnt needles and non-combustible waste are placed in the ash pit. ➢ Always close the trap door of the ash pit to avoid accidents.	▪ Project management/ Project Proponent ▪ Incinerator operators	▪ Use of appropriate PPE always ▪ Supervision records ▪ Proper disposal of ash ▪ Clean incineration area and shelter ▪ Availability of the right tools and equipment	▪ This is immediate and then maintained throughout	-
	➢ Proper Record-Keeping and Reporting:	It is advisable that once the incinerator is fully operationalized, its activities are recorded on a daily basis on different forms such as the following: ➢ The **<u>Waste Deposit Record</u>** to show the	▪ Project management/ Project Proponent ▪ Incinerator	▪ Incinerator operating records	▪ This is immediate and then maintained throughout	-

		source, amount and type of waste deposited at the incinerator when the operator is present, and provide a monthly record of the waste burnt. ➢ The **Waste-Disposal Record** to show the amount of waste destroyed and the amount of incineration ash produced at each burn session while the fuel and energy record should show amount of fuel (diesel) and number of electricity units consumed each burn session ➢ The **Tools and Equipment Record** lists the equipment available and its condition, as well as problems and defects encountered with any of the elements of the incinerator. The operator should be responsible for maintaining these records in accordance with the steps below: ➢ Submitting each record monthly to the waste-management supervisor. ➢ Keeping a carbon copy of all records at the incinerator site. These records must always be available for inspection at the site. ➢ Preparation of monthly/quarterly reports of the waste-management activity on the basis of the information in the daily records. ➢ Initiate proper records to indicate the fuel consumption versus waste incinerated	operators ▪ Supervisor			
	➢ Operator's Maintenance Responsibilities-It is advisable that servicing of the incinerator is being carried out adequately by the contractor through a service contract/ after sale	The operators should be able to observe maintenance of the incinerator by carrying out the following activities: ➢ Keeping the area around the incinerator clean; not allowing it to become littered. ➢ Storing safety boxes and other medical	▪ Project management/ Project Proponent ▪ Incinerator operators	▪ Incinerator operating records ▪ Supervision records ▪ Clean incineration area and shelter	▪ This is immediate and then maintained throughout	-

		waste in an orderly manner in the incinerator waste boxes and store. ➢ Storing fuel stocks in the incinerator fuel store or tank. ➢ Keeping the concrete slabs on either side of the incinerator clean; not using them as permanent storage zones. However, they could be temporarily storage of the HCW that is being dried prior to burning. ➢ Keeping tools, records and PPE in the storage box/office provided in the incinerator shelter. ➢ Handling tools and PPE carefully and keeping them clean. ➢ Immediately reporting to the supervisor any damage to the incinerator that affects operation or performance. ➢ Performing simple repairs but avoiding makeshift solutions. ➢ Systematically completing and submitting monthly reports for all records. ➢ Keeping the incinerator site locked at all times. ➢ Not allowing unauthorized persons to enter the incinerator area during periods of incineration. ➢ Ensuring that the waste-management supervisor has a key to the incinerator. ➢ Immediately reporting any vandalism, theft or unauthorized entry to the supervisor.	▪ Supervisor ▪	▪ Availability of the right tools and equipment ▪ Reports ▪		
Incinerator and ancillary facilities	▪ Incinerator chimney can get very hot- although it is not insulated	▪ There is need to insulate the chimney during the construction phase	▪ Project management/ Project Proponent	▪ Insulated chimney	▪ During construction phase	▪ Part of the construction Budget

	▪ Adequate provision of fuel for the incinerator	▪ Provide adequate fuel for the incinerator to enable full operationalization	▪ Department of Procurement and Supplies	▪ Continuous availability of adequate fuel	▪ To be maintained always	▪ Budgeted for earlier
	▪ Energy use and conservation-The Incinerator to have an independent electricity meter	▪ Install an independent electricity meter for the incinerator to enable monitor its energy use	▪ Project management/ Project Proponent	▪ Electricity meter installed	▪ Can be achieved within one month	▪ 3000
Public Consultation, Participation and Socio-Economic Issues	**Support for the Incinerator**					
	Members of the public are in full support of the incinerator project with the believe that if fully operationalized it would lead to reduced cases of foul emissions and explosions	▪ The project proponent should not allow open burning of waste at the site	▪ Project management/ Project Proponent	▪ Fully operating incinerator ▪ Lack of open burning of waste ▪ Lack of complaints from the surrounding members of the public	▪ Can be initiated immediately	▪ -
	Emissions and the Surrounding Community					
	▪ Emission from the open burning of waste should not be witnessed at all nor toxic emissions from the incinerator.	▪ The management should fully operationalize the incinerator and avoid open burning of waste at the site	▪ Project management/ Project Proponent	▪ Fully operating incinerator ▪ Lack of open burning of waste ▪ Lack of complaints from the surrounding members of the public	▪ Throughout	▪ -
	Scavenging Animals and Public Health					
	▪ Due to the potential lack of good securing of the facility and open dumping of waste, animals such as dogs and cats could access and rummage through the waste carrying some to the surrounding homesteads	▪ Fence off the incinerator site properly ▪ No open dumping of waste at the site ▪ Develop a schedule of delivering waste from the surrounding health care facilities ▪ Avoid open burning of waste	▪ Project management/ Project Proponent	▪ Proper fence around the incinerator area ▪ Waste delivery schedule in place ▪ Fully operating incinerator	▪ Can be initiated immediately	▪ -
	Livelihood Value of the Facility					
	▪ The community is aware that it is a source of employment to the intended	▪ The project management is requested to consider the locals especially in hiring of	▪ Project management/	▪ More locals as casuals and	Throughout the operation of the	▪ -

	operators and suppliers of diesel.	causals ▪ Operationalize the incinerator fully	Project Proponent	reduced complaints	incinerator	
	Maintenance of the Facility					
	▪ The local community feared that the incinerator would go down after commissioning owing to lack of funds for maintaining the project sustainably	▪ The project proponent should ensure that adequate resources are put forward for proper maintenance of the incinerator so as to ensure that there is no likely of open burning of waste in the area	▪ Project management/ Project Proponent	▪ Continuous operation of the incinerator	Throughout the operation of the incinerator	At least 10000 per week to purchase fuel
	Public Health and Sanitation					
	▪ The local community felt that waste management in the locality would continue improving with proper utilization of the incinerator. ▪ Some public members are aware that use of an incinerator in waste management is way better than open burning	▪ The project proponent should be ready to address the issue of any emission ▪ Never allow open burning of waste	▪ Project management/ Project Proponent	▪ Never allowing open burning of waste; Reduced emissions via high notch management of incinerator and especially the thermocouple	▪ Throughout the operation of the incinerator	At least 10000 per week to purchase fuel
	Staff Awareness and Training					
	▪ The incinerator attendants should be trained by the incinerator supplier on its operation as well as handling of especially hazardous/infectious waste management.	▪ Owing to the dynamics associated with HCWM, regular refresher trainings should be done to make sure that the operators are equipped with the best knowhow with regard to handling HCW ▪ It is also advisable that the management organizes for a training of the operators on operation of the incinerator to ensure that they are efficient in their tasks ▪ Such retraining can be organized to be carried out by the incinerator installer	▪ Project management/ Project Proponent	▪ Refresher training reports ▪ Report of retraining of the operators on operation of the incinerator	▪ Immediate	▪ 20, 000

7.1 Operational of the Incinerator EMP

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

Table 11: Summary Environmental Management/Monitoring Plan for Operation of the incinerator

Expected Negative	Recommended Mitigation Measures	Responsible	Monitoring	Monitoring	Monitoring	Cost (Ksh)

Impacts		Party	Frequency	Means	Entity (ies)	
Emissions	To reduce emissions, adhere to the following Best Practices: i. Provide adequate incineration diesel ii. Rigorously segregate waste so that no unnecessary plastic/PVC (IVs, etc.) waste is incinerated. iii. Ensure that the incinerator chimney is clear of excessive soot. iv. Ensure that the incinerator is preheated adequately and that supplementary fuel is added whenever necessary to maintain the burning temperature above 600^0C. v. Minimize poor burning in the chimney through correct loading practices and regulation of the self-adjusting draft control in the chimney. This increases the gas residency period. vi. Load the incinerator according to the recommended "Best Practices". Ensure proper functioning of the scrubber at all times; Ensure timely servicing of the incineration machine vii. Adopt rigid quality control measures	Project management/ PHO/ Project Engineering Department and the CDE	Throughout the operating period of the incinerator	Observation of the incinerator operating temperatures, volume and weight of incineration ash against incinerated HCW, colour of smoke from the incinerator chimney	Project management/ PHO/ Project Engineering Department and the CDE	Part of the incinerator operating costs
Need for close supervision	i. Training all the staff in best HCWM and general waste handling practices; Ensuring good waste segregation practices from source through to final disposal point; ii. Coordination and supervision of waste transportation, packaging, storage and handling; Monitoring of waste handling at the incinerator and other appropriate locations iii. Proper Supervision of the incinerator operators; and Reporting			Level of waste segregation, records form the incineration operation		
Proper operation	i. The incinerator operators should be subjected to training on the best practices of operating it, maybe by the Incinerator Installer; Only well-trained, qualified and equipped operators should operate the incinerator. ii. The operators must always be on-site while the incinerator is functioning; iii. The operators must be motivated to follow "Best Practices." iv. The incinerator should be operated according to Best Practices to minimize emissions and other risks. v. The incinerator operators should have long-term contracts or be permanent hires			Observation of the incinerator operating temperatures, volume and weight of incineration ash against incinerated waste, colour of smoke from the incinerator chimney and records related to proper operation		100, 000

				of the incinerator		
OSH concerns	**a)** Implement all necessary measures to ensure health and safety of the facility to workers and the general public during operation of the facility as stipulated in the Occupational Safety and Health Act of 2007 **b)** Subject the incinerator operators to First Aid Administration as well as fire emergency responses	Project management/ PHO/ Project Engineering Department and the CDE	Throughout the operating period of the incinerator	General awareness of OSH related matters by the incinerator operators	Project management/ PHO/ Project Engineering Department and the CDE	0
General safety and security concerns	i. Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the incinerator ii. Ensure only authorized personnel get to the site iii. Fire extinguishers should be placed strategically and operators of the incinerator trained on how to use them in case of a fire outbreak and Fence off the incinerator site	Project Proponent and the Security Officer	Continuous	Observation for the adequacy of security measures	Project Proponent and the Security Officer	50, 000
Emergence of new environmental concerns	Undertake an ESA within 12 months following the commissioning date of incinerator as required by law	Project management/ and the CDE	Once per annum		Project management/ and the CDE	As per the prevailing conditions

Table 12: Health Care Waste Management Plan

HEALTH CARE WASTE MANAGEMNET PLAN						
NB-All Health care wastes should be disposed in accordance to the guidelines offered by the ministry of health. The proposed incinerator management should not hesitate to consult other relevant government agencies like NEMA with regard to disposal of HCW. Special reference should be made to the Environmental Management and Coordination Act, Waste Management Regulations (2006)						
Waste Category	**Recommended Treatment and Disposal Method**	**Responsibility**	**Monitoring Means**	**Monitoring Frequency**	**Monitoring Entity (ies)**	**Cost (Ksh)**
1. Human Anatomical Waste (human tissues, organs, body parts)	-Deep burial	The generating party-mostly a Hospital	Lack of such waste at the proposed project site	When picking the waste from a hospital	Hospitals and project proponent	-
2. Microbiology & Biotechnology Waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of	- Local autoclaving / microwaving / incineration	Hospital Management	Observation	Before picking the waste from a hospital	Hospital Management NEMA, PHO and project proponent	Part of the incinerator operating cost

cultures)						
3. Waste sharps (needles, syringes, scalpels, blades, glass, etc. This includes both used and unused sharps)	-Disinfection (chemical treatment/ autoclaving /microwaving and mutilation/ shredding) / incineration					
4. Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated, contaminated and expired medicines)	-Incineration, destruction and proper disposal in authorized secure landfills	Hospital Management and project proponent	Observation	Before picking the waste	Hospital Management and project proponent	50, 000
5. Some types of Solid Waste (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood)	- Incineration / autoclaving / microwaving			Before picking the waste		Part of the incineration cost
6. Other types of Solid Waste (wastes generated from disposable items other than the waste sharps such as tubings, catheters, intravenous sets etc.).	-Disinfection by chemical treatment / autoclaving / microwaving and mutilation shredding/incineration					

7.2 Relevant HCW Management Guidelines

In the course of managing health care wastes at the hospital and operating the incinerator; the following guidelines should be observed:

i. The Constitution of Kenya 2010;
ii. The Environment Management and Coordination Act of 1999 (EMCA)
iii. The Kenya National Guidelines on Safe Disposal of Pharmaceutical Waste;
iv. The Radiation Protection Act, Cap 243, provides for directions on radioactive waste management;
v. The Medical Practitioners and Dentist Board Act;
vi. National IPC Policy;
vii. Injection Safety and Medical Waste Management Policy 2007;
viii. Infection Prevention and Control (IPC) Policy and Guide-lines 2011;
ix. The Kenya Health Policy 2012 to 2030;
x. The Environmental Management and Coordination (Waste Management) Regulations 2006;
xi. Sessional Paper No. 6 of 1999 on Environment and Development;
xii. The environment policy of 2012

International binding agreements that Kenya has domesticated should be observed too.

7.3 Maintenance of the Incinerator Machine

For optimality and efficiency during operation of the incinerator, the operators should be guided by the user manual provided by the supplier of the machine. The operators should be trained by the machine supplier on how to operate and maintain the machine. Key to successful maintenance of the machine is regular servicing of the machine

7.4 Decommissioning Phase

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

Table 13: Environmental Management/Monitoring Plan for the decommissioning phase the facility

Recommended Mitigation Measures	Responsible Party	Time Frame	Cost (Ksh)
1. Demolition waste management			
1. All equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible	Project Proponent	One-off	As per that time
2. All foundations must be removed and recycled, reused or disposed of at a licensed disposal site	Project Proponent	One-off	As per that time
3. Where recycling/reuse of the, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site	Project Proponent	One-off	As per that time
4. Donate reusable demolition waste to charitable organizations, individuals and institutions	Project Proponent	One-off	As per that time
2. Rehabilitation of project site			
1. Implement an appropriate re-vegetation programme to restore the site to its original status	Project Proponent	One-off	As per that time
2. Consider use of indigenous plant species in re-vegetation	Project Proponent	One-off	As per that time
3. Trees should be planted at suitable locations so as to interrupt slight lines (screen planting), between the adjacent residential area and the development.	Project Proponent	Once-off	As per that time
4. Proper treatment of the site should be carried out	Project Proponent	Once-off	As per that time

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The ESIA found out that if the incinerator is put into optimal use as per the manufacturers user guide, the benefits are immeasurable in terms of efficiency in disposing especially hazardous and infectious waste. However, there are several challenges that can bedevil the operations of the incinerator hence not achieving optimal results; central to this is lack of adequate fuel to support the operations of the machine. Other challenges are related to Occupation Health and Safety of the operators.

Noted is that there were no adverse environmental and social impacts associated with incinerator identified if operated as to per the manufacturer's guidelines and as per the recommendations given in this report. Therefore, addressing the identified management challenges would result in numerous environmental and social benefits as far as the local environment is concerned with regard to disposal of mostly HCW. Potential identifiable and noted impacts are of Low Significance and through proper mitigation measures they can be addressed satisfactorily as stipulated on the environmental management plan.

8.2 Recommendations

The project management is commended for embracing such technology in waste disposal and it is incumbent upon it to sort out the management challenges that can bedevil full operationalization of the incinerator in order to realize its intended benefits. Based on the ESIA findings, the experts recommend the following to enhance sustainability in utilization of the incinerator:

i. **Supplies**- the project management should ensure that there are adequate supplies that can support the optimal running of the incinerator such as diesel at all times. Consumption rates should be established to enable proper planning. This can only be attained via proper record keeping.

ii. **Sustainability-** the project management should map out a partnership with local private health care facilities that lack functional incinerators by assisting in disposing the HCW from such facilities at a fee. By so doing the project management will raise the required finances required to fuel and maintain the incinerator. In this regard the following should be formulated:

- Map out the catchment to be served by the incinerator;
- Establish an affordable fee preferably per kilogram of HCW delivered at the incinerator for disposal;
- Initiate a clean HCWM and incinerator operations record keeping at the facility
- Establish a mutually agreed timetable on delivery of HCW from private and other health care facilities within the vicinity of Lusiggetti;
- Retrain the incinerator operators and if possible give them permanent employment terms or long-term contracts
- Ensure close supervision of the incinerator operators

iii. **OHS and Emergency Services:** In order to ensure optimum OSH status at the incinerator site, there should be put in place a ash pit; a washroom; a fully equipped office; a toilet; waste store fitted with waste boxes; a supplies store; a fire suppression system and an emergency alert alarm system. There should be provision of proper and adequate PPEs to the incinerator operators who should be properly trained on emergency preparedness and response, first aid administration and provided with adequate first aid kits and other requisite materials.

iv. **Environmental Management Strategies –** the facility should endeavour to comply to set standards with regard to environmental and public health/social management. Reference should be made to the Environmental Management and Coordination Act-2015 (Waste Management) Regulations of 2006 for compliance purposes. The project proponent should apply from NEMA for a waste disposal license

v. **Security and access by non-authorized persons and animals-**the facility should be secured adequately to fend away delinquent persons as well as deny scavenging animals the access to waste.

vi. **Never allow open burning of waste-**With the above in place, the project proponent should never allow open burning of waste as a matter of principle

9. REFERENCES

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xxvi. National Health Care Waste Management Strategic Plan (2016 – 2021), MOH (K)
xxvii. National Infection Prevention and Control Guidelines for Health Care Services in Kenya, 2014, MOH (K)
xxviii. United Nations (1987). The Rio Declaration on Environment and Development.

10. LIST OF ANNEXES

i. Copies of NEMA Practicing Certificates
ii. Sample Public Consultation Form
iii. Minutes of the Meeting between the Consultants and the Members of the Public
iv. Waste Management (EMCA, 2015) Regulations, 2007
v. Air Quality Management Regulations, 2014
vi. Project Design Images

10.1 Copies of NEMA Practicing Certificates

FORM 7 (r.15(2))

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/12407

Application Reference No: NEMA/EIA/EL/16570

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registration number **2355**

in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **3/11/2020** Expiry Date: **12/31/2020**

Signature…..

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified

FORM 7 (r.15(2))

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/12408

Application Reference No: NEMA/EIA/EL/16571

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Issued Date: **3/11/2020**

Expiry Date: **12/31/2020**

Signature…..

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified

FORM 7 (r.15(2))

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/11673

Application Reference No: NEMA/EIA/EL/15773

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in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **1/22/2020** Expiry Date: **12/31/2020**

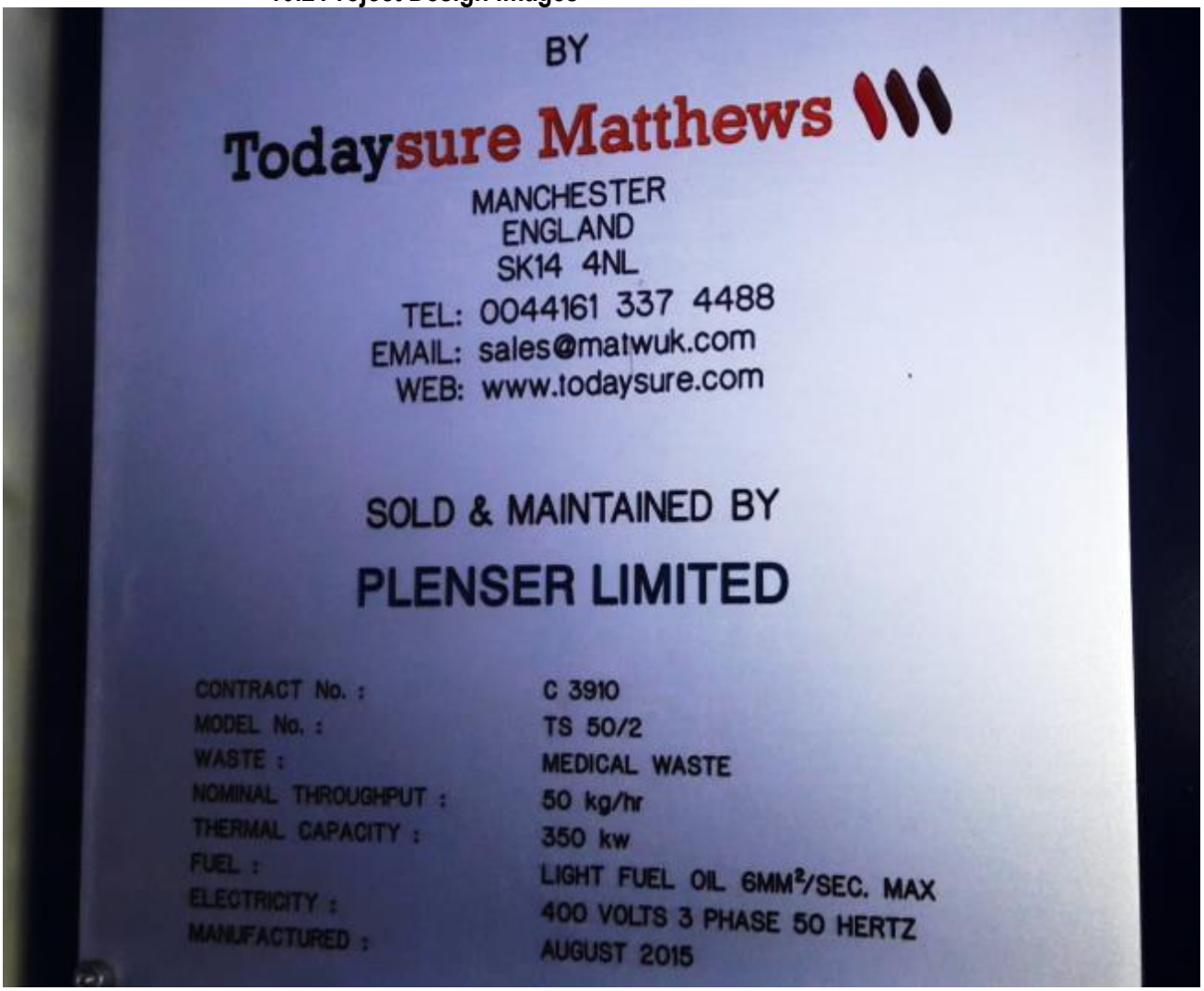
Signature.....

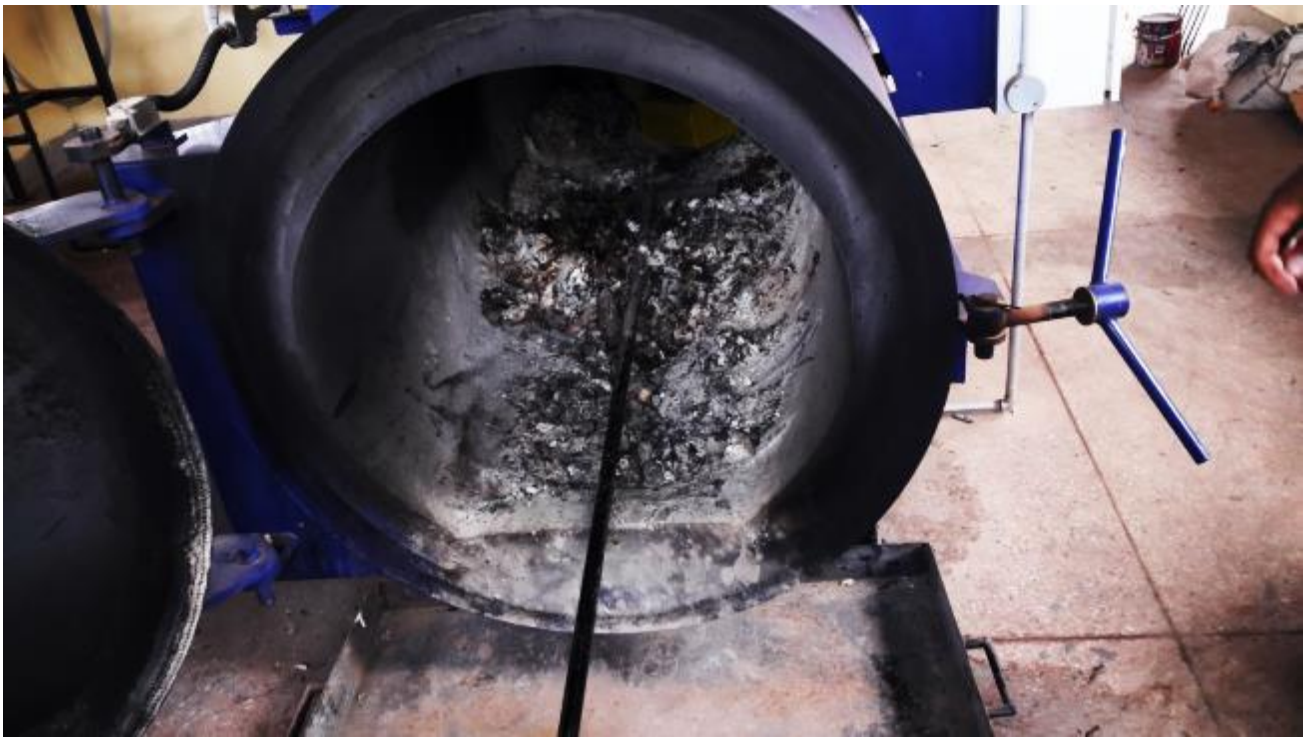
(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified

10.2 Project Design Images





10.3 Sample Public Consultation Form

10.4 Minutes of the Meeting between the Consultant and Representatives of the Public of the Project Area

10.5 Waste Management (EMCA, 1999) Regulations, 2007

10.6 Air Quality Management Regulations, 2014

10.7 Land Ownership Documents