ENVIRONMENTAL IMPACT ASSESSMENT PROJECT REPORT

80MW THIKA ROAD MSD POWER PROJECT

L.R. No. 8380/2

JANUARY, 2010
Client: Kenya Power & Lighting Company Limited

Assignment: To carry out an Environmental Impact Assessment of the proposed 80 MW MSD Power Plant Project along Thika Road on Plot No. L.R. 8380/2, next Mangu High School and opposite Witeithie Village.

Project Cost: USD 125,000,000 (One hundred and twenty-five Million US Dollars).

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EXECUTIVE SUMMARY

Introduction and Study Objectives
The Ministry of Energy and The Kenya Power & Lighting Company Limited (KPLC) are desirous to construct a Medium Speed Diesel (MSD) Power Generating Plant along Thika Road, on Plot No. L.R. 8380/2, next Mangu High School and opposite Witeithie Village, in Thika District. The location of the proposed MSD Power plant is on a 10 acre plot hived off from a 100 acre coffee farm. The proposed project will inject an additional 80 MW. This is in response to the increasing demand and also the expected shortfall of electricity generation from hydro power plants caused by unfavorable climatic conditions. The study objectives were to:

- Conduct an Environmental Impact Assessment to identify both positive and negative impacts of the proposed project and propose most appropriate interventions during construction, operation and decommissioning of the project,
- Collect baseline socioeconomic data of the project area and potential impact expected from project construction, implementation, operation and decommissioning,
- Develop an Environmental Monitoring Program during construction and operation and present plans to minimize, mitigate, or eliminate negative effects and impacts,
- Describe Environmental Management Plan implementation mechanisms; review the power plant design and its compliance to environmental requirements,
- Identify and contact stakeholders to seek the views on the proposed project,

Scope Objective and Criteria of the Environmental Impact Assessment (EIA)
The Government of Kenya policy on all new projects, programmes or activities requires that an environmental impact assessment is carried out at the planning stages of any proposed undertaking. The scope of this Environmental Impact Assessment, therefore, covers:

- The baseline environmental conditions of the area,
- Description of the proposed project,
- Provisions of the relevant environmental laws,
- Public participation
- Identification and discuss of any adverse impacts to the environment anticipated from the proposed project,
- Appropriate mitigation measures,
- Development of an environmental management plan outline.

The scope covered various activities related to; construction works of the proposed development which included ground preparation, construction of the MSD Power Project, operation of the MSD Power Project, decommissioning of the MSD Power Project and
installation of service lines as well as the utilities required by the proposed MSD Power Project.

The study terms of reference included:

- Establish the suitability of the proposed location of the proposed MSD Power Project along Thika Road on Plot No. L.R. 8380/2, next Mangu High School and opposite Witeithie Village.
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
- A description of the technology, procedures and processes to be used, in the implementation of the project.
- A description of materials to be used in the construction and implementation of the project, the products, by-products and wastes to be generated by the project.
- A description of the potentially affected environment.
- A description of environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
- To recommend a specific environmentally sound and affordable wastes’ management system.
- Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.
- Analysis of alternatives including project site, design and technologies.
- Development of Environmental Management Plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.
- Provide an action plan for the prevention and management of the foreseeable hazardous activities in the cause of the project cycle.
- Propose measures to prevent health hazards and to ensure security in the working environment for the employees, residents and for the management of emergencies.
- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information.
- An economic and social analysis of the project.

**Study Methodology**

This study was carried out through desk and field investigations. The experts conducted extensive literature review pertaining to this project. During the field investigation, reconnaissance survey was conducted to gather information on biophysical and socio-economic aspects of the area and its environs.
In order to address these issues, the study team adopted a participatory approach where the client and the immediate surrounding communities were consulted in addition to reviews and references to sources of information including legal statutes, design and relevant project documents. Among the key activities undertaken during the assessment are:

(i) Interviews and consultations with the immediate neighbouring land users. A questionnaire was circulated to the people in the neighbourhood to obtain their honest opinion regarding the project (samples have been annexed to this report),
(ii) Review of documents with necessary information on the proposed project details, the site planning and implementation plan as well as the desired nature building,
(iii) Physical inspection of the proposed site and photography,
(iv) Evaluation of the activities around the site and the environmental setting of the wider area, through review of existing information, literature and physical observations,
(v) Reporting, review and submissions.

The Environmental considerations evaluated for the proposed development include: Ecological considerations (biological diversity, sustainable use of ecological resources and ecosystem maintenance), social considerations (economic impacts, social cohesion or disruption, effects on human health, immigration or emigration, communication and effects on culture and objects of cultural value), Landscape considerations (views opened up or closed, visual impacts, compatibility with surrounding areas and amenity opened up or closed) and land use considerations (water sources, effects of proposal on surrounding land use potentials and possibility of multiple uses).

Project Description

The proposed site is located along the Nairobi - Thika highway, about 30 Kilometres from Nairobi City centre, on plot number L.R. 8380/2, measuring approximately 10 acres. The proposed project site is also approximately 10 kilometers to Thika Town. The general area that surrounds the project area has a variety of uses including agricultural, industrial, residential and commercial. The original land from which the project site was acquired, is a coffee farm measuring 100 acres and next to Mangu High School on one side and an urban dwelling, known as Witeithie, on the other side of the Nairobi - Thika highway.

The operator is expected to provide and install all plant and equipment, including 10 WARTSILA 4-stroke medium speed diesel engines type 20V32 and a steam turbine with a combined capacity of 80MW, transformers, cables, switchgear, protection and metering equipment for take-off at 11KV. The project duration is 25 (twenty-five) years with clause of early termination, extension and generation capacity upgrade. The engines will be housed together with the steam turbine. The type of fuel to be used to power the engines is HFO with low sulphur content of 1.9%. 7,500m$^3$ of fuel is expected to be stored in the plant area using above-ground storage tanks.

The estimated cost of the project is approximately USD125,000,000.
PROJECT POTENTIAL IMPACTS AND MITIGATION MEASURES

Both positive and negative impacts that are associated with the proposed MSD Power Project during the construction phase, operation phase and decommissioning phase were identified. The following positive and negative impacts are associated with the proposed project.

Positive Impacts
The following are positive impacts associated with the proposed MSD Power Project on Thika Road:

- Reliable supply of electrical energy.
- Direct and indirect skilled and no-skilled employment opportunities.
- Gains in the local and national economy through increased business activities.
- Provision of market for supply of building materials.
- Informal sectors benefits.
- Optimal use of land and increased value of land.
- Improvement in security as a result of lighting.
- Improvement in social infrastructure.
- Reduction in pressure on biomass which comes from forest resources.

Negative Impacts

Against the background of the above positive impacts, there will be anticipated negative impacts emanating from the construction and subsequent operation activities of the facility. The negative impacts will include:

Air Emissions
The project will potentially have adverse impacts on air quality during operation mainly from stack gases emitted. Emissions will be comprised of particulate matter (PM), sulphur dioxide (SO₂), oxides of nitrogen (NOₓ), carbon monoxide (CO), the greenhouse gases (GHGs) and carbon dioxide (CO₂), trace amounts of various metals, and trace amounts of organic and inorganic compounds. The proportions and amounts of pollutants emitted will depend on the fuel quality and condition of combustion. Dust will be generated during construction.

Noise Pollution
The proposed area has existing activities which are relatively quite during both day and night. The proposed civil works and operation of the facility will bring about an increase in cumulative noise levels. Noise pollution from the operation of the generators is inevitable during night and day time as the generators run 24 hours non-stop throughout except during maintenance time. There are however no sensitive receptors of noise especially at night. The project developer should ensure that design specifications take into consideration the reduction of noise from the generators using sound proofing technology that ensures that minimal noise is heard beyond the generating plant.
Fire Hazards
Potential adverse impacts related to fire hazards remain a main feature of this project. The plant will deal with combustible products (diesel), with a large oil storage facility at the site and the risks associated with fire hazards form a significant adverse impact on the human health and environment.

Soil Erosion
There is a likelihood of localized soil erosion during the civil works which entail clearing the existing vegetative soil cover, earth excavations, compacting and vehicular movements. However, these impacts will be largely localized to the project area and will only occur during the construction phase. The existing coffee plantation will have to be uprooted to pave way for the construction of the power plant thus leading to increase soil erosion especially during the construction period.

Oil Spills
The transferring of fuel Oil, from the tankers used for transportation, to the aboveground storage tanks and pumping for use to the generator sets could result in accidental oil spills. This could lead to potential contamination of surface and groundwater as well as soil. Oil spills could also occur during the transportation of fuel by road using tankers.

Waste oil pollution
Waste oil is also an output of the project that poses potential environmental hazard in case of poor handling and disposal methods. This may affect the environment through water and soil contamination.

Increase in Traffic flow
During the construction phase, heavy vehicles moving in and out of the project site are likely to increase traffic along the main Thika road near the project site and could cause congestion. Deliveries of fuel by road during project operation will also increase the amount of traffic flow in the project area.

Strain in local resources
The proposed development is likely to strain the resources available like water in the area in the short term. This is as a result of increased population in the project personnel and other activities arising there-from without commensurate services and facilities.

Occupational Health and Safety
There will be potential risk of occupational hazards that could lead to occupational accidents and during construction and operation phases of the project. Adverse impacts on the workers health and safety is likely to occur especially through workers interaction with the equipments and machines during construction and operation of the plant. Accidents, injuries and diseases are likely to occur during project construction and operation and this could potentially harm the safety and health of the employees.
**Solid waste generation**
Solid waste materials during construction and solid waste during operation are likely to be encountered. The waste will include soil, construction materials and office papers.

**Visual Intrusion**
The proposed project will change the natural appearance of the project area landscape.

**PROPOSED MITIGATION MEASURES**

**Air Emissions Mitigation Measures**

- During construction, any stockpiles of earth should be enclosed / covered / watered during dry or windy conditions to reduce dust emissions;
- Construction trucks removing soil from the site, delivering sand and cement to the site should be covered to prevent material dust into the surrounding areas;
- During construction, where water is available, sprinkle the construction area with water to keep dust levels down.
- Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.
- Drivers of construction vehicles must be supervised so that they do not leave vehicles idling and they limit the vehicular speeds so that dust levels are lowered.
- Maintain all machinery and equipment in good working order to ensure minimum emissions including carbon monoxide, NOₓ, SOₓ and suspended particulate matter;
- Increase generator stack heights high
- No burning of any waste materials whatsoever should be permitted within the site both during construction and operation;
- During operation, Generators will require appropriate maintenance to ensure minimal emissions into the neighbouring areas;
- Use of low sulphur diesel fuel or installing desulphurisation equipment though it’s expensive for such a project.
- Nitrogen oxide emission should be controlled through:- burner management and water injection to the combustion turbines; Smoke treatment (denitrification); Choice of combustion technology; Burners/low-NOₓ combustion chambers; Water or steam injection.
- Particulate emissions should be reduced through good combustion control to minimize the products of incomplete combustion. Reduction of ash content in fuels: Choice of combustion technology, Electrostatic precipitators, bag filters, Control of combustion conditions operating measures (including stack cleaning)
- The Plant operator will be required to install and operate dedicated stack gas samplers or analyzers, and report analytical results.
- Source testing will also routinely be required to confirm continued compliance with emission limits.
To mitigate the effects of flue gas affecting the micro-climate of the area, the stack chimney of the generators will be constructed up to 6 metres high. This will enable plume dispersal high preventing smoke and heat from affecting the surrounding area.

**Dust Emission Mitigation Measures**

- Fugitive emissions from roads and site work to be eliminated or minimized by applying water on a need to need basis to the dirt roads, unpaved surfaces and exposed construction areas during the dry season.
- The dusty roads and exposed construction areas should be moisturized during the dry season to prevent or minimize the fugitive dust emissions.

**Noise Abatement Measures**

- All equipments and machinery installed must be tested to verify if they are compliant with Kenya and the internationally acceptable standards of noise. Tested noise levels should be recorded as baseline and used for future monitoring.
- Noise emitting equipment should be properly maintained.
- All workers in the project site must be equipped with suitable and adequate Personal Protective Equipment (PPE) for hearing protection.
- Each diesel generator shall be provided with at least one exhaust silencer.

**Soil Erosion Mitigation Measures**

- Excavations of the site will be confined only on the sections of the plant where structures and equipment shall be located.
- Excavated earth will be held away from the drains and on locations of the site not susceptible to surface runoff of storm water.
- The earth removed for external disposal will require to be deposited on sites without the risk of being washed down during rains and where it will not compromise other land use activities in those areas.
- Caution will be required during construction at times of heavy rains.
- Re-vegetate exposed areas around the site so as to mitigate erosion of soil by storm water runoff.
- The final site grade should facilitate drainage and avoid flooding and pooling. A site drainage plan should be developed to protect against erosion.
- Protecting stockpiles through the use of silt fencing and reduced slope angles should be used to minimize soil erosion during construction.
- Installation of drainage ditches, construction of runoff and retention ponds is necessary. Minimization of disturbances and scarification of the surface should be observed to reduce erosion impacts.
- All slopes and working surfaces should be returned to a stable condition.
- Topsoil on the final site would be graded and planted as appropriate.
Oil Spill Mitigation Measures

- To prevent oil spills and environmental contamination, the power plant and pipelines should be designed with spill prevention and detection systems to protect the environment.
- Need to design appropriate protection devices against accidental discharge of oil substances (bases/airtight tanks for machines, reservoirs etc.).
- Storage and liquid impoundment areas for fuels, raw and in-process material solvents, wastes and finished products should be designed with secondary containment to prevent spills and the contamination of soil, ground and surface water.
- All the aboveground fuel storage tanks should have secondary containment or retention area (bund wall) with sufficient volume to contain a spill from the largest tank in the containment structure. The containment area should have a means of removing accumulated water.
- Use of rail, as the site is next to a railway line, to transport the generator fuel to the plant instead of using road oil tankers.
- The plant operator should provide adequate storage areas for the storage of chemical and lubricating substances.
- Drains should be routed through an oil/water separator.
- Frequent inspection and maintenance of the facility should be done to minimize spilling from the transfer pipeline.
- A written workplace response plan should be prepared and retained on the site and the workers should be trained to follow specific procedures in the event of a spill.
- Constructing and maintaining facilities should be done so as to enable the easy removal of rainwater from the secondary containment structures and proper removal of oil from the surface of the accumulated storm water.
- The project operator should ensure the proper containment or collection and disposal for the waste oil or used oil. In the Environmental Management Plan (EMP), disposal of used oil will be the responsibility of the project operator.
- All waste oils and lubricants from maintenance of equipment and the containers for the lubricants should be segregated and disposed properly by a reputable/registered waste handler in accordance with the waste disposal plan.
- Used oil filters should be segregated in a place where dripping used oil can be accumulated and disposed properly. The plant operator will identify a reputable company to handle disposal of oil filters.
**Solid waste generation and littering**

- The solid waste would consist primarily of packaging materials for lubricants, used oil filters and used rags.
- Contractor should develop a solid waste disposal plan which includes the provision of receptacles at strategic points within the site, recycling programmes for recyclable wastes.
- Solid wastes must be segregated and labelled to separate hazardous from non-hazardous waste. The plant should be provided with an inbuilt solid waste collection bin with compartments for recyclable materials, biodegradable materials and hazardous materials.
- The most appropriate options in waste management are identification of the waste types, segregation into the various categories and establish suitable mechanisms of collection, storage, transfer and final disposal. The ultimate destination for each of the waste categories should also be known.
- The contractor and project operator should engage a refuse handling company to remove the wastes from the site to the recommended waste management site.
- Warning signs against littering and dumping wastes in wrong places within the project site should be erected.
- Earth excavated from the construction site should be used as land fill in quarries or other excavated sites within or outside the project site. It is suggested that the contractors identify suitable land fill sites.
- Solid waste audit should be an integral section of the annual environmental audit of premises upon commissioning.

**Hazardous waste**

- The amount of hazardous waste generated will be very low and possibly originate from maintenance sources.
- The waste would consist primarily of spent lubricants, used rags and spent clean-up solvents.
- Hazards on the site should be clearly marked and the entire workforce trained to recognize the hazards and familiarize themselves with procedures to be followed before entering hazardous areas.

**Fire Prevention Measures**

- The project site must have in place appropriate and adequate fire fighting equipments of recommended standards and in key strategic points.
- A fire alarm system should be installed in the plant.
- A fire evacuation plan must be posted in various points of the project site including procedures to take when a fire is reported. All workers must be trained on fire management and fire drills undertaken regularly.
- A fire assembly point must be identified and labeled accordingly.
Public and Workers Health and Safety Mitigation Measures

- All workers entering the construction site must be equipped with Personal Protective Equipment (PPE) such as ear muffs, safety footwear, overalls, gloves, dust masks, among others. The PPE’s should be those that meet the international standards.
- Personal protection gear must be provided, maintained and its use made compulsory to all. The entire workforce of the plant should be trained in the use and care of protective gear and in all relevant safety measures.
- Restricted ‘ENTRY’ signs should be installed to keep away unauthorized persons from access to restricted areas.
- Machines and Equipments must be operated only by qualified staff and a responsible person should be on site at all times to ensure adherence to safety requirements.
- The contractor and operator must develop a workplace Safety and Health Policy Manual which should be communicated to all persons at the site.
- The contractor and operator should develop an MSD Response Plan for handling any emergencies arising thereof during the construction.
- During construction, temporary washrooms should be constructed with soak-pits that can be easily exhausted.
- A well equipped first aid kit and a person who has been trained in first aid should always be available at the site.

Visual Impact

- Structures at the site should be designed in such a way that they will improve the beauty of the surroundings.
- Restore site area through backfilling, landscaping and planting of trees, shrubs and grass on the open spaces to re-introduce visual barriers,
- Landscaping and planting of trees at the site would also serve to mitigate any perceived negative visual impacts

Economic and Social Impact

- The Proponent should continually participate in community development activities where possible as part of their corporate social responsibility.
- Casual labourers should be sourced from the local community to boost them economically and create employment for the youth.

Public Consultation

Consultations were also undertaken as part of the EIA in order to obtain the views of members of the immediate community and interested and affected groups within the site’s immediate area of influence. The consultation was done with randomly selected people in the neighbourhood of the proposed site and involved use of a semi-structured public participation form. In general the project is acceptable and no objections were raised concerning the development as proposed.
Conclusion
An Environmental Management Plan (EMP) outline has been developed to ensure sustainability of the site activities from construction through operation to decommissioning. The plan provides a general outlay of the activities, associated impacts, mitigation action plans and appropriate indicators for monitoring. Implementation timeframes and responsibilities are defined, and where practicable, the cost estimates for recommended measures are also provided.

A monitoring plan has also been developed and highlights some of the environmental performance indicators that should be monitored. Monitoring creates possibilities to call to attention changes and problems in environmental quality. It involves the continuous or periodic review of operational and maintenance activities to determine the effectiveness of recommended mitigation measures. Consequently, trends in environmental degradation or improvement can be established, and previously unforeseen impacts can be identified or pre-empted.

It is strongly recommended that a concerted effort is made by the site management in particular, to implement the Environmental Management and Monitoring Plan provided herein. Following the commissioning of the MSD Power Plant, statutory Environmental and Safety Audits must be carried out in compliance with the national legal requirements, and the environmental performance of the site operations should be evaluated against the recommended measures and targets laid out in this report.

*It is quite evident from this study that the construction and operation of the proposed MSD Power Project will bring positive effects in the project area including improved supply of electricity, creation of employment opportunities, gains in the local and national economy, provision of market for supply of building materials, Informal sectors benefits, Increase in national industrial production, increase in revenue, Improvement in the quality of life for the workers, Optimal use of land and Improved security. However, although the project will come with various positive impacts, negative impacts will also be experienced hence the need to also look at them.*

*Considering the proposed location, construction, management, mitigation and monitoring plan that will be put in place, the project is considered important, strategic and beneficial and may be allowed to proceed.*
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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AGO</td>
<td>Automotive Gas Oil</td>
</tr>
<tr>
<td>AST</td>
<td>Above Ground Storage Tank</td>
</tr>
<tr>
<td>CO_x</td>
<td>Oxides of Carbon</td>
</tr>
<tr>
<td>DOSHS</td>
<td>Directorate of Occupational Safety and Health Services</td>
</tr>
<tr>
<td>DPK</td>
<td>Dual Purpose Kerosene</td>
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<tr>
<td>EA</td>
<td>Environmental Audit</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
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<tr>
<td>EMCA</td>
<td>Environmental Management and Coordination Act, 1999</td>
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<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
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<tr>
<td>EPP</td>
<td>MSD Power Plant</td>
</tr>
<tr>
<td>GHGs</td>
<td>Green House Gases</td>
</tr>
<tr>
<td>GoK</td>
<td>Government of Kenya</td>
</tr>
<tr>
<td>HFO</td>
<td>Heavy Fuel Oil</td>
</tr>
<tr>
<td>KENGEN</td>
<td>Kenya Electricity Generating Company Limited</td>
</tr>
<tr>
<td>KPLC</td>
<td>Kenya Power and Lighting Company Limited</td>
</tr>
<tr>
<td>kV</td>
<td>Kilo Volt</td>
</tr>
<tr>
<td>L.R.</td>
<td>Land Registration</td>
</tr>
<tr>
<td>mg/kg</td>
<td>Milli grams per kilogram</td>
</tr>
<tr>
<td>MW</td>
<td>Mega Watts</td>
</tr>
<tr>
<td>MoE</td>
<td>Ministry of Energy</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Environment Management Authority</td>
</tr>
<tr>
<td>NO_x</td>
<td>Oxides of Nitrogen</td>
</tr>
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<td>OSHA</td>
<td>Occupational Safety and Health Act, 2007</td>
</tr>
<tr>
<td>PM</td>
<td>Particulate Matter</td>
</tr>
<tr>
<td>SO_x</td>
<td>Oxides of Sulphur</td>
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<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
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<tr>
<td>SHE</td>
<td>Safety, Health and Environment</td>
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<tr>
<td>STD</td>
<td>Sexually Transmitted Diseases</td>
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<tr>
<td>TPH</td>
<td>Total Petroleum Hydrocarbon</td>
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</table>
CHAPTER ONE: INTRODUCTION

1.1 Project Background

In Kenya, the Kenya Electricity Generating Company Limited (KenGen) is responsible for the
generation of electrical energy. Most of the electrical energy is generated from hydro-dams. Thermal
generation is there to a lesser extent, while generation from wind is on a very small scale.
Independent Power Producers also supplement electricity generation using thermal generators.

The weather patterns have changed in the recent past with the amount of rainfall gradually reducing
over the years. The problem has been compounded by destruction of natural forests which are water
towers. Therefore the volume of water in the hydro-dams has gone down, especially last year - 2009.
Heavy siltation in the dams has also had a negative effect on the volume of water in the hydro-dams.
Thus the electrical generation capacity at the dams has dwindled over time. At the same time,
Kenya’s population has been rising steadily with a corresponding demand for energy in various forms.

Last year, 2009, saw a significant decrease electrical energy generation as compared to the demand
and this can be attributed to the prevailing drought situation. The Government of Kenya through the
Ministry of Energy and Kenya Power & Lighting Company Limited (KPLC) with expected financing from
the World Bank, have decided to boost the country’s electricity generation capacity by constructing
MSD Thermal Power Plants to produce 240 MW of electricity at three sites within the environs of the
Nairobi Metropolis. One of the sites chosen is along Thika Road on Plot No.8380/2 next to Mangu High
School and opposite Witeithie Village. This site is approximately 40 kilometres from Nairobi and 10
kilometres to Thika town.

The proposed Thika Road MSD Power Plant will generate 80 MW of electrical energy. Therefore this
Environmental Impact Assessment study has been commissioned in line with Environmental
Legislation, EMCA 1999 and its subsidiary Legislation i.e. Environmental Impact Assessment and
Auditing Regulations of 2003, before commencement of the project.

This Environmental Impact Assessment is identify both positive and negative impacts of the proposed
project to the environment and propose mitigation measures in the Environmental Management Plan
developed to address potential negative impacts, during the construction, operation and
decommissioning phases of the project, for overall environmental sustainability.

1.2 Objectives and Scope of the Study

The Kenyan Government Policy on all new projects, programs or activities requires that an
Environmental Impact Assessment is carried out at the planning stages of any proposed undertaking
that is likely to harm the environment to ensure that significant impacts on the environment are
taken into consideration during the design, construction, operation and decommissioning of the facility.
1.2.1 Scope

The main objective of this assessment was to identify significant potential impacts of the project to environmental and social aspects, and formulate recommendations to ensure that the proposed project takes into consideration appropriate measures to mitigate any adverse impacts to the environment and people’s health through all phases of its implementation.

The assessment was undertaken in full compliance with the Environmental Management and Coordination Act 1999 and also the Environmental Impact Assessment and Audit Regulations, 2003. In addition, appropriate sectoral legal provisions touching on such projects have also been referred to for the necessary considerations during the construction, commissioning and operation of the proposed office block.

Specific objectives of the study included the following:

- Present an outline of the project background,
- Establish the environmental baseline conditions of the project area and review all available information and data related to the project,
- Identify key areas for environmental, health and safety concerns as well as the anticipated impacts associated with the proposed project implementation and commissioning,
- Establish a comprehensive environmental management plan covering the construction, operation and decommissioning phases of the project,
- Preparation of a comprehensive Project Report in accordance with the local environmental legislation and submission to NEMA for further instructions and/or approval.

The EIA scope largely covered the following areas:

(1) Baseline Conditions:
- Environmental setting (climate, topography, geology, hydrology, ecology, water resources, sensitive areas, etc.),
- Socio-economic activities in the surrounding areas (land use, human settlements, economic activities, institutional aspects, water demand and use, health and safety, public amenities, etc.),
- Infrastructural issues (roads, water supplies, drainage systems, power supplies, etc.).

(2) Legal and policy framework:
- Focusing on the relevant national environmental laws, regulations and by-laws and other laws and policies focusing on allied activities relative to the project in question.

(3) Interactive approach was adopted for the immediate neighbourhood in discussing relevant issues including among others:
• Land use aspects,
• Neighbourhood issues,
• Project acceptability,
• Social, cultural and economic aspects,

(4) Environmental impacts:
• Physical impacts,
• Biological impacts,
• Legal Compliance.

1.2.2 Terms of Reference (TOR) for the EIA Process

The EIA Experts were appointed to conduct the Environmental Impact Assessment of the proposed MSD Power Project on Thika Road on Plot No.8380/2 next to Mangu High School and opposite Witeithie Village an area of the greater Nairobi Metropolitan. The scope of the assessment covers construction works of the proposed development which include ground preparation, civil works, structural works, Installation of the generators, installation of service lines as well as the utilities required by the MSD Power Plant. The output of this work is a comprehensive Environmental Impact Assessment Project Report for the purposes of seeking a NEMA licence that will approve the project construction and operation.

The EIA experts on behalf of the project proponent conducted the study by using the following terms of reference:

• Establish the suitability of the proposed location of the proposed MSD Power Project in Thika Road.
• A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
• A description of the technology, procedures and processes to be used, in the implementation of the project.
• A description of materials to be used in the construction and implementation of the project, the products, by-products and waste to be generated by the project.
• A description of the potentially affected environment.
• A description of environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
• To recommend a specific environmentally sound and affordable wastewater management system.
• Provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.
• Analysis of alternatives including project site, design and technologies.
• Development of an Environmental Management Plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.
• Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the course of project construction, operation and decommissioning.
• Propose measures to prevent health hazards and to ensure safety in the working environment for the employees and the neighbouring community.
• An identification of gaps in knowledge and uncertainties which were encountered in compiling the information.
• An economic and social analysis of the project.

1.2.3 EIA Approach and Methodology

The approach to this exercise was structured such as to cover the requirements under the EMCA, 1999 as well as the Environmental Impact Assessment and Audit Regulations, 2003. It involved largely an understanding of the project background, the preliminary designs and the implementation plan as well as commissioning.

In addition, baseline information was obtained through physical investigation of the site and the surrounding areas, informal interviews with a random sample of people from the surrounding community, use of public participation forms, site checklist, photography, and discussions with other stakeholders.

The key activities undertaken during the assessment were:

⇒ Continuous discussions with the stakeholders and accessing other sources of information on the proposed project details, the site planning and implementation plan,
⇒ Physical inspection of the proposed site, photography, and interviews with people in the immediate neighbourhood. A public participation form was used to record their opinion regarding the project (samples have been annexed to this report),
⇒ Evaluation of the activities around the site and the environmental setting of the wider area. This was achieved through existing information, literature and physical observations,
⇒ Review of available documentation,
⇒ Reporting, review and submissions.

Below is an outline of the basic EIA steps that were followed during this assessment:

Step 1: Screening
This was the first stage when the proposed project was evaluated, guided by EMCA (1999). Urban development activities are listed under schedule 2 of EMCA, 1999 among projects requiring EIA before commencement. In addition, other considerations taken into account during the screening process included the physical site location, zoning, nature of the immediate neighbourhood, sensitivity of the areas surrounding the site and socio-economic activities in the area, among others.

Step 2: Desk Study
Documentation review was a continuous exercise that involved a study of available documents on the project including the project set-up plans and architect’s statement, land ownership documentation, environmental legislation and regulations, district development plans, location maps, etc.
Step 3: Site Assessment and Consultations
With the background obtained from the site investigation, discussions held, and the documentation review, the proposed project was evaluated and an assessment made on the potential environmental and social impacts. Consultations were made with the Proponent, as well as selected members of the surrounding community.

Step 4: Establishment of Baseline Conditions
Physical inspections and observations constituted the main baseline survey activities. It was considered necessary to carry out environmental sampling and analysis (e.g. air, water, noise, soil) because of the location of the proposed development in an agricultural area.

Step 5: Reporting
Specific issues covered in the project report include but are not limited to:

- Name of the proponent, address and contact person
- Title of the project
- Objectives and scope of the project
- Nature of the project;
- Location of the proposed project, including the physical area that may be affected by the project’s activities;
- Types of activities that will be undertaken during the project construction, operation and decommissioning phases;
- Design of the project;
- Proposed Project budget;
- Materials to be used, products and by-products, including waste to be generated by the project and the method(s) of their disposal;
- Potential environmental impacts of the project;
- Economic and social impacts to the local community and the nation in general;
- Laboratory analysis report for air, water, noise and soil
- Views of the public/potentially affected people about the project; and
- An Environmental Management Plan (EMP) for the entire project cycle to include mitigation measures to be taken during and after implementation of the project and an action plan for the prevention and management of foreseeable accidents during the project cycle.
CHAPTER TWO: PROJECT DESCRIPTION

2.1 Site Location Characteristics

Thika Road is within the jurisdiction of Thika County Council in Thika District, in the Central Province of Kenya. Thika, an industrial town, is closer to Nairobi City than to Nyeri, the headquarters of Central Province. Thika town is strategically located on the road leading to the northern Kenya frontier districts of Isiolo, Marsabit and Moyale. This road is also part of the Trans-Africa Great North Road that connects Cairo in Egypt to Cape Town in South Africa. From Thika is also the road leading the North-Eastern Province of Kenya via Garissa town.

The proposed site is located on a 10 acre parcel of land along Nairobi - Thika highway within Thika County Council approximately 30 km from Nairobi City Centre and 10 km to Thika.

Figure 1: Map showing the Nairobi - Thika highway.

The proposed project site is after Juja and just after Mangu High School, at the point where the railway line crosses the Nairobi - Thika highway.
Figure 2: Map showing the project site location along the Nairobi - Thika highway
Figure 3: Satellite photo showing proposed project site, the existing Thika Highway, the Railway line and the old Thika Road
2.2 Nature of the Project

On account of anticipated power supply-demand imbalance, the Government of Kenya (GoK) has decided through the Ministry of Energy and The Kenya Power and Lighting Company Limited to build an 80 MW MSD thermal power plant to generate electricity. This is in response to the increasing demand for electricity vis-à-vis the existing capacity and against a foreseeable electricity shortfall due to erratic rainfall which has resulted in shortage of water in the dams for hydro-power generation.

The operator will be identified to build, operate and handover after some agreed concessionary period and therefore the operator is expected to provide and install all plant and equipment, including engines, transformers, cables, switchgear, protection and metering equipment for off-take at 11KV. KPLC will construct a transmission substation at the project site so to enable connection to the national grid.

The plant will be constructed using a modular design concept that enables the plant to be optimized for specific need of the project, utilising well proven standard units and components. The plant will consist of 10 WARTSILA 4-Stroke Medium Speed Diesel (MSD) engines type 20V32, as the prime mover for the generator sets and a Steam Turbine with a combined capacity of 80MW. The engines will use Heavy Fuel oil (HFO) but shall also be capable of using the alternative Light Fuel Oil (LFO) with low sulphur content. The engines shall be cooled using treated water. The exhaust gases from the engines shall be discharged into the atmosphere at the required height (30metres) through exhaust gas stack pipes fitted with silencers.

The transmission of vibration and structure borne noise is minimised by having the engine generator set flexibly mounted on spring packages on a concrete foundation. The engine generator sets shall be installed in an engine hall so as to be isolated from the other structures. The technology to be used shall be with minimal external noise, vibration and air pollution.

The total heavy fuel oil storage capacity is dimensioned for 30 days for full power operation of all the engines. The storage capacity shall be 7,500 m³ of above-ground vertical mounting and made from prefabricated tank material for erection at site, in a fuel containment area surrounded by a leak-proof fuel containment wall.

Water from underground sources (bore well) shall be sourced for use at the plant in engine cooling, steam turbines, fire fighting and in washrooms. A water treatment plant shall be put up for this purpose.

The plant shall also consist of Power Transmission area complete with transformers, switch yards, steel structures and cabling units. The plant will also have offices, a control room, a workshop, a warehouse, a fuel treatment unit, a parking lot and a guard house. An access road of approximately 300m shall be constructed from the main Nairobi - Thika highway.
2.3 Site Ownership
The land parcel, L.R. No. 8380/2, measuring approximately 10 acres has been acquired by KPLC on a willing seller - willing buyer basis (See copy of the land Sale Agreement in the Appendix) and the process of Land Transfer and Title Registration under the Registration of Titles Act (Cap. 281), is being progressed by the KPLC Property Department. An application for change of user from agricultural to industrial shall be made to the Thika County Council and the public will also have to be notified on the same.

2.4 Project Justification
The project is a response to the MSD power generation programme by the Government of Kenya (GoK) through the Ministry of Energy and KPLC following the unpredictable weather patterns that may negatively affect the hydro power generation capacity thus leading to the institution power load management or rationing in Kenya. The generation capacity of the hydro-power dams has been greatly reduced due the prevailing climatic conditions, hence the need to put up MSD power plants for a continued supply of reliable electrical energy with minimal interruptions or rationing.

Additionally, the Nairobi - Thika highway is currently being reconstructed and expanded into a superhighway. This will spur up development activities along the road. The development activities may include industrial, commercial and residential, all of which will increase the demand for electricity, coupled with KPLC’s target of connecting at least 200,000 new customers per year. Therefore there is need to boost the capacity of available electrical energy.

2.5 Project Activities
It is expected that the proposed site will undergo alteration during the construction process to install the power plant and associated structures. The World Bank Safeguard Policies, Safety protocol and established International Environmental Protection Regulations/ Standards shall guide the Contractor and project operator.

Modest construction procedures will be followed to reduce noise levels and the production of dust that may affect the neighbouring community.

2.6 Construction Procedures
All construction activities including ground preparation, earth moving, materials delivery, building, walling, roofing and the installation of amenities (power, water, communication equipment, etc.), fittings (doors, windows, safety provisions, etc.) will be carried out by competent personnel obtained through respectable contractors/sub-contractors to ensure consistent high standard of finish and providing superb value for money.
2.6.1 Construction activities Outline

Construction activities will involve the following:

(i) Site preparation (clearance of existing vegetation, preparation of a site office and stores, fencing to avoid intrusion),
(ii) Disposal of excavation and site clearance wastes,
(iii) Landscaping, earth moving and filling
(iv) Procurement of construction materials and delivery of the same to the site,
(v) Civil, mechanical, and electrical works,
(vi) Building works, trampling and removal of construction wastes,
(vii) Storage and utilization of materials,
(viii) Installing of generators
(ix) Installation of transformers
(x) Cabling
(xi) Construction of fuel storage tanks and piping of fuel lines
(xii) Testing the generation plant
(xiii) Completion of the plant,
(xiv) Solid waste collection and commissioning of the plant.

2.6.2 Input Materials

The MSD power plant will be constructed using common construction materials and construction procedures that are not expected to compromise the safety of the neighbouring communities as well as the general environment. The following inputs will be required for construction:

(i) Raw construction materials e.g. sand, cement, natural building stone blocks, hard core, gravel
(ii) Timber (e.g. doors and frames, fixed furniture, etc.),
(iii) Paints, solvents, white wash, etc.,
(iv) Generator Sets,
(v) A construction labour force (of both skilled and unskilled workers).

2.7 Project Budget

The estimated project cost is approximately project is $125,000,000 (One hundred and twenty-five Million US Dollars).
CHAPTER THREE: BASELINE INFORMATION OF THE STUDY AREA

This chapter gives the physical description of the project site in terms of position and size, topography, climate and soils as sourced from the District Development Plan of 2002-2008.

3.1 Location
The proposed project site location is along Thika Road just next to Mangu High School and opposite Witeithie market centre, some 30km from Nairobi and some 10km to Thika town. Thus the site location is best described using Thika as a reference point. Nairobi city is also cross-referenced.

Thika is a market town in Central Province, Kenya, lying on the A2 road 40 km north east of Nairobi, and on the Thika River. Thika town had a population of 88,265 (1999 census) and is growing rapidly, as is the entire greater Nairobi Metropolis area. Thika District had been projected to have a population of approximately 710,000 people by 2010, as per the Thika District Strategic Plan of 2005-2010. Thika is home to the Chania Falls and the Thika Falls, while Ol Donyo Sabuk National Park lies to its south east. The town has a railway station, but there is limited train passenger service.

Thika is externally serviced by a dual carriage way road to Nairobi, a highway to Garissa and also a railway line. The Nairobi - Thika road is currently (2009 - 2012) being reconstructed and expanded. Internally, the town has a well-maintained road network. The economic activities of the town include agriculture, particularly in the horticulture (exports mainly to Europe) and coffee industry (exports mainly to the USA and Europe). Other industries include textile (cotton), food processing (pineapples, macadamia nuts and wheat), tannery, motor vehicle assemblies, tobacco processing, bakeries and stone quarries. Hundreds of small scale industries and at least twenty major factories exist in and around Thika town.

3.2 Topography
Thika district lies between latitudes 3° 53′ and 1° 45′ south of Equator and longitudes 36° 35′ and 37° 25′ east. The elevation of Thika is 1531 meters (5026 feet) in altitude. The district covers an area of 1,960.2 sq Km². It borders Nairobi City to the south, Kiambu District to the west, Maragua District to the north and Machakos District to the east.

The landscape is generally level save for a few ridges and depressions in wetlands. Part of the proposed project site land is a gentle slope with red clay soil. Some sections bear visible surface rock.
3.3 Climate

3.3.1 Average Daily Temperatures

The average daily temperature throughout the year (See Table 1 below) varies slightly from month to month with average temperatures of around 17 degrees Celsius during the months of July and August to about 20 degrees Celsius in March. But, the daily range is much higher, with the differences between maximum and minimum temperatures each day around 10 degrees in May and up to 15 degrees in February. Between the months of June to September, southeast winds prevail in the coastal parts of Kenya and last up to several days without a break. The clouds cause day temperatures to remain low and most times the maximum temperature stay below 18 degrees Celsius. The minimum temperatures also remain low during cloudy nights, usually hovering around 12 degrees Celsius. Clear skies in January and February also bring colder nights. The highest temperature ever reached in Thika is 22.4 degrees Celsius and the lowest was 3.9 degrees Celsius.

Table 1. Average Daily Temperatures in Thika

<table>
<thead>
<tr>
<th>Months</th>
<th>Mean Maximum</th>
<th>Mean Minimum</th>
<th>Mean Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>°C</td>
<td>°C</td>
<td>°C</td>
</tr>
<tr>
<td>January</td>
<td>26.8</td>
<td>13.1</td>
<td>13.7</td>
</tr>
<tr>
<td>February</td>
<td>28.0</td>
<td>13.4</td>
<td>14.6</td>
</tr>
<tr>
<td>March</td>
<td>27.4</td>
<td>14.4</td>
<td>13.0</td>
</tr>
<tr>
<td>April</td>
<td>24.6</td>
<td>14.3</td>
<td>10.3</td>
</tr>
<tr>
<td>May</td>
<td>24.1</td>
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<tr>
<td>June</td>
<td>23.1</td>
<td>12.6</td>
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<tr>
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<td>August</td>
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<tr>
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<td>25.3</td>
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<tr>
<td>October</td>
<td>26.2</td>
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<td>November</td>
<td>23.6</td>
<td>14.4</td>
<td>9.2</td>
</tr>
<tr>
<td>December</td>
<td>25.1</td>
<td>13.8</td>
<td>11.6</td>
</tr>
<tr>
<td>Year</td>
<td>24.9</td>
<td>13.3</td>
<td>11.6</td>
</tr>
</tbody>
</table>

3.3.2 Average Humidity Values

Because of Thika’s location just south of the equator (between 3°53’ and 1°45’) in combination with humid air pumped in from the Indian Ocean, the humidity values for each day are generally on the higher end (See Table 2 below).

Table 2. Mean Relative Humidity Values (%)

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.00 A.M</td>
<td>79</td>
<td>74</td>
<td>82</td>
<td>86</td>
<td>85</td>
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<td>3.00 P.M</td>
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<td>50</td>
<td>47</td>
<td>57</td>
<td>54</td>
</tr>
</tbody>
</table>
This is not to say that values are always high, since the easterly winds coming off the Indian Ocean tend to keep the temperatures standard throughout the country; therefore the “warm sticky” feeling is usually not associated with Thika as much as one would think. In the summer to autumn months of January to April, relative humidity values have been known to plummet to anywhere from 10% to 20%. The typical day, humidity-wise, starts off with nearly saturated in the morning hours, and steadily decreases throughout the remainder of the day.

3.3.3 Average Rain Amounts
With these routinely high relative humidity figures, it is not surprising that the Thika climate is one that produces much rain annually. In fact, from the past 50 years, the expected amount of rain could be anywhere in the range of 500 to 1500 mm, with the average ringing in at 900 mm. The majority of these rainfall figures crash down in Thika in one major and one minor monsoon seasons respectively. The major monsoon season occurs within the months of March to May, and locally referred to as the “Long Rains” by the locals. The minor monsoon seasons emerges within the October to December Months, and is called the “Short Rains”. That is what the meteorologists as a whole know about the monsoon season. What they do not know is exactly when these seasons will start. There is usually not an indication of when these rainy seasons will start, since it is difficult to determine when one starts and when the other finishes. Consequently, a person may think there is only one rainy season when looking at the annual rainfall amounts (See Table 3 below).

Table 3. The average rainfall (mm) for each month of the year, based on the records for 50 years

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
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<td>52</td>
<td>114</td>
<td>77</td>
</tr>
</tbody>
</table>

3.3.4 Average Winds
Winds along the surface are predominantly easterly throughout the entire year. They are shifted to northeast between October and April, and they are shifted southeast between May and September. Right before the “Long Rains” season, the strongest winds occur, reaching speeds of 20 to 25 miles per hour. During the rest of the year, winds are usually at speeds of 10 to 15 miles per hour. During the night, the winds are calm.

3.3.5 Average Sunshine
Early mornings in Thika are often cloudy, but the sun peeks through by early mid-morning. Throughout the year, there is an average of ten hours of sunshine per day. More sunlight reaches the ground during the afternoon than in the morning. Of course, there is more sunshine during the summer months, when the sun is more overhead in the southern hemisphere. Very rarely during the rainy season the sun never shows through the clouds. Even in August, the cloudiest month, there is a period of some hours of sunshine.
3.4 Geological Setting

In the North Machakos-Thika area, in contrast to the area south of Machakos, there is less hill-country made up of ancient rocks and what there is concentrated in the east side of the area. More than half the area has a rather monotonous topography underlain by volcanic rocks of relatively recent age. The volcanic area is, however, of importance as the volcanic rocks yield constructional materials, notably building-stone in the Thika to Juja area. The area consists of flat volcanic plains in the west and generally hilly country to the east, formed by dissection of the sub-Miocene and end-Cretaceous peneplains. The north-western end of the lava-capped Yatta Plateau passes across the area east of Ol Doinyo Sapuk, and the surface on which the lava rests is believed to represent a remnant of the sub-Miocene bevel. The rocks exposed consist of horizontal Tertiary lavas, pyroclastics and sediments in the west, and folded Basement System gneisses and schists to the east. The Basement System rocks are metamorphic, and have been in places granitized to a considerable degree, with the production of granitoid gneisses. Soil types in the area are dependent on drainage; black-cotton soils develop in poorly drained regions while sandy soils and murrams form in well-drained regions.

3.5 Potential Disaster Sites for Thika

Thika sits close to the eastern flanks of the Great Rift Valley and recent revelations that the valley may be expanding at a rate of (2-3) mm per year due to tensional forces in the crust. The high heat flow beneath the crust is represented by the geothermal activities at Olkaria, Bogoria and Kapedo in Turkana District and the high seismicity around Lake Magadi is evidence of the continental plate break-up. Recent geodynamic studies based on the International GPS Service (IGS) indicate that the African plate has moved northwards by 7 cm into European plate between 1993 and 2000. This proximity to the active rifting system and general behaviour of African plate calls for continuous assessment of the tectonic state. No faultlines are available within the district. Seismicity in the Thika is also minimal and all the points are below magnitude. The most notable observation for seismic data is that Lake Magadi is the most seismic area in Kenya and since the area is approximately 150km due south-west of Thika, this high seismic activity can easily affect Thika.

Some areas of Thika District that receive relatively high amounts of rainfall are prone to landslides. The other areas that receive very little rainfall are prone to drought and crop failure which can lead to famine, malnutrition and hordes of correlated diseases.

3.6 Soils and Geology

In Thika District in general, the rocks exposed consist of horizontal Tertiary lavas, pyroclastics and sediments in the west, and folded Basement System gneisses and schists to the east. The Basement System rocks are metamorphic, and have been in places granitized to a considerable degree, with the production of granitoid gneisses. Soil types in the area are dependent on drainage; black-cotton soils develop in poorly drained regions while sandy soils and murrams form in well-drained regions. The proposed project area consists of red soils suitable for farming and brick-making.
3.7 Infrastructure
Due to such rapid urban growth, provision of basic infrastructure for all has become an important concern of development planners between Nairobi and Thika. Basic infrastructural services that have deteriorated due to such rapid increase in population include: Solid Waste Management (SWM) system; water and sewage systems; drainage and flood protection; roads; mass transportation; electric installations; and telecommunications. Greater environmental pollution, congestion and other problems have been the result of under-provision of such basic services. Thika is well served, with good communication and transport network mainly road and railway. It is strategically located to connect Nairobi, Central, Eastern and North-Eastern provinces of Kenya. Road transport is used much more than rail transport. Thika town is strategically located on the road leading to the northern Kenya frontier districts of Isiolo, Marsabit and Moyale. This road is also part of the Trans-Africa Great North Road that connects Cairo in Egypt to Cape Town in South Africa. From Thika is also the road leading the North-Eastern Province of Kenya via Garissa town. The main Nairobi to Nanyuki railway line runs through Thika town. On air transport Thika relies on the Jomo Kenyatta International Airport in Nairobi. The Nairobi - Thika highway is dual road carriageway that is currently under reconstruction and expansion into a four-lane dual super-highway.

3.8 Population
As per the 1999 Population and Housing Census, Thika District had a population of 645,713 persons with an estimated growth rate of 2.8 percent. This population was projected to increase to 701,664 in 2002 and 828,531 in 2008, assuming that constant fertility rate and the same growth rate prevail. However, with HIV/AIDS pandemic, which is at approximately 34 percent prevalence rate of the total population, the trend is expected to rise but at a decreasing rate. The district has a large proportion of youthful population. The demand for facilities such as schools, hospitals and recreation facilities is already high and is poised to increase further in future. There is therefore a need to check the population growth through intensification of family planning campaigns so that available resources can be directed to the stimulation of industrial activities instead of being allocate for social investments to cater for the rising population. All forms of poverty including food and absolute poverty are being experienced and indeed, poverty incidence is taking an upward trend due to factors such as rising unemployment, collapse of agricultural sectors, collapse of industries, poor infrastructure and rise in HIV/AIDS cases. The poverty prevalence stands at 48.4 percent.

3.9 Economic Activities
Economic activities in Thika district include agriculture, industrial, commercial and small scale entrepreneurship. Agricultural activities include: coffee, macadamia nuts and pineapple farming. Other horticultural activities include flower farming and food crop farming using irrigation. Large industries include food processing, vehicles manufacturing/assembling and metal industries. Thika district has many public and private schools and now hosts a university. The town and other urban centres have many large and small shops. The building construction industry is also quite active.
3.10 Waste Management

Thika town is under the Thika Municipal Council which manages waste collection and disposal. However, there are many logistical challenges for the council including resource capacity against the rising population. Thus private waste disposal companies have come in to fill the gap, especially in the residential areas. The council has a designated waste disposal site on the outskirts of the town. Other urban areas beyond the jurisdiction of Thika Municipal Council are managed by the Thika County Council. Such areas have got fewer wastes as compared to the Municipal Council areas. Most of the wastes generated are a conglomeration of solid wastes that are not sorted out. Hospitals and some industries have their own incinerators for burning solid wastes. Thika town has a good sewage system for disposal of liquid waste.

3.11 Drainage

The most important rivers are the Nairobi, Athi and Thika, which receive water throughout the year from streams rising further west, on the high ground at the edge of the Rift Valley. All the other rivers are intermittent, flowing only during times of flood. Another important feature of the soils on the plains south of Thika is the development of mound topography. The low mounds on the plains are extremely abundant near Juja. They are usually about 20 to 50 yards in diameter, at 50-to 100-yard intervals, and develop a stronger growth of vegetation than the surrounding depressions. In the Juja region the mounds occur in crude radiating patterns and are not haphazard in their arrangement. On top of the mounds, the underlying rock surface, usually composed of cemented material is exposed or is covered by only a few inches of soil. In between the mounds the soil is much deeper. The mound topography can be attributed to the production and swelling of montmorillonite by weathering in the underlying rock. In the present area, the mounds and depressions probably owe their shape to the action of drainage along the channels, which may have originated due to subsidence along polygonal joint systems in the underlying rocks.

3.12 Human Settlement

Thika district was initially in the early years a sisal plantation that stretched all the way from Nairobi to parts of Machakos district. This attracted job seekers who eventually settled in the district. The pineapple farms and major industries also contributed to human settlement. White settlers also settled in the area during the pre-independence period. The district is densely populated but with diverse distribution varying from one division to the other and from region to region. The settlement pattern is mainly determined by climatic conditions among other factors. The highest population density is in Thika Town. High population density has put pressure on land leading to its subdivision into small uneconomical units.
3.13 Transport

Thika is well served, with good communication and transport network mainly road and railway. It is strategically located to connect Nairobi, Central, Eastern and North-Eastern provinces of Kenya. Road transport is used much more than rail transport. Thika town is strategically located on the road leading to the northern Kenya frontier districts of Isiolo, Marsabit and Moyale. This road is also part of the Trans-Africa Great North Road that connects Cairo in Egypt to Cape Town in South Africa. From Thika is also the road leading the North-Eastern Province of Kenya via Garissa town. The main Nairobi to Nanyuki railway line runs through Thika town. On air transport Thika relies on the Jomo Kenyatta International Airport in Nairobi. The Nairobi - Thika highway is dual road carriageway that is currently under reconstruction and expansion into a four-lane dual super-highway. Thika district is poised to form part of the larger Nairobi Metropolitan that is envisaged in Kenya’s Vision 2030.

3.14 Industry

In addition to Thika being a rich agricultural district, it is one of the leading industrial districts in the country. Large industries include food processing, vehicles manufacturing/assembling and metal industries. The agricultural sector has industries such as coffee processing, fruit canning and juice extraction, flour milling, processing of tobacco products and many others. Thika town has industries for assembling vehicles, vehicle body building and manufacturing of various metal products. There are quite a number of textile industries although most of them collapsed in the 1990’s. Industries for producing medicines also exist in Thika. Small scale (juakali) industries exist in the form of metal fabricators that produce a variety of products.
CHAPTER 4: RELEVANT LEGISLATIVE AND REGULATORY FRAMEWORKS

4.1 Introduction

There is a growing concern in Kenya and at global level that many forms of development activities cause damage to the environment. Development activities have the potential to damage the natural resources upon which the economies are based. Environmental Impact Assessment is a useful tool for protection of the environment from the negative effects of developmental activities. It is now accepted that development projects must be economically viable, socially acceptable and environmentally sound.

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

4.2 Environmental Problems in Kenya

There are many environmental problems and challenges in Kenya today. Among the cardinal environmental problems include: loss of biodiversity and habitat, land degradation, land use conflicts, human animal conflicts, water management and environmental pollution. This has been aggravated by lack of awareness and inadequate information amongst the public on the consequences of their interaction with the environment.

4.3 Environmental Policy Framework

Environmental Impact Assessment (EIA) critically examines the effects of a project on the environment. An EIA identifies both negative and positive impacts of any development activity or project, how it affects people, their property and the environment. EIA also identifies measures to mitigate the negative impacts, while maximizing on the positive ones. EIA is basically a preventive process. It seeks to minimize adverse impacts on the environment and reduces risks. If a proper EIA is carried out, then the safety of the environment can be properly managed at all stages of a project-planning, design, construction, operation, monitoring and evaluation as well as decommissioning. The assessment is required at all stages of project development with a view to ensuring environmentally sustainable development for both existing and proposed public and private sector development ventures. The National EIA regulations were issued in accordance with the provisions of Environmental Management and Coordination Act (EMCA) of 1999. The EIA Regulations must be administered, taking into cognizance provisions of EMCA 1999 and other relevant national laws.
4.4 Institutional Framework

At present there are over twenty (20) institutions and departments which deal with environmental issues in Kenya. Some of the key institutions include the National Environmental Council (NEC), National Environment Management Authority (NEMA), the Forestry Department, Kenya Wildlife Services (KWS) and others.

4.4.1 National Environment Management Authority (NEMA)

The objective and purpose for which NEMA is established is to exercise general supervision and coordinate over all matters relating to the environment and to be the principal instrument of the government in the implementation of all policies relating to the environment. However, NEMA’s mandate is designated to the following committees:

4.4.1.1 Provincial and District Environment Committees

According to EMCA, 1999 No. 8, the Minister by notice in the gazette appoints Provincial and District Environment Committees of the Authority in respect of every province and district respectively. The Provincial and District Environment Committees are responsible for the proper management of the environment within the Province and District in respect of which they are appointed. They are also to perform such additional functions as are prescribed by the Act or as may, from time to time be assigned by the Minister by notice in the gazette. The decisions of these committees are legal and it is an offence not to implement them.

4.4.1.2 Public Complaints Committee

The Committee performs the following functions:

- Investigate any allegations or complaints against any person or against the authority in relation to the condition of the environment in Kenya and on its own motion, any suspected case of environmental degradation and to make a report of its findings together with its recommendations thereon to the Council.

- Prepare and submit to the Council periodic reports of its activities which shall form part of the annual report on the state of the environment under section 9 (3) and

- To perform such other functions and excise such powers as may be assigned to it by the Council.

4.4.1.3 National Environment Action Plan Committee

This Committee is responsible for the development of a 5-year Environment Action Plan among other things. The National Environment Action Plan shall:

- Contain an analysis of the Natural Resources of Kenya with an indication as to any pattern of change in their distribution and quantity over time.

- Contain an analytical profile of the various uses and value of the natural resources incorporating considerations of intergenerational and intra-generational equity.
• Recommend appropriate legal and fiscal incentives that may be used to encourage the business community to incorporate environmental requirements into their planning and operational processes.

• Recommend methods for building national awareness through environmental education on the importance of sustainable use of the environment and natural resources for national development.

• Set out operational guidelines for the planning and management of the environment and natural resources.

• Identify actual or likely problems as may affect the natural resources and the broader environment context in which they exist.

• Identify and appraise trends in the development of urban and rural settlements, their impact on the environment, and strategies for the amelioration of their negative impacts.

• Propose guidelines for the integration of standards of environmental protection into development planning and management.

• Identify and recommend policy and legislative approaches for preventing, controlling or mitigating specific as well as general diverse impacts on the environment.

• Prioritise areas of environmental research and outline methods of using such research findings.

• Without prejudice to the foregoing, be reviewed and modified from time to time to incorporate emerging knowledge and realities and;

• Be binding on all persons and all government departments, agencies, States Corporation or other organ of government upon adoption by the national assembly.

4.4.1.4 Standards and Enforcement Review Committee

This is a technical Committee responsible for environmental standards formulation methods of analysis, inspection, monitoring and technical advice on necessary mitigation measures.

4.4.1.5 National Environment Tribunal

This tribunal guides the handling of cases related to environmental offences in the Republic of Kenya.

4.4.2 National Environment Council (NEC)

EMCA 1999 No. 8 part iii section 4 outlines the establishment of the National Environment Council (NEC). NEC is responsible for policy formulation and directions for purposes of EMCA; set national goals and objectives and determines policies and priorities for the protection of the environment and promote co-operation among public departments, local authorities, private sector, non-governmental organisations and such other organisations engaged in environmental protection programmes.
4.4.3 The World Commission on Environment and Development (The Brundtland Commission of 1987)

The commission focused on the environmental aspects of development, in particular the emphasis on sustainable development that produces no lasting damage to the biosphere and to particular ecosystems. In addition to environmental sustainability is the economic and social sustainability. Economic sustainable development is development for which progress towards environmental and social sustainability occurs within available financial resources. While social sustainable development is development that maintains the cohesion of a society and its ability to help its members work together to achieve common goals, while at the same time meeting individual needs for health and well being, adequate nutrition, and shelter, cultural expression and political involvement.

4.4.4 The National Poverty Eradication Plan (NPEP)

The NPEP has the objective of reducing the incidence of poverty in both rural and urban areas by 50 percent by the year 2015; as well as strengthening the capabilities of the poor and vulnerable groups to earn income.

4.5 Environmental Legal Framework

4.5.1 The Environment Management and Co-ordination Act, 1999

Part II of the Environment Management & Coordination Act, 1999 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment. In order to partly ensure this is achieved, Part VI of the Act directs that any new programme, activity or operation should undergo environmental impact assessment and a report prepared for submission to the National Environmental Management Authority (NEMA), who in turn may issue a license as appropriate.

Part VIII section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. Section 73 require that operators of projects which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. Section 74 demands that all effluent generated from point sources be discharged only into the existing sewerage system upon issuance of prescribed permit from the local authorities or from the licensee. Finally, section 75 requires that parties operating a sewerage system obtain a discharge license from NEMA to discharge any effluent or pollutant into the environment.

Section 87 Sub-section 1 states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while section 88 provides for acquiring of a license for generation, transporting or operating waste disposal facility. According to section 89, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste, shall apply to the NEMA for a licence. Sections 90 through 100 outline more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides.

Finally the Environmental Impact Assessment Guidelines require that a study be conducted in accordance with the issues and general guidelines spelt out in the Second and Third schedules of the Environmental Regulations (2003). 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.
The Proponent has commissioned the environmental impact assessment study in compliance with the Act. The environmental management and monitoring plan laid out in this report shall be adhered to by the Proponent.

4.5.2 Public Health Act (Cap. 242)
Part IX, section 115, of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires that Local Authorities take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to be injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 and include nuisances caused by accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

The environmental management plan (EMP) advises the Proponent on safety and health aspects, potential impacts, personnel responsible for implementation and monitoring, frequency of monitoring, and estimated cost.

4.5.3 Local Authority Act (Cap. 265)
Section 160 helps local authorities ensure effective utilization of the sewages systems.
Section 170, allows the right to access to private property at all times by local authorities, its officers and servants for purposes of inspection, maintenance and alteration or repairs of sewers.

The Act under section 176 gives powers to local authority to regulate sewage and drainage, fix charges for use of sewers and drains and require connecting premises to meet the related costs. According to section 174, any charges so collected shall be deemed to be charges for sanitary services and will be recoverable from the premise owner connected to the facility. Section 264 also requires that all charges due for sewage sanitary and refuse removal shall be recovered jointly and severally from the owner and occupier of the premises in respect of which the services were rendered. This in part allows for application of the “polluter-pays-principle”

Section 163 allows the County Council to prohibit all business, which may be or become a source of danger, discomfort, or annoyance due to their noxious nature through smoke, fumes, dust, noise, or vibrations. Section 165 allows the local authority to refuse to grant or renew any license which is empowered in this act or any other written law on the grounds that the activity does not conform to the requirements of any by-laws in force in the area of such local authority the granting of the license would be contrary to the public interest.

Part XI section 168 provides that every municipal council, town council or urban council may establish and maintain sewerage and drainage works within or without its area of jurisdiction. For purposes of the land required for such development, section 144 states in part “A local authority may, subject to the approval of the Minister, apply to the government or any other authority having power to acquire land required for purposes of any of its functions, to be acquired compulsorily for and on behalf of, and at the expense of the local authority”. The Act, however, does not indicate the repercussions of impacts on landowners.

Section 160 helps local authorities ensure effective utilization of the sewerage systems. It states in part that municipal authorities have powers to establish and maintain sanitary services for the removal and destruction of, or otherwise deal with all kinds of refuse and effluent and where such service is established, compel its use by persons to whom the service is available. However, to protect against illegal connections, section 173 states that any person who, without prior consent in writing from the council, erects a building on: excavate or opens-up: or injures or destroys an
sewers, drains or pipes shall be guilty of an offence. Any demolitions and repairs thereof shall be carried out at the expense of the offender.

For maintenance of such sewerage systems, the following relevant clauses have been drawn from section 169 of the Act that reads in part “A municipal council may for purposes of carrying out any drainage or sewerage works------”:

“--------cause such sewers, drains and pipes to be made, altered, deepened, covered, laid and maintained either within or without as may be necessary for effectively disposing of the sewage and draining of its area -------”

“--------carry such sewers, drains and pipes through, across, or under any public road, street, square or open place laid out for public road, street, square or open space without paying compensation and after giving 30 days notices in writing to the owner or occupier of the intention to do so ------“

“------from time to time alter, enlarge, divert, discontinue, close-up or destroy any sewers, drains, or pipes under its control -------”

Section 170, allows the right of access to private property at all times by local authorities, its officers and servants for purposes of inspection, maintenance and alteration or repairs. In addition, the municipal Council may establish and maintain sewage farms or disposal works, and dispose of the effluent therefrom, but shall not be liable for any nuisance or damage as a consequence of proper and ordinary conduct of the sewage farms or disposal works (section 171). To ensure sustainability in this regard, the local authority is empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and wellbeing of the inhabitants of its area as provided for under section 201 of the Act.

To ensure sustainability in this regard, the local authority is empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and wellbeing of the inhabitants of its area as provided for under section 201 of the Act.

**The Proponent shall observe the guidelines as set out in the environmental management and monitoring plan laid out in this report as well as the recommendation provided for mitigation/minimisation/avoidance of adverse impacts arising from the project activities.**

4.5.4 Waste Management Standards (Legal Notice 121: The Environmental Management Coordination (Waste Management) Regulations)

The regulation provides that a waste generator shall use cleaner production methods, segregate waste generated and the waste transporter should be licensed. The notice further states no person shall engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment licence issued by the National Environment Management Authority.

Hazardous waste will not be generated from this development. The project proponent will ensure that waste is segregated and a licensed waste transporter is contracted to disposed solid waste.

4.5.5 Waste Management Standards (Legal Notice 120: The Environmental Management Coordination (Water Quality) Regulations)

This Legal Notice on Water Quality provides that anyone who discharges effluent into the environment or public sewer shall be required to apply for Effluent Discharge License. The license for discharge is Ksh 5,000 while annual license fee for discharge into the environment will be Ksh. 20,000 or Ksh 100,000 depending on the facility. Non compliance with the regulations attracts a fine not exceeding Ksh 500,000 and the polluter pay principle may apply depending on the court ruling. Table 4 below, gives Waste Water Discharge Guidelines from NEMA.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Discharge into public sewers</th>
<th>Discharge into open water bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>-</td>
<td>6.0 - 9.0</td>
<td>6.0 - 9.0</td>
</tr>
<tr>
<td>BOD (5 days at 20°C) not to exceed</td>
<td>Mg/l</td>
<td>500</td>
<td>20</td>
</tr>
<tr>
<td>COD not to exceed</td>
<td>Mg/l</td>
<td>1000</td>
<td>50</td>
</tr>
<tr>
<td>Total suspended solids not to exceed</td>
<td>Mg/l</td>
<td>500</td>
<td>30</td>
</tr>
<tr>
<td>n-hexane extract not to exceed</td>
<td>Mg/l</td>
<td>Nil</td>
<td>30</td>
</tr>
<tr>
<td>Oils (mineral, animal &amp; vegetable)</td>
<td>Mg/l</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Total phenol not to exceed</td>
<td>Mg/l</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Copper (Cu) not to exceed</td>
<td>Mg/l</td>
<td>1.0</td>
<td>0.05</td>
</tr>
<tr>
<td>Zinc (Zn) not to exceed</td>
<td>Mg/l</td>
<td>5.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Lead (Pb) not to exceed</td>
<td>Mg/l</td>
<td>1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Arsenic (As) not to exceed</td>
<td>Mg/l</td>
<td>0.2</td>
<td>0.002</td>
</tr>
<tr>
<td>Total Mercury (Hg) not to exceed</td>
<td>Mg/l</td>
<td>0.05</td>
<td>0.005</td>
</tr>
<tr>
<td>Alkyl mercury not to exceed</td>
<td>Mg/l</td>
<td>0.01</td>
<td>0.001</td>
</tr>
<tr>
<td>PCB (Polychlorinated biphenyl) not to exceed</td>
<td>Mg/l</td>
<td>Nil</td>
<td>0.003</td>
</tr>
<tr>
<td>Pesticides residues not to exceed</td>
<td>Mg/l</td>
<td>Nil</td>
<td>0.05</td>
</tr>
<tr>
<td>Sulphates not to exceed</td>
<td>Mg/l</td>
<td>1000</td>
<td>500</td>
</tr>
<tr>
<td>Dissolved manganese (Mn)</td>
<td>Mg/l</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Chromium (total)</td>
<td>Mg/l</td>
<td>1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Chloride not to exceed</td>
<td>Mg/l</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Fluoride not to exceed</td>
<td>Mg/l</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>Coliform bacteria</td>
<td>-</td>
<td>-</td>
<td>1000/100ml</td>
</tr>
<tr>
<td>Free ammonia not to exceed</td>
<td>Mg/l</td>
<td>2.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Sulphides (S) not to exceed</td>
<td>Mg/l</td>
<td>2.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Cadmium (Cd) not to exceed</td>
<td>Mg/l</td>
<td>0.5</td>
<td>0.05</td>
</tr>
<tr>
<td>Cyanide (CN) total not to exceed</td>
<td>Mg/l</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Organic phosphorous not to exceed</td>
<td>Mg/l</td>
<td>30</td>
<td>1.0</td>
</tr>
<tr>
<td>Chromium six (Cr 6) not to exceed</td>
<td>Mg/l</td>
<td>0.5</td>
<td>0.005</td>
</tr>
<tr>
<td>Total dissolved solids not to exceed</td>
<td>Mg/l</td>
<td>3000</td>
<td>1200</td>
</tr>
<tr>
<td>Selenium (Se) not to exceed</td>
<td>Mg/l</td>
<td>1.0</td>
<td>0.05</td>
</tr>
<tr>
<td>Nickel (Ni) not to exceed</td>
<td>Mg/l</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Barium (Ba) not to exceed</td>
<td>Mg/l</td>
<td>10</td>
<td>2.0</td>
</tr>
<tr>
<td>Temperature not to exceed</td>
<td>-</td>
<td>+/- 2°C of the ambient temperature of the sewer</td>
<td>+/- 2°C of ambient temperature of the water body</td>
</tr>
<tr>
<td>Oil/grease</td>
<td>Mg/l</td>
<td>No trace</td>
<td>Nil/no trace</td>
</tr>
<tr>
<td>Toxic substances</td>
<td>Mg/l</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>Odour</td>
<td>-</td>
<td>-</td>
<td>Not objectionable to the nose</td>
</tr>
<tr>
<td>Colour</td>
<td>-</td>
<td>-</td>
<td>Not objectionable to the eye or not to exceed 5 mg Pt/l</td>
</tr>
</tbody>
</table>

Table 4: NEMA Waste Water Discharge Guidelines
4.5.6 Waste Management Standards (Legal Notice 61: The Environmental Management and Coordination (Noise and Excessive vibration pollution) (Control) Regulations, 2009

This regulation prohibits any person to cause unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment.

Part 11 section 6(1) provides that no person is shall cause noise from any source which exceeds any sound level as set out in the First Schedule of the regulations.

4.5.7 Physical Planning Act, 1996

The Local Authorities are empowered under section 29 of the Act to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same section, therefore allows for the prohibition or control of the use and development of land and buildings in the interest of proper and orderly development of an area.

Section 24 of the Physical Planning Act gives provision for the development of local physical development plan for guiding and coordinating development of infrastructure facilities and services within the area of authority of County, municipal and town council and for specific control of the use and development of land. The plan shows the manner in which the land in the area may be used.

Section 29 of the physical Planning Act gives county councils power to prohibit and control the use of land, building, and subdivision of land, in the interest of proper and orderly development of its area. The same section also allows them to approve all development applications and grant development permissions as well as to ensure the proper execution and implications of approved physical development plans. On zoning, the act empowers them to formulate by-laws in respect of use and density of development.

Section 30 states that any person who carries out development within an area of a local authority without development permission shall be guilty of an offence and the development shall be invalid. The act also gives the local authority power to compel the developer to restore the land on which such development has taken place to its original conditions within a period of ninety days. If no action is taken, then the council will restore the land and recover the cost incurred thereto from the developer. In addition, the same section also states that no person shall carry out development within the area of a local authority without development permission granted by the local authority. At the same time, sub-section 5, re-enforce it further that, no licensing authority shall grant under any written law, a license for commercial use for which no development permission had been granted by the respective local authority.

Section 36 states that if in connection with development application a local authority is of the opinion that, the proposed activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an Environmental Impact Assessment report. The environmental impact assessment report must be approved by the National Environmental Management Authority (NEMA) and followed by annual environmental audits as spelled out by EMCA 1999. Section 38 states that if the local authority finds out that the development activity is not complying to all laid down regulations, the local authority may serve an enforcement notice specifying the conditions of the development permissions alleged to have been contravened and compel the developer to restore the land to it's original conditions.

*The Proponent has applied for Development Permission from the local authority and has also commissioned an environmental impact assessment study for approval by NEMA.*
4.5.8 Land Planning Act (Cap. 303)

Section 9 of the subsidiary legislation (The Development and Use of Land Regulations, 1961) under this Act requires that before the local authorities submit any plans to then Minister for approval, steps should be taken as may be necessary to acquire the owners of any land affected by such plans.

4.5.9 Water Act, 2002

Part II, section 18, of the Water Act 2002 provides for national monitoring and information system on water resources. Following on this, sub-section 3 allows the Water Resources Management Authority (WRMA) 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 a facility operator and the information thereof furnished to the authority.

The Water Act Cap 372 vests the rights of all water to the state, and the power for the control of all body of water with the Minister, the powers is exercised through the Minister and the Director of water resources in consultation with the water catchments boards, it aims at provision of conservation of water and appointment and use of water resources.

Part II Section 18 provides for national monitoring and information systems on water resources. Following on this, Sub-section 3 allows the Water Resources Management Authority to demand from any person, specified information, documents, samples or materials on water resources. Under these rules, specific records may be required to be kept and the information thereof furnished to the authority on demand.

Section 25 of the Act requires a permit to be obtained for among others any use of water from a water resources, discharge of a pollutant into any water resource. According to section 29 of the same Act, application for such a permit shall be subject to public consultation as well as an environmental impact assessment as per the Environmental Management and Coordination Act, 1999. The conditions of the permit may also be varied if the authority feels that the water so used is causing deterioration of water quality or causing shortage of water for other purposes that the authority may consider has priority. This is provided for under section 35 of the Act.

Section 73 of the Act allows a person with a license to supply water (licensee) to make regulations for purposes of protecting against degradation of sources of water which he is authorised to take. Under the Act, the licensee could be a local authority, a private Trust or an individual and the law will apply accordingly under the supervision of the Regulatory Board.

Section 76 states that no person shall discharge any trade effluent from any trade premises into sewers of a licensee without the consent of the licensee upon application indicating the nature and composition of the effluent, maximum quantity anticipated, flow rate of the effluent and any other information deemed necessary. The consent shall be issued on conditions including the payment rates for the discharge as may be provided under section 77 of the same Act.

The proposed site shall include the construction of drainage channels for the Management of waste water. Bund walls and paved surface will be constructed so as to contain oil spills.
4.5.10 Energy Act of 2006

The Energy Act of 2006, replaced the Electric Power Act of 1997 and The Petroleum Act, Cap 116. The Energy Act, amongst other issues, deals with all matters relating to all forms of energy including the generation, transmission, distribution, supply and use of electrical energy as well as the legal basis for establishing the systems associated with these purposes.

The Energy Act, 2006, also established the Energy Regulatory Commission (ERC) whose mandate is to regulate all functions and players in the Energy sector. One of the duties of the ERC is to ensure compliance with Environmental, Health and Safety Standards in the Energy Sector, as empowered by Section 98 of the Energy Act, 2006.

In this respect, the following environmental issues will be considered before approval is granted:

1. The need to protect and manage the environment, and conserve natural resources;
2. The ability to operate in a manner designated to protect the health and safety of the project employees; the local and other potentially affected communities.

Licensing and authorisation to generate and transmit electrical power must be supported by an Environmental Impact Assessment Report (EIA) approved by NEMA.

Part IV Section 80(1) provides that a person shall not conduct a business of importation, refining, exportation, whole sale, retail, storage or transportation of petroleum, except under and in accordance with the terms and conditions of a valid licence.

Part IV Section 90 (1) stipulates that a person intending to construct a pipeline, refinery, bulk storage facility or retail dispensing site shall before commencing such construction, apply in writing to the Energy Regulatory commission for a permit to do so. The application shall: specify the name and address of the proposed owner; be accompanied by three (3) copies of plans and specifications and be accompanied by an Environmental Impact Assessment (EIA) Report.

Part IV section 91(1) stipulates that the Energy Regulatory Commission shall, before issuing a permit under section 90, take into account all relevant factors including the relevant government policies and compliance with Environment Management and Coordination Act, 1999 and in particular EIA report as per Impact Assessment and Audit Regulations 2003, the Physical Planning Act, 1996 and the Local Government Act.

Part iv section 100 (1) provides that it is an offence if a person being the owner or operator of a refinery, pipeline, bulk liquefied Petroleum gas or natural gas facility, service station, filling station or storage depot, fails to institute appropriate environmental, health or safety control measures. The offence if convicted, he/she shall be liable to a fine not exceeding two million shillings or to a maximum term of imprisonment of two years, or to both.

4.5.11 Building Code 1968

Section 194 requires that where sewer exists, the occupants of the nearby premises shall apply to the local authority for a permit to connect to the sewer line and all the wastewater must be discharged into sewers. Currently, the Building Code is under Review.

4.5.12 Penal Code Act (Cap.63)

Section 191 of the penal code states that if any person or institution that voluntarily corrupts or foils water for public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same Act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution, dwelling or business premises in the neighborhood or those passing along public way, commits an offence.
The Proponent shall observe the guidelines as set out in the environmental management and monitoring plan laid out in this report as well as the recommendation provided for mitigation/minimisation/avoidance of adverse impacts arising from the project activities.

4.5.13 The Wildlife Conservation and Management Act, Cap 376

This Act provides for the protection, conservation and management of wildlife in Kenya. The provisions of this Act should be applied in the management of the project.

Part III Section 13 subsection (1) stipulates that any person who not being an officer of Kenya Wildlife Service hunts any animal in a National Park shall be guilty of a forfeiture offence and liable to a fine or imprisonment. Subsection 2 of the Act likewise provides that any person who, without authorisation conveys into a National Park, or being within the area thereof, in possession of, any weapon, ammunition, explosive, trap or poison, shall be guilty of a forfeiture offence.

The Act provides that no person is allowed to use any aircraft, motor vehicle or mechanically propelled vessel in such a manner as to drive, stampede or unduly disturb any protected animal or game animal. Therefore it will be prudent that the construction workforce is conversant with the provisions of this Act.

4.5.14 The Lakes and Rivers Act Chapter 409 Laws of Kenya:

This Act provides for protection of rivers, lakes and associated flora and fauna. The provisions of this Act may be applied in the management of the project.

4.5.15 The Forestry Services Act, 2005

The Act led to the establishment of Kenya Forest Service which is charged with management of forests in consultation with the forest owners. The body enforces the conditions and regulations pertaining to logging, charcoal making and other forest utilisation activities.

To ensure community participation in forest management, the service collaborates with other organizations and communities in the management and conservation of forests and for the utilisation of the biodiversity.

Section 43 (1) provides that if mining, quarrying or any other activity carried out in the forest, where the activity concerned is likely to result in forest cover depletion, the person responsible shall undertake compulsory re-vegetation immediately upon the completion of the activity.

4.5.16 The Occupational Safety and Health Act (OSHA), 2007

Before any premises are occupied, or used as a workplace, a certificate of registration must be obtained from the Director of Occupational Safety and Health Services. The Act provides for the health, safety and welfare for employees at workplaces. This shall be considered at the construction, implementation and decommissioning phases of the project.

4.5.16.1 Health

The premises must be kept clean, A premise must not be overcrowded. The circulation of fresh air must secure adequate ventilation of workrooms. There must be sufficient and suitable lighting in every part of the premise in which persons are working or passing. There should also be sufficient and suitable sanitary conveniences separate for each sex, must be provided subject to conformity with any standards prescribed by rules. Food and drinks should not be partaken in dangerous places or workrooms. Provision of suitable protective clothing and appliances including where necessary, suitable gloves, footwear, goggles, gas masks, and head covering, and maintained for the use of workers in any process involving expose to wet or to any injurious or offensive substances.
4.5.16.2 Safety
Fencing of premises and dangerous parts of other machinery is mandatory. Training and supervision of inexperienced workers, protection of eyes with goggles or effective screens must be provided in certain specified processes. Floors, passages, gangways, stairs, and ladders must be soundly constructed and properly maintained and handrails must be provided for stairs. Special precaution against gassing is laid down for work in confined spaces where persons are liable to overcome by dangerous fumes. Air receivers and fittings must be of sound construction and properly maintained. Adequate and suitable means for extinguishing fire must be provided in addition to adequate means of escape in case of fire must be provided.

4.5.16.3 Welfare
An adequate supply of both quantity and quality of wholesome drinking water must be provided. Maintenance of suitable washing facilities, accommodation for clothing not worn during working hours must be provided. Sitting facilities for all female workers whose work is done while standing should be provided to enable them take advantage of any opportunity for resting.

Every premise shall be provided with maintenance, readily accessible means for extinguishing fire and person trained in the correct use of such means shall be present during all working periods.

Regular individual examination or surveys of health conditions of industrial medicine and hygiene must be performed and the cost will be met by the employer. This will ensure that the examination can take place without any loss of earning for the employees and if possible within normal working hours.

The (OSH) Act provides for development and maintenance of an effective programme of collection, compilation and analysis of occupational safety. This will ensure that health statistics, which shall cover injuries and illness including disabling during working hours, are adhered.

The environmental management plan (EMP) advises the Proponent on safety and health aspects, potential impacts, personnel responsible for implementation and monitoring, frequency of monitoring, and estimated cost.

4.5.17 The Traffic Act Chapter 403 Laws of Kenya
This Act consolidates the law relating to traffic on all public roads. The Act also prohibits encroachment on and damage to roads including land reserved for roads. The project is under the provision of the Act.

4.5.18 Food Drugs and chemicals substances Act (Cap 254)
The purpose of this Act is to make provisions for the prevention of adulteration of food, drugs and chemical substances.

4.5.19 The Way leaves Act Cap 292
According to the Way leaves Act cap 292 Section 2, Private land does not include any land sold or leased under any Act dealing with Government lands. Section 3 of the Act states that the Government may carry any sewer, drain or pipeline into, through, over or under any lands whatsoever, but may not in so doing interfere with any existing building. Section 8 further states that any person who, without the consent of the Permanent Secretary to the Ministry responsible for works (which consent shall not be unreasonably withheld), causes any building to be newly erected over any sewer, drain or pipeline the property of the Government shall be guilty of an offence and liable to a fine of one hundred and fifty shillings, and a further fine of sixty shillings for every day
during which the offence is continued after written notice in that behalf from the Permanent Secretary; and the Permanent Secretary may cause any building erected in contravention of this section to be altered, demolished or otherwise dealt with as he may think fit, and may recover any expense incurred by the Government in so doing from the offender.

4.5.20 The Registration of Titles Act Cap 281

Section 34 of this Act states that when land is intended to be transferred or any right of way or other easement is intended to be created or transferred, the registered proprietor or, if the proprietor is of unsound mind, the guardian or other person appointed by the court to act on his/her behalf in the matter, shall execute, in original only, a transfer in form F in the First Schedule, which transfer shall, for description of the land intended be dealt with, refer to the grant or certificate of title of the land, or shall give such description as may be sufficient to identify it, and shall contain an accurate statement of the land and easement, or the easement, intended to be transferred or created, and a memorandum of all leases, charges and other encumbrances to which the land may be subject, and of all rights-of-way, easements and privileges intended to be conveyed.

4.5.21 The Land Titles Act Cap 282

The Land Titles Act Cap 282 section 10 (1) states that there shall be appointed and attached to the Land Registration Court a qualified surveyor who, with such assistants as may be necessary, shall survey land, make a plan or plans thereof and define and mark the boundaries of any areas therein as, when and where directed by the Recorder of Titles, either before, during or after the termination of any question concerning land or any interest connected therewith, and every area so defined and marked shall be further marked with a number of other distinctive symbol to be shown upon the plan or plans for the purposes of complete identification and registration thereof as is herein after prescribed.

4.5.22 The Land Acquisition Act Chapter 295 Laws of Kenya

The Act provides for the compulsory or otherwise acquisition of land from private ownership for the benefit of the general public. Section 3 states that when the Minister is satisfied on the need for acquisition, notice will be issued through the Kenya Gazette and copies delivered to all the persons affected. Full compensation for any damage resulting from the entry onto land to do things such as survey upon necessary authorisation will be undertaken in accordance with section 5 of the Act. Likewise where land is acquired compulsorily, full compensation shall be paid promptly to all persons affected in accordance to sections 8 and 10 along the following parameters:

(i) Area of land acquired
(ii) The value of the property in the opinion of the Commissioner of land ( after valuation),
(iii) Amount of the compensation payable,
(iv) Market value of the property,
(v) Damages sustained from the severance of the land parcel from the land,
(vi) Damages to other property in the process of acquiring the said land parcel,
(vii) Consequences of changing residence or place of business by the land owners,
(viii) Damages from diminution of profits of the land acquired.

Part II of the Act allows for the temporary acquisition of the land for utilisation in promotion of the public good for periods not exceeding 5 years. At the expiry of the period, the Commissioner of Land shall vacate the land and undertake to restore the land to the conditions it was before. Any damages or reduction of value shall be compensated to the landowners.
4.6 Relevant Policies

4.6.1 Draft National Wetlands Conservation and Management 2003
The draft National Wetlands policy recognizes the importance of wetlands in development and the need to conserve and protect our wetlands. The project in question has the potential of polluting the wetlands in the area as a result of oil spills. The draft policy proposes mechanisms for protecting wetlands from agricultural, industrial and municipal activities.

Section 4.6 on Pollution, Eutrophication and Salinisation of the wetland policy recognizes the threat facing wetlands due to industrial activities including power generation which have often led to oil pollution and reclamation. The draft policy recognizes that the quality of many water sources in Kenya has declined as a result of municipal, agricultural and industrial wastes/discharges. These have negatively impacted water quality and biodiversity within the wetland ecosystems thereby reducing their values. Increased nutrient loads have led to eutrophication and episodes of algal blooms in wetlands near major settlements. In certain areas excessive abstraction of fresh waters, diversions, and catchment degradation, have led to increased salinity.

The draft Policy proposes the need for effluent discharges into wetlands and (excessive) abstraction of water be strictly regulated and requires meeting laid down standards and regulations. For this to be achieved the policy will require enhanced coordination of all leading agencies dealing with natural resource management, including local authorities and agriculture. The policy proposes the following which is relevant to this study

(a) Appropriate measures shall be taken to protect riverbanks and lakeshores.
(b) Dumping of waste in wetlands shall be disallowed and disposal sites close to wetlands shall be subjected to EIA.
(c) Any effluent discharged into wetlands shall be treated to meet appropriate wastewater standards beforehand.
(d) Environmentally friendly farming techniques that reduce nutrient silt and pollutant loading in the wetlands shall be promoted.
(e) Public awareness on proper management of waste including reduction, reuse and recycling shall be promoted.
(f) Coordination and enforcement of sectoral laws shall be enhanced.

The draft Policy is in response to the government’s responsibilities under the Ramsar Convention. The policy takes cognizance of broader national environmental frameworks, particularly the National Environment Action Plan (NEAP) process and the National Biodiversity Strategy and Action Plan (NBSAP), both of which put great emphasis on the need to take proper care of the country’s wetlands. The National Environment Management and Coordination Act (EMCA 1999), the country’s premier framework environmental law, also provides for the conservation and management of wetlands.

4.6.2 Draft Environmental Policy 1999
Kenya had been without a functional environmental policy for some time. It’s until 1999 did the stakeholders started to prepare a comprehensive policy on environment and development after the enactment of the EMCA 1999. However the policy is still just a paper that is yet to be made into a working document. The relevant section of the draft policy is on energy. The draft policy relevance to this project is on the sections on energy resources, waste management, pollution and atmospheric resources sections.

The policy recognizes the role of energy the productive process of the economy and is regarded as a lubricant to the development process. Wood fuel is a major source of household energy and accounts for about 73% of total energy demand. The harvesting of wood fuel leads to deforestation and therefore is of great importance in terms of environmental consideration.
Energy sector according to the draft policy is a source of important gaseous pollutants is carbon monoxide, hydrocarbons, hydrogen sulphide, nitrogen oxide and fluorides. Major sources of air pollution are domestic cooking and heating, electric power generation, refuse burning, industrial and vehicle fuel consumption and emissions and industrial by-products. These pollutants are injurious to living things and property when they exceed certain levels. Gaseous emissions are often made more harmful by synergism.

This project has the potential to pollute the atmospheric resources that sustains life through generation of atmospheric pollutants. Some of the pollutants expected to be emitted during operation of the project are, CO2, SO2, particulate matter among others as described in the impacts section of this report. Increasing atmospheric concentrations of various gases such as chlorofluorocarbons and methyl bromide have contributed to the depletion of the ozone layer; while others threaten to bring about climatic changes including global warming, with consequences which are detrimental to life on earth. Kenya is party to international efforts with regard to protection of the ozone layer and the control of greenhouse gases.

Greenhouse gases in the atmosphere are increasing rapidly and disrupting the earth’s radiative balance. This could result in dramatic climate changes with significant effects, particularly in the arid and semi-arid lands where rainfall is very variable and unreliable. Additionally, the rise of the sea level as a result of global warming could adversely affect coastal settlement, agricultural activities, the beaches and infrastructure along parts of the coastal strip.

Though Kenya is a signatory to the Convention on Climate Change, there is inadequate legislation on the standards or management of air quality. Management is shared by a number of institutions who administer it from their sectoral concerns. The challenges facing the implementation of the policy include absence of a comprehensive policy and supporting legislation for controlling atmospheric pollution and air quality, absence of an inventory of sources of gaseous emissions, inadequate information on characteristics of gases emitted and their impact on the environment, human health, and climate, inadequate emission standards and regulations, underdeveloped early warning systems and mitigation options on the dangers of gaseous emissions and their management and inadequate institutional capacities and coordination.

4.6.3 Waste Management
Wastes from thermal energy generation include used oil, used oil filters and other parts that are replaced from the gensets. Wastes from the gensets can have properties, which include being radioactive, toxic, explosive, corrosive, flammable, infectious, or other characteristics causing or likely to cause danger to human health or the environment, whether alone or together with other wastes. Inadequate management of solid wastes and effluents can have devastating and often irreversible effects on the environment. Wastes emanating from industries and factories in the form of effluents tend to find their way into waters and soils, thereby making them less habitable for living organisms. Solid wastes disposed of in the open dumps or crude sanitary landfills are health hazards.

4.6.4 Environmental Challenges
These include:
- Weak enforcement of existing laws and regulations, unrealistic penalties, inadequate human resources to monitor and enforce regulations, and cumbersome procedures.
- Absence of discharge standards and methods for measuring the quality and quantity of effluents.
- Inadequate incentives to encourage adoption of efficient waste management technologies.
- Insensitivity of industry to the legal requirements for health and safety in the workplace.
- Low priority and status given to waste management and sanitation.
- Inadequate training facilities for occupational health and safety services.
4.7 International Legislations
Kenya is a signatory to a number of conventions on sustainable development and is a member of various bilateral and multilateral organizations. Some of the relevant development partners in this project are the World Bank and a number of United Nations agencies.

4.7.1 World Bank Environment and Social Safeguards Policy
World Bank Operational Policies (OP) and Bank Procedures (BP) Environmental Assessment - BP4.01 and OP 4.01 (January 1999 all of which require environmental assessment of projects proposed for World Bank financing to help ensure that they are environmentally sound and sustainable. Environmental Assessment is one of the 10 environmental, social, and legal Safeguard Policies of the World Bank. World Bank Environment and Social Safeguard Policy aims at improving decision making, to ensure that project options under consideration are sound and sustainable, and that potentially affected people have been properly consulted.

The World Bank’s environmental assessment policy and recommended processing are described in Operational Policy (OP)/Bank Procedure (BP) 4.01. The MSD Power Project falls under Category B of the World Bank Operational. A proposed project is classified as Category B if it’s potential adverse environmental impacts on human populations or environmentally important areas including; wetlands, forests, grasslands, and other natural habitats that are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigation measures can be designed more readily than for Category A projects. The scope of EA for a Category B project may vary from project to project, but it is narrower than that of Category A Environmental Assessment. Like Category A Environmental Assessment, it examines the project’s potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.

4.7.2 Climate Change Convention
The Convention on Climate Change 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. Kenya having ratified and signed the convention has the obligation to adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases. The project falls under the Climate Change Convention due to the fact that it generates greenhouse emissions.

Article 4 of the protocol calls for development of measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change, Promoting and development of application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors, taking climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change, promoting cooperation in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies and promoting cooperation in education, training and public awareness related to climate change and encourage the widest participation in this process.
CHAPTER FIVE: PUBLIC PARTICIPATION

5.1 Sources of Information
Public participation was a key component of the EIA of the Proposed MSD Power Project, in Thika Road. Positive and negative views of the neighbouring residents were sought as from 6th to 13th of January 2010. The exercise was conducted using pre-designed questionnaires and interviews in the premises neighbouring the proposed project area. The table below shows the names of the neighbours who were interviewed and given the questionnaires to fill in relation to the proposed MSD Power Project, in Thika Road area.

Table 5. Names of neighbours consulted

<table>
<thead>
<tr>
<th>Name of Respondent</th>
<th>ID. NO.</th>
<th>Tel. Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 James Mwangi - Deputy Principal, Mangu High School</td>
<td>10863888</td>
<td>0721311864</td>
</tr>
<tr>
<td>2 Bernard Okoth Odongo - Mangu High School</td>
<td>24590111</td>
<td>0726211489</td>
</tr>
<tr>
<td>3 Susan Wanjohi</td>
<td>0714941590</td>
<td></td>
</tr>
<tr>
<td>4 Tabitha W. Njuguna</td>
<td>20969036</td>
<td>0729857070</td>
</tr>
<tr>
<td>5 Kiarie Stephen M.</td>
<td>11067049</td>
<td>0720390487</td>
</tr>
<tr>
<td>6 Edith Wambui</td>
<td>0727033195</td>
<td></td>
</tr>
<tr>
<td>7 John Muriuki</td>
<td>25403165</td>
<td>0726260007</td>
</tr>
</tbody>
</table>

5.2 Issues Raised by the would be affected community
The following issues were raised by the project neighbours who were interviewed during public participation of the proposed MSD Power Project along Thika Road.

5.2.1 Positive Issues

5.2.1.1 Employment opportunities
Most neighbours close to the proposed project site especially expected the project to create casual and permanent employment opportunities during the proposed project construction work, operation and decommissioning phases. The employment opportunities could be either directly in the project or indirectly through associated businesses. One of the main positive impacts during projects construction phase will be the availability of job opportunities especially to casual workers and several other specialised workers.
Employment opportunities are of benefit both economically and in a social sense. In the economic sense it means abundant unskilled labour will be used in construction hence economic production and circulation of money. In the social sense the young and energetic labour force will be engaged in productive employment other than remaining idle which may lead them into social ills such as drug abuse and criminoology. Several workers including casual labourers, masons, carpenters, joiners, electricians and plumbers are expected to work on the site for a period that the project will start to the end. Apart from casual labour, semi skilled and unskilled labour and formal employees are also expected to obtain gainful employment during the period of construction.

5.2.1.2 Improvement of local and national economy

Through the use of locally available materials during the construction phase of the proposed MSD Power Project will contribute towards growth of the economy by contributing to the gross domestic product. The consumption of these materials, fuel oil and others will attract taxes including VAT which will be payable to the government hence increasing government revenue while the cost of these raw materials will be payable directly to the producers. The power that could be produced from the proposed MSD Power Project will be sold KPLC which in turn will enter the national grid and sold to various consumers in the country who in turn will pay taxes to the country.

5.2.1.3 Boosting of the informal sector

During the construction, operational and decommissioning phase of the proposed MSD Power Project it is expected that the other businesses in the informal sector will flourish. These include activities such as food vending who will be benefiting directly from the construction, operational and decommissioning staff members who will be buying food and other commodities from them. This will promote the informal sector in securing some temporary revenue and hence livelihood.

5.2.1.4 Increased land Value around the project area

Due to the construction of the proposed MSD Power Project on Thika Road, compounded with the ongoing reconstruction of Nairobi-Thika highway, there will be considerable increased plot value as compared to its current state. This will be advantageous to the owners of the plot.

5.2.1.5 Improved Security

Security within the proposed project site will be enhanced by employment of guards so as to make the MSD Power Plant equipments and facilities to be safe from being stolen. Security lights will be installed at the power plant, thus lighting up a section of the area. Some of the neighbours are currently not on power supply as the transformer that serves them has been vandalized. The new power plant will most likely have a local and secure transformer that will serve the neighbours.

5.2.1.6 Improved Electricity Supply

The project aims to provide an additional 80 megawatts to the national grid. The neighbours were optimistic that power outages will be minimized and that they will not be subjected to power rationing. With this additional reliable electricity in the national grid, the country and the local area are expected to attract more investments.
5.2.2 Negative Issues

5.2.2.1 Water Demand
Water supply within the proposed MSD Power Project will be mainly from piped water that is supplied by the water and sewerage company serving Nairobi City and its environs. However, the respondents were concerned that there will be worse water shortage in the area due to a lot of water that could be used in the proposed MSD Power Project activities.

5.2.2.2 Destruction of existing vegetation
The construction and installation of the proposed MSD Power Plant project will involve clearing of the little existing vegetation cover. The developer shall be advised to some trees and grass in all the gardens and strategic green areas as proposed in the landscape plan.

5.2.2.3 Increased Emissions (Air Pollution)
During construction, operational and decommissioning phase of the proposed MSD Power Project, there will be undesirable emissions that will be emitted especially from heavy machines that could be used for construction and during the operation of the plant. Dust will be emitted during construction and decommissioning phases. Exhaust fumes will be emitted by the generators. Neighbours asked for air pollution control measures to be put in place.

5.2.2.4 Increased Noise Level and Vibration
There was concern over the possibility high noise and vibration levels in the project site as a result of construction works and when running the generators. However, the proponent will have to take appropriate steps to minimize noise production by housing the Generators in a sound-proof & vibration-proof structure and ensuring that all equipments are well maintained.

5.2.2.5 Accidents during Construction
Some neighbours thought that there workplace accidents could occur during construction, implementation and decommissioning of the project. However, they expected accident prevention measures to be put in place. Pedestrians, cyclists and motorcyclists to and from the neighbouring peoples’ settlement (squatters) could be involved in road accidents when using the roads in the project area. The transporters to the project site are expected to adhere to road safety measures.

5.2.2.6 Oil Spillage and Fire Incidents
Some neighbours expressed their concerns on the possibilities of oil spills and fire outbreaks during project implementation. Neighbours want the project proponent to put in place oil spill and fire prevention measures and to have the facility well fenced to prevent unauthorized access.

5.2.2.7 Increase in the cost of electricity
Neighbours feared that use of diesel generators to produce electricity will result in increased costs to be borne by the chain of consumers. Their request was that the Government cushions them against any resultant increase in the cost of electricity.
CHAPTER 6: IDENTIFICATION OF ENVIRONMENTAL IMPACTS OF THE PROPOSED MSD POWER PLANT PROJECT

6.1 Introduction
This Section identifies and discusses both negative and positive impacts associated with the proposed MSD Power Project, in Thika district. The impacts are identified according to Phases namely: Construction Phase, Operational Phase and Decommissioning Phase.

The project being a national development agenda in the energy sector has immense benefits that could save the country losses in terms of power rationing due to long drought duration which is affecting the country. However poor planning of the project could also affect the environment that supports millions of Kenyans through the potential hazards that the project could pose to the public like pollution of water and atmospheric resources. The project impacts are classified as positive or adverse. However the study goes further to categorize the impacts in terms of their magnitude, significance, time of occurrence, extent, reversibility and scope of the impacts.

6.2 Positive Impacts during Construction Phase
A number of positive impacts associated with the proposed MSD Power Project during construction phase are as discussed below;

6.2.1 Employment Opportunities
With the construction of MSD Power Project, there will be employment opportunities especially for casual workers from the local community. Creation of employment opportunities has both economic and social benefit. In the economic benefit, abundant unskilled labour will be used in economic production while socially the young and energetic otherwise poor people will be engaged in productive employment other than remaining idle. Employees with diverse skills are expected to work on the site during the construction period. Unskilled employees will gain some skills.

6.2.2 Gains in the Local and National Economy
There will be gains in the local and national economy as a result of the construction of the proposed MSD Power Project, through consumption of locally available materials including: timber, metals and cement. The consumption of these materials in addition to fuel oil and others will attract taxes including Value Added Tax (VAT) and Income Tax which will be payable to the government. The cost of the materials will be payable directly to the suppliers.
6.2.3 Provision of Market for Supply of Building Materials
The project will require supply of large quantities of building materials most of which will be sourced locally from the surrounding areas. This provides ready market for building material suppliers such as quarrying companies, hardware shops and individuals with such materials.

6.2.4 Informal Sectors Benefits
During construction phase of MSD Power Project, the informal sectors are temporarily likely to benefit from the operations. This will involve kiosk operators who will be selling food to the workers on site. This will finally promote Jua Kali (informal sector) entrepreneurs at Witeithie area for the period that the construction will be taking place.

6.2.5 Environmental Benefits
MSD power project has a potential for contributing to the good of the environment of the area. The project will supply an additional 80 MW to the National grid which will enable KPLC connect more consumers leading to a substantial reduction in reliance on other sources of energy e.g. charcoal and firewood, that have impacts on the forest cover and greenhouse.

6.3 Negative Impacts during Construction Phase
The following negative impacts are expected to be associated with the construction of the proposed MSD power plant.

6.3.1 Noise pollution
The proposed area is relatively tranquil. The construction works of the proposed MSD power project is most likely to be a noisy operation due to the moving construction machines and vehicles. Also, the construction workers who will be working in the site will generate some noise as they are communicating to one another. This will be a potential source of disturbance at the site and surrounding neighbourhoods of the proposed MSD power project.

6.3.2 Generation of Exhaust Emissions
Exhaust emissions are likely to be generated by the construction equipment during the construction phase of proposed MSD power project. Motor vehicles that will be used to ferry construction materials would cause air quality impact by emitting pollutants through exhaust emissions. The impacts will not be significant.

6.3.3 Dust Emissions
Particulate matter pollution is likely to occur during the site clearance, excavation and spreading of the topsoil during construction of proposed MSD power project. There is a very small possibility of PM_{10} suspended and settleable particles affecting the site workers and even neighbours’ health, it is minimal given the construction method of minimum excavation and nil cart away of soil.
6.3.4 Disposal of Excavated Soil
Though little excavation is likely to take place at the proposed MSD power project site, the excavation works to level the site will result in the generation of small amounts of excavated material. But there will be no cart away of excavated material.

6.3.5 Increased water demand
During the construction phase of the proposed MSD power project, both the construction workers and the construction works will create additional demand for water in addition to the existing demand. Water will be mostly used in the mixing of concrete for civil construction works and for wetting surfaces or cleaning completed structures. It will also be used in the washrooms at the construction site and also during the running period of the project.

6.3.6 Workers accidents and hazards during construction
During construction of the proposed MSD Power Project, it is expected that construction workers especially unskilled temporary employees are likely to have accidental injuries as a result of exposure to workplace hazards. Because of these intensive engineering and construction activities including erection of steel structures, welding, metal grinding and cutting and concrete work among others, construction workers will be exposed to risks of accidents and injuries. Injuries can result from trips & falls and other physical and mechanical hazards.

6.3.7 Energy Consumption
The proposed MSD Power Project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil energy is non-renewable and its excessive use may have serious environmental implications on its availability, price and sustainability.

6.3.8 Extraction and Use of Building Materials
Building materials such as hard core, ballast, cement, rough stone and sand required for the construction of the proposed MSD Power Project will be obtained from nearby quarries and hardware shops. Sand harvesters extract sand from rivers and land. Small quantities of these materials will be required for construction of the buildings, the availability and sustainability of such resources at the extraction sites will be negatively affected as they are not renewable in the short term. In addition, the sites from which the materials will be extracted may be significantly affected in several ways including landscape changes, displacement of animals and vegetation, poor visual quality and opening of depressions on the surface leading to human and animal health impacts.

6.3.9 Solid Waste Generation
During construction of the proposed MSD Power Project in Thika district, solid waste will be generated. These include packaging materials, plastics, scrap metal and timber remains among others. Dumping around the site will interfere with the aesthetic status of the area. This has a direct effect to the surrounding community. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment, invasion of scavengers and informal recycling communities.
6.3.10 Possible Exposure of Workers to Diseases
Workers are likely to be exposed to diseases from building materials during the construction phase of the proposed MSD Power Project. It is therefore recommended that before the construction phase of the proposed MSD Power Project commences, there is need for the materials to be well inspected according to the occupational health and safety standards and worker encouraged to use personal protective equipments. Employees who are new to the area may spread or acquire Sexually Transmitted Infections including HIV/AIDS in view of the prevailing prevalence rate in the district.

6.3.11 Increased Storm Water Runoff from New Impervious Areas
Construction of the proposed MSD Power Project buildings and pavements within the proposed project site will lead to additional runoff through creation of impervious areas and compaction of soils. Impervious areas and compacted soils generally have higher runoff coefficients than natural area, and increased flood peaks are a common occurrence in developed areas.

6.3.13 Soil Erosion
There are possibilities of soil erosion occurring during the construction of the proposed MSD Power Project especially during rainy and windy seasons. The impact will however be minimal as there area to be disturbed is small. Roadways and footpaths will be paved with impervious material to minimize soil erosion. Drainages will be constructed to control storm rain water.

6.3.14 Oil Spills
The machines on site may be containing moving parts which will require continuous lubrication to minimise the usual corrosion or wear and tear. This will contaminate the soil. Likewise, moving vehicles on site may require oil change.

6.3.15 Destruction of existing vegetation
The construction process of the proposed MSD Power Project buildings will involve clearing of the existing vegetation cover consisting of mainly coffee bushes. The developer intends to replace this with trees and grass in the lawns and land boundaries around the project area.

6.3.16 Surface and ground water Hydrology and Water Quality Degradation
Changes in surface hydrology alter the flow of water through the landscape. Construction of impervious surfaces such as parking lots, roads and buildings increase the volume and rate of runoff, resulting in habitat destruction, increased pollutant loads, and flooding. Contaminated soil or ground water in the path of the project could be disturbed by excavation resulting in a potential transfer of the contamination to surface waters. Oil spills during construction could introduce contaminants into subsurface which may end-up into ground water. Development activities such as MSD Power Project development as well as the spill-over effects of development such as increased demand for water use and increased auto use can impact water quality by contributing sediment, nutrients, and other pollutants to limit water supplies, increasing the temperature of the water, and increasing the rate and volume of runoff.
6.3.17 Fire Outbreaks
Due to various construction activities at the proposed MSD power plant project, fire outbreaks can occur. Handling of inflammable products increases fire risks.

6.4 Positive Impacts during Operation Phase
Like construction phase, there are positive impacts associated with the proposed MSD Power Project during operation phase. These positive impacts are discussed below.

6.4.1 Increase in electricity supply
In Kenya the electricity demand by far outstrips the electricity supply. This is because currently the country is experiencing a long drought spell which has lead reduction in water volumes in hydro-power generation dams that produce the electricity. The project aims to provide an additional of 80 megawatts to the National grid. With additional electricity in the national grid, more investors are expected to be attracted due to the reliable supply of electrical energy.

6.4.2 Employment Opportunities
Employment opportunities are one of the long-term major positive impacts of the proposed MSD Power Project in Thika Road district. This will occur during the operation and maintenance of the MSD Power Project. Other sources of employment will involve direct technical service provision to the MSD Power Project e.g. electrical engineers, mechanical engineers, drivers among others. There could be other indirect sources of employment e.g. businesses, associated with the project.

6.4.3 Increase in Revenue
There will be positive gain for the revenue system arising from the sale of the electricity power from the proposed MSD Power Project to Government, the fuel provider, project operator and KPLC which in turn will be supplied to various customers who will be paying taxes to the Government.

6.4.4 Improved Security
With the establishment of the proposed MSD Power Project in Thika Road, the level of security will be improved around the project area. This is as a result of more security lights and security personnel being employed to guard the MSD Power Project. The project site will also be well fenced. Hence if the level of security is increased, the residents will feel more secure than before.

6.5 Negative Impacts during Operation Phase
The following are the negative impacts that are associated with the proposed MSD Power Project during the operation phase.
6.5.1 Waste Generation
The proposed MSD Power Project in Thika Road is expected to generate some amounts of wastes during its operation phase. The bulk of the solid waste generated during the operation of the project will consist of drums, paper, plastic, glass, metal, textile and inorganic wastes. Such wastes can be injurious to the environment. Some of these waste materials especially the plastic/polythene are not biodegradable hence may cause long-term injurious effects to the environment.

6.5.2 Fuel Oil Consumption
The proposed MSD Power Project shall consume large amount of diesel in the process of generating electricity. Since fuel oil is produced mainly through non renewable resources, this will have adverse impacts on these non renewable resources base and their sustainability.

6.5.3 Increased Population around the project area
With the construction and operation of the proposed MSD Power Project on Thika Road will lead to the establishment of businesses within the proposed project area and operated by persons who were not previously resident in the area. This will in turn increase the population in the project area.

6.5.4 Water Use
The operation activities during the operation phase of the proposed MSD Power Project in Thika Road district will involve the use of large quantities of water. These will increase the strain on water resources in the area.

6.5.5 Increased Pressure on Infrastructure
The proposed MSD Power Project in Thika Road will have a potential of increasing pressure on existing infrastructure such as roads and water among others. This would be due to increased use of volumes on water, human and vehicle traffic in the project area.

6.5.6 Air Pollution
Operational phase of the proposed MSD Power Project off Thika Road effects of the air emissions on air quality. Particulate emissions represents the main pollutant of concern, with gaseous emissions such as oxide of sulphur (SOx), oxides of nitrogen (NOx) and carbon monoxide (CO) potentially significant due to combustion of the generator fuel. Measurements were made on air samples from the proposed project area and were found to be far much below the limits. Air sampling and tests for pollutants will be done periodically during the operation of the project. The operation of the plant might have some impact on the health of the people working or living in the area.

6.5.7 Increased Storm Water Flow
The building roofs and pavements of the proposed MSD Power Project will lead to increased volume and velocity of storm water or run-off flowing across the area covered by the proposed MSD Power Project during operation phase. This will lead to increased amounts of storm water in the area and this may lead to soil erosion.
6.5.8 Water Pollution
During the operation phase of the proposed MSD Power Project on Thika Road, if the sites for dumping solid wastes are not well taken care of, they may cause contamination of ground water sources. There is need therefore for the project proponent to put in place an efficient waste management scheme that will prevent the accumulation of uncontrolled waste, as well as an efficient collection system and off-site disposal. Oil spills might also lead to contamination of wetlands and ground water sources.

6.5.9 Noise Pollution
Noise pollution from the operation of the generators from the proposed MSD Power Project along Thika Road is inevitable. The only existing source of noise is from vehicular traffic along the busy Nairobi - Thika road, especially during the day. However, there are no sensitive receptors of the noise emission as the area is mainly agricultural with very few activities at night. The Generator sets will be housed in a sound and vibration proof building, hence low noise emissions. Noise measurements have been made before commencement of the project construction (see SGS Laboratory Report in the annex). The noise levels were found to be negligible. However, periodic noise audits will made during the project operation phase.

6.5.10 Vibration
During the operational phase of the proposed MSD Power Plant Project in Thika Road, the generators will create a low level ground vibration within the surrounding areas. This will be monitored periodically.

6.5.11 Oil Spills Hazards
Potential oil spills and accidents during oil transportation, storage and operations of the generators of the proposed MSD Power Plant Project in Thika Road may occur. In the case of oil spill the relatively lighter, more volatile, mobile, and water soluble compounds in diesel will tend to evaporate fairly quickly into the atmosphere or migrate to groundwater. When exposed to oxygen and sunlight, most of these compounds will tend to break down relatively quickly. Accidental oil spills can occur due to leakage from the storage tanks or site oil pipelines. Poor maintenance of machines can also lead to oil spills. A small amount of used oil may drip from spent oil filters. Test for hydrocarbons were made from soil sampled from the proposed project site. This soil was found to be environmentally clean. Annual tests will be done on soil samples during the project operation.

6.5.12 Visual Impacts
Though the site is an electric substation, the front yard has been open with occasional use as an electric transmission poles yard. The plant might present unwanted visual impacts, both by its physical presence and profile against the surrounding area, and by visual impacts of the plume (particularly during periods of poor atmospheric dispersion) and secondary formation of aerosols that can reduce visibility on a more regional scale. Large structures such as stacks and fuel tanks towers may also adversely impact the visual quality of the area.
6.6 Positive Impacts during Decommissioning Phase

The following positive impacts are associated with the proposed MSD Power Project during the decommissioning phase:

6.6.1 Site Rehabilitation

Upon decommissioning of the proposed MSD Power Project in Thika Road, rehabilitation of the project site will be carried out to restore the site to its original status or to a better state than it was originally. This will include replacement of topsoil and re-vegetation which will lead to restoration of the visual quality of the area.

6.6.2 Employment Opportunities

For demolition to take place properly and in good time, several people will be involved. As a result, several employment opportunities will be created for the demolition staff during the demolition phase of the proposed MSD Power Project in Thika Road.

6.7 Negative Impacts during Decommissioning Phase

The following are the negative impacts that are likely to be associated with the proposed MSD Power Project along Thika Road during its decommissioning phase.

6.7.1 Noise and Vibration

The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding areas. This will be as a result of the noise and vibration that will be experienced as a result of demolishing the proposed MSD Power Project in Thika Road.

6.7.2 Solid Waste Generation

Demolition of the proposed MSD Power Plant and other related infrastructure will result in generation of solid waste. The waste will contain the materials used in construction including concrete, metal, drywall, wood, glass, paints, adhesives, sealants and fasteners. Although demolition waste is generally considered as less harmful to the environment since they are composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment.

6.7.3 Dust

Some dust will be generated during demolition works of the proposed MSD Power Plant. This will affect demolition staff as well as the neighbours.
CHAPTER SEVEN: MITIGATION MEASURES AND MONITORING PROGRAMMES

This section highlights the mitigation measures for the expected negative impacts of the proposed MSD Power Plant in Thika Road. The potential impacts and the possible mitigation measures have herein been analyzed under three categories: Construction, Operational and Decommissioning.

7.1 Mitigation of Negative Impacts during Construction

The following measures can be considered as mitigation measures of the negative impacts associated with the proposed MSD Power Plant in Thika Road during construction phase.

7.1.1 Minimization of Noise and Vibration

The project proponent of the proposed MSD Power Plant in Thika Road shall put in place several measures that will mitigate noise pollution arising during the construction phase. The following noise-suppression techniques will be employed to minimise the impact of temporary construction noise at the project site.

- Install portable barriers to shield compressors and other small stationary equipment where necessary.
- Install sound barriers for pile driving activity.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Co-ordinate with relevant agencies regarding all construction.
- Limit vehicles to a minimum idling time and observe a common-sense approach to vehicle use, and encourage drivers to switch off vehicle engines whenever possible.

Compliance with the recently issued Noise and Vibration Regulations of 2009 is expected at all the phases of the project.

7.1.2 Generation of Exhaust Emissions

In order to control exhaust emissions that are likely to occur during the construction of the proposed MSD Power Plant in Thika Road, the following measures shall be implemented during construction.

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

This will also be achieved through proper planning of transportation of materials to be used during construction of the project to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road.
7.1.3 Dust Emissions and Air quality

Controlling dust emissions that is likely to take place during construction phase of the proposed MSD Power Plant along Thika Road is useful in minimizing nuisance conditions. It is recommended that a standard set of feasible dust control measures be implemented for all construction activities. Emissions of other contaminants (NO\textsubscript{x}, CO\textsubscript{2}, SO\textsubscript{x}, and diesel related PM\textsubscript{10}) that would occur in the exhaust from heavy equipment are also included. The project proponent is committed to implementing measures that shall reduce air quality impacts associated with construction.

- During construction, any stockpiles of earth should be enclosed / covered / watered during dry or windy conditions to reduce dust emissions;
- During construction, where water is available, sprinkle the construction area with water to keep dust levels down.
- Construction trucks removing soil from the site, delivering sand and cement to the site should be covered to prevent material dust into the surrounding areas;
- All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction. This means that construction workers will be trained regarding the minimization of emissions during construction and they limit their speeds so that dust levels remain low.
- Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Drivers of vehicles used during construction will be under strict instructions to minimize unnecessary trips and minimize idling of engines.
- Dust masks should be provided to all personnel in areas prone to dust emissions throughout the period of construction.
- Maintain all machinery and equipment in good working order to ensure minimum emissions including carbon monoxide, NO\textsubscript{x}, SO\textsubscript{x} and suspended particulate matter;

7.1.4 Excavated Soil during Construction

The Excavated soil during the construction of the proposed MSD Power Plant will not be disposed. It is recommended that part of the topsoil excavated from the proposed construction site be re-spread in areas to be landscaped.

7.1.5 Minimization of increased Water Demand

The proponent of the proposed MSD Power Plant in Thika Road shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water use. A bore-hole may be dug so as not to strain the existing water sources.
7.1.6 Minimization of Worker accidents and hazards during Construction phase
To reduce the workers accidents and hazards during the construction phase of the proposed MSD Power Plant along Thika Road, the contractor and proponent are expected to adhere to the provisions of the Occupational Safety and Health Act, 2007 and its subsidiary legislation. It is the responsibility of the project proponent and contractor to provide a safe and healthy environment for construction workers as outlined in the EMP. An MSD Response and Evacuation Plan must be in place in addition to safety education and training shall be provided to the employees.

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

7.1.8 Reduction of Impacts at Extraction Sites and Efficient Use of Raw Materials
The proponent of the proposed MSD Power Plant along Thika Road will source building materials such as sand, ballast and hard core from registered quarry and sand mining firms whose projects have undergone satisfactory environmental impact assessment/audit and received NEMA approval. Since such firms are expected to apply acceptable environmental performance standards, the negative impacts of their activities at the extraction sites are considerably well mitigated.

To reduce the negative impacts on availability and sustainability of the materials, the proponent will only order for what will be required through accurate budgeting and estimation of actual construction requirements. This will ensure that materials are not extracted or purchased in excessive quantities. Moreover, the proponent will ensure that wastage, damage or loss (through run-off, wind, etc) of materials at the construction site is kept minimal, as these would lead to additional demand for and extraction or purchase materials.

In addition to the above measures, the proponent shall consider reuse of building materials and use of recycled building materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites.

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

The proponent shall put in place measures to ensure that construction materials requirements are carefully budgeted for and to ensure that the amount of construction materials left on site after construction is kept minimal. It is further recommended that the proponent should consider the use of recycled or refurbished construction materials. Purchasing and using once-used or recovered construction materials will lead to financial savings and reduction of the amount of construction debris disposed of as waste.

Additional recommendations for minimization of solid waste during construction of the proposed MSD Power Plant in Thika Road include:

i. 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
ii. Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements
iii. Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials
iv. Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste
v. Use of construction materials containing recycled content when possible and in accordance with accepted standards.
vi. Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided.

7.1.10 Possible exposure of workers to diseases
Possible exposure of workers to diseases from building materials at construction site shall be mitigated by compliance with occupational health and safety standards.

7.1.11 Minimization of Storm Water Run-off and Soil Erosion
The proponent of MSD Power Plant along Thika Road will put in place some measures aimed at minimizing soil erosion and associated sediment release from the project site during construction. These measures will include terracing and levelling the project site to reduce run-off velocity and increase infiltration of rain water into the soil. In addition, construction vehicles will be restricted to designated areas to avoid soil compaction within the project site, while any compacted areas will be ripped to reduce run-off. Increased runoff from paved grounds and expansive roofs causing extreme flooding and overflows of drainage systems shall be mitigated. Surface runoff and roof water shall be harvested and stored in underground reservoir for reuse. A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structures will be designed.

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Excavations at the site will be restricted to the sections where the plant will be. Excavated earth will be held away from trenches and on locations of the site not susceptible to surface runoff of storm water. The earth removed for external disposal will require to be deposited on sites without the risk of being washed down during rains and where it will not compromise other land use activities in those areas. Caution will be required during construction at times of heavy rains.

- Re-vegetate exposed areas around the site so as to mitigate erosion of soil by storm water runoff.
- The final site grade should facilitate drainage and avoid flooding and pooling. A site drainage plan should be developed to protect against erosion.
- Installation of drainage trenches, construction of runoff and retention ponds is necessary. Minimization of disturbances and scarification of the surface should be observed to reduce erosion impacts.
- All slopes and working surfaces should be returned to a stable condition and topsoil on the final site would be graded and planted as appropriate.

### 7.1.12 Controlling Oil Spills during Construction Phase

The proponent of the proposed MSD Power Plant along Thika Road will control the dangers of oil spills during construction by maintaining the machinery in specific areas designed for this purpose hence might not be a serious impact as a result of the construction of MSD Power Plant along Thika Road.

### 7.1.13 Minimization of Vegetation Disturbance

Clearance of part of the vegetation (mainly grass and shrubs) at the Proposed MSD Power Plant along Thika Road site to pave way for construction will be inevitable. However, the project proponent will ensure proper demarcation of the project area to be affected by the construction works. This will be aimed at ensuring that any disturbance to flora is restricted to the actual project area and avoid spill-over effects to the neighbouring areas. In the same vein, there will be strict control of construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works. Another important measure aimed at reducing disturbance of vegetation in the proposed project area will be preservation of individual trees within the site. In addition, the proponent will be involved in re-vegetation of some of the disturbed areas through implementation of a well designed landscaping programme.

### 7.1.14 Hydrology and Water Quality Degradation

Several measures shall be put in place to mitigate the impacts that are likely to lead to Hydrology and water quality degradation at the proposed MSD Power Plant along Thika Road. The project proponent will prepare a hazardous substance control and MSD response plan that will include preparations for quick and safe clean up of accidental spills. It will prescribe hazardous-materials
handling procedures to reduce the potential for a spill during construction, and will include an MSD response programme to ensure quick and safe cleanup of accidental spills. The plan will identify areas where refuelling and vehicle maintenance activities and storage of hazardous materials, if any, will be permitted. Trial holes digging will be conducted before construction begins and soil information will be provided to construction crews to inform them about soil conditions and potential hazards. Oil absorbent material, tarps and storage drums will be used to contain and control any minor releases of engine and other equipment oil.

7.2 Mitigation of Negative Impacts during the Operation Phase
The negative impacts of the proposed Thika Road MSD Power Plant will be mitigated as discussed below.

7.2.1 Ensuring Efficient Solid Waste Management
The project proponent of the proposed Thika Road MSD Power Plant will be responsible for efficient management of solid waste generated by the project during its operation. In this regard, the proponent will provide waste handling facilities such as labelled waste bins and skips for temporarily holding solid waste generated at the site. In addition, the project proponent will ensure that such are disposed off regularly and appropriately. It is recommended that the proponent puts in place measures to ensure that the MSD Power Plant operating personnel manage the waste efficiently through segregation, recycling, reuse and proper disposal procedures.

The proponent will put in place an integrated solid waste management system and give priority to reduction at source of the materials. This option will demand a solid waste management awareness programme in the management and the operator employees. Solid wastes shall be disposed off in a manner that is acceptable to NEMA and Environmental Regulations.

7.2.2 Ensure Efficient Energy Consumption
To ensure efficient energy consumption during the operation phase of the proposed Thika Road MSD Power Plant, the proponent plans to install an energy-efficient lighting system at the site. This will contribute immensely to energy saving during the operational phase of the project. In addition, the plant operators be sensitised to ensure energy efficiency in their domestic operations. To complement these measures, it will be important to monitor energy use during the operation of the proposed MSD Power Plant in Thika Road and set targets for efficient energy use.

7.2.3 Ensure Efficient Water Use
The proponent of the proposed Thika Road MSD Power Plant will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff. In addition, the plant operators of the proposed MSD Power Plant will be sensitized to use water efficiently. The project will adopt the policy of water reuse especially for cooling purposes of the plant.
7.2.4 Air Pollution
The proponent of the proposed Thika Road MSD Power Plant will ensure minimal CO\textsubscript{x} and SO\textsubscript{x} emissions through timely and frequent service and maintenance of the generators. This will improve combustion of fuel which will make the generators more efficient and reduce emissions. For reduction of oxides of sulphur, a Desulphurization process, which usually involves using crushed limestone to react with sulphur dioxide in the hot flue gases, can reduce sulphur dioxide emissions by as much as 90 per cent. The operator will ensure that the fuel oil used in the generators shall have a low sulphur content of not more than 2.5%. One way of NO\textsubscript{x} reduction is injecting water directly into the combustion chamber, humidifying the charge air, or mixing the water with diesel fuel.

- No burning of any waste materials whatsoever should be permitted within the site both during construction and operation;
- Use of low sulphur fuel will help in minimizing SO\textsubscript{x} emissions. Alternatively, SO\textsubscript{x} emissions can be minimized by installing desulphurisation equipment in the plant.
- Nitrogen oxide emission should be controlled through burner management and water injection to the combustion turbines. Smoke treatment (denitrification); Choice of combustion technology; Burners/low-NO\textsubscript{x} combustion chambers; Water or steam injection.
- Particulate emissions should be reduced through good combustion control to minimize the products of incomplete combustion. Reduction of ash content in fuels: Choice of combustion technology, Electrostatic precipitators, bag filters, CO Control of combustion conditions operating measures (including stack cleaning)
- The MSD Plant operator will be required to install and operate dedicated stack gas samplers or analyzers, and report both summary data and violations of standards or limits.
- Annual source testing will also be routinely required to confirm continued compliance with emission limits.

7.2.5 Oil Spills

To prevent oil spills and environmental contamination, the power plant and pipelines should be designed with spill prevention and detection systems to protect the environment. With spill prevention and protection measures there should no adverse effects to the ground and surface water and soil. Need to design appropriate protection devices against accidental discharge of toxic substances (bases/airtight tanks for machines, reservoirs etc.).

- Storage and liquid impoundment areas for fuels, raw and in-process material solvents, wastes and finished products should be designed with secondary containment (e.g. dikes/berms) to prevent spills and the contamination of soil, ground and surface water.
• All the fuel aboveground storage tanks should have secondary containment with sufficient volume to contain a spill from the largest tank in the containment structure. The containment area should have a means of removing accumulated water. The containment area should have a means of removing accumulated water. A retention area should be designed that surrounds the fuel storage tanks.

• The plant operator should provide containers for the storage of chemical and lubricating products. Drains should be routed through a site/water separator. A spill and MSD response plan would be developed and put in place prior to commencement of construction.

• A written MSD response plan should be prepared and retained on the site and the workers should be trained to follow specific procedures in the event of a spill. The project proponent will orientate the workers on site on their specific EHS policies to prevent incidents and accidents of oil spill.

• Frequent inspection and maintenance of facility can minimize spilling from the transfer pipeline.

• The project operator will collect the waste oil or used oil and lubricants from maintenance of operational equipment for proper disposal. In the Environmental Management Plan (EMP), disposal of used oil will be the responsibility of the project operator. The proponent will identify a reputable company to handle disposal of oil and oil filters.

• Fuel supplier proposes to enclose fuel tanks in an earth bund wall and the floor lined with plastic sheets to prevent accidental contamination of soils and groundwater. At the off loading area, they propose to mitigate leakage by constructing a sump for temporal containment when fuel is off loaded.

• It is proposed that the operator uses rail transport for fuel in order to minimize chances of oil spillage on the roads.

7.2.6 Visual Impacts
The visual negative impacts can be mitigated through landscaping the area with trees to screen the project stacks and fuel tanks by the project proponent of the proposed Thika Road MSD Power Plant.

7.2.7 Minimization of Sewage Release
The project proponent of the proposed Thika Road MSD Power Plant will ensure that there are adequate means for handling the sewage generated at the proposed MSD Power Plant. It will also be important to ensure that toilets are kept clean and properly maintained.

7.2.8 Fire Suppression
The proposed Thika Road MSD Power Plant must have fire fighting equipments of high standards and in key strategic points all over the project site. Fire pumps, Hydrants, Sprinkler/water spray systems, Hose houses, Dry chemical systems, Carbon dioxide systems, Detection/alarm systems, Portable fire extinguishers among others shall be installed at the site. A fire evacuation plan must be posted in various points of the construction site including procedures to take when a fire is reported. All workers must be trained on fire management and fire drills undertaken regularly.
7.2.9 Flue Gas
To mitigate the effects of flue gas affecting the micro-climate of the area, the stack chimney of the generators will be to at least 30 (thirty) metres. This will enable plume dispersal high preventing smoke and heat from affecting the surrounding area.

7.2.10 Workers Health and Safety
All workers entering the MSD power plant site must be equipped with appropriate and adequate PPE including ear muffs, safety footwear, overalls, gloves, dust masks, among others. The PPE should be those meeting the international standards of PPE. Personal protection gear must be provided and its use made compulsory to all. The entire workforce of the plant should be trained in the use of protective gear, handling of chemical products and acid storage cells, electric safety equipment, procedures for entering enclosed areas, fire protection and prevention, disaster response and evacuation procedures. Employees shall under periodic health and safety training. Safety signs shall be posted where necessary. Machines and Equipments must be operated only by qualified staff and a site supervisor should be on site at all times to ensure adherence. The project operator must develop a Workplace Health and Safety Policy Manual for which all the workers should be conversant and comply with. The project operator should appoint a responsible person from the management team to be in charge of workplace Safety, Health and Environmental issues. The operator should develop a Disaster Response Plan for handling any emergencies arising thereof during the project implementation phase.

7.2.11 Hazardous waste
The amount of hazardous waste created will be very low and possibly originate from maintenance sources. The waste would consist primarily of spent lubricants and their containers, spent oil filters, used rags and spent clean-up solvents. The used oil filters should be segregated and stored in a place with a drip collection mechanism before they are collected by the disposal agent for proper disposal. The plant operator should ensure that the filters are properly disposed and should apply the principle of cradle to grave.

The mitigation measure is to provide training to site operation staff and to properly handle and dispose hazardous wastes using acceptable methods. Hazardous wastes on the site shall be clearly marked out and the entire workforce trained to recognize the danger signs and familiarize themselves with procedures to be followed before entering hazardous areas.

7.2.12 Noise and Vibration
Noise and vibration are expected during the operation phase of the project. Mitigation is through installation of generators house in suitable structures with inbuilt sound and vibration absorption mechanisms.
- The project operator will be expected to comply with the recent EMCA (Noise and Vibration) Regulations of 2009 during the operation phase of the project.
- All equipments and machinery installed must be tested to verify if they are compliant with Kenya and the World Bank acceptable standards of noise. Tested noise levels should be recorded as baseline and used for future monitoring.
- Noise emitting equipment should comply with the applicable Kenya and World Bank noise standards and should be properly maintained.
- All workers in the project site must be equipped with the necessary and required Personal Protective Equipment (PPE) such as ear muffs and ear plugs. The employees should undergo annual audiometric tests by a designated medical health practitioner.
- The engines shall be provided with exhaust silencers. The generators shall be placed on suitable vibration dampers.

7.3 Mitigation of Decommissioning Phase Impacts
Just as in the case during the construction and operation phase, the negative impacts of the decommissioning phase of the proposed Thika Road MSD Power Plant can be mitigated as follows:

7.3.1 Minimization of Noise and Vibration
Significant impacts on the acoustic environment will be mitigated by the project proponent of the proposed Thika Road MSD Power Plant shall put in place several measures that will mitigate noise pollution arising during the decommissioning phase. The following noise-suppression techniques will be employed to minimise the impact of temporary destruction noise at the project site.

- Install portable barriers to shield compressors and other small stationary equipment where necessary.
- Install sound barriers for pile driving activity.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Co-ordinate with relevant agencies regarding all substation construction activities in the residential areas.
- Limit vehicles and other small equipment with engines to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- Demolish mainly during the day, a time with minimal noise disturbance.

7.3.2 Efficient Solid Waste Management
Solid waste resulting from demolition or dismantling works associated with the proposed Thika Road MSD Power Plant during decommissioning phase will be managed as follows:

- Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of demolition waste generated during decommissioning phase
7.3.3 Reduction of Dust Concentration

High levels of dust concentration resulting from demolition or dismantling works will be minimized as follows:

- Watering all active demolition areas as and when necessary to lay dust.
- Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard.

7.3.4 Site Rehabilitation after Decommissioning

The project operator shall, on decommissioning of the project, restore the site to its original status as far is practicable and plant trees at the site.
CHAPTER 8: ANALYSIS OF PROJECT ALTERNATIVES

This chapter describes and examines the various alternatives available for the project. Alternatives examined during the study included;

- Alternative sources of energy such as renewable energy sources other than generators,
- Site alternatives in project location particularly with regards to location based impacts and land use conflicts was assessed,
- Process alternatives including evaluation of the alternatives in process open to the project with an objective of minimizing raw material use, waste generation and energy requirements,
- Technology alternatives examining any alternatives in technology to generate electricity open to the project and
- Alternatives in equipment and facilities so as to determine best affordable options and finally
- A No Project alternative was also assessed to determine the impact of this No Project Scenario.

8.1 Alternative Fuel

There are different types of fuels available in the market depending on the engine use. These fuels have the environmental and economic advantages and disadvantages. Environmental advantages include low pollutant levels while economic advantages include combustion efficiency.

The project operator proposes to use Heavy Fuel Oil (HFO) Oil for running of the engines. HFO is more viscous that it has to be heated, which requires a special heating system, before use and it contains relatively high amounts of Sulphur, which forms sulfur dioxide upon combustion. However, its undesirable properties make it very cheap. In fact, it is the cheapest liquid fuel available. HFO has less energy per litre than lighter fuels like diesel. The high sulfur content of the fuel is also another disadvantage.

The alternative fuel that can be used is Light Fuel Oil (LFO) or Automotive Gas Oil (AGO). The other alternative fuels include natural gas, industrial Kerosene, Industrial Diesel Oil (IDO) and Coal.

Industrial Diesel oil is a light product that contains water-soluble and acutely toxic components that could impact water resources. It is moderately volatile and has a rapid evaporation rate which helps to naturally remove toxic components from the environment.

Automotive Gas Oil (AGO) also known as diesel oil is a medium petroleum distillate. It is obtained via distillation of petroleum, followed by other technological processes such as hydrogenation refining, hydro cracking, catalytic cracking, etc. One of the most important characteristics of diesel oil is its low temperature behaviour. Sulphur content in diesel oil produced today is relatively high.
In terms of transportation of the fuel to the area, the project will take advantage of good roads, rail transport and the close proximity to Nairobi. Transporting these alternative fuels will require road or rail transport as there is no pipeline to the proposed project area. The cost implication of road and rail transport would be cheaper since the site is within the Nairobi Metropolitan area.

Use of coal for energy generation is common in heavy industries but has not picked up for electricity generation in Kenya. However this is set to change as the country prospects for coal in Eastern Province specifically in Kitui District. The environmental impacts of such plants as well as the cost of building one is high in a scenario where the country needs urgent additional electricity supply as in this case. Coal is bulky and transporting it can be environmentally unfriendly as well as expensive. In most cases the firing plant for electricity generation is normally sited near the coal mines or deposits.

Another alternative fuel for the project would be natural gas. Kenya does not have a supply of natural gas at the moment. Importing the gas would require heavy investment in infrastructure for both transporting and storage.

The efficient and effective movement of natural gas requires an extensive and elaborate transportation system. In many instances, natural gas produced from a particular well will have to be transported over a great distance to reach its point of use. The transportation system for natural gas consists of a complex network of pipelines, designed to quickly and efficiently transport natural gas from its origin, to the project site.

Natural gas is usually stored underground, in large storage reservoirs. In addition to underground storage, however, natural gas can be stored as Liquefied Natural Gas (LNG). LNG allows natural gas to be shipped and stored in liquid form, meaning it takes up much less space than gaseous natural gas. Use of locally non-available fuel which would require heavy investment in terms of transportation and storage. However diesel fuel is more expensive and more polluting as compared to natural gas.

8.2 Alternative Site
Relocation option to a different site is an option available before the project implementation. At present the project proponent does not have an alternative site in the general direction of the proposed site. This means that the project proponent has to look for the alternative land. Looking for the land to accommodate the scale and size of the project and completing official transaction on it may take a long time although there is no guarantee that the land would be available. The developer will spend another one year on design and approvals since design and planning has to be according to site conditions. Project design and planning before the stage of implementation will cost the developer a large sum of money. Whatever has been done and paid to date will be counted as a loss to the developer.
Assuming the project will be given a positive response by the relevant authorities including NEMA, this project would have been delayed for about two (2) years period before implementation. This is a delay that our economy cannot afford. This would also lead to a situation like No Project Alternative option. The other consequence of this is that it would be a discouragement for private/local investors especially in the energy sector that has been shunned by many public and private investors already aggravating our critical energy. In consideration of the above concerns and assessment of the current proposed site, relocation of the project is not a viable option.

8.3 Alternative Project / Technology

The project being an MSD generation power plant intervention to the energy sector in Kenya, the alternatives that are available for similar objective of the project are quite few. Putting up a hydro plant will take a long time and identifying a feasible site would require a longer time and resources.

Solar power panels is a viable alternative but would be too slow in installing and would require a vast area of land for laying the panels which can tap 80 MW of energy. Although the area receives a good amount of solar rays, the project could work on a long term basis when it is not a stop gap measure for the current electrical energy deficiency in the country.

Another technological alternative is wind energy. Installing wind turbines is not as long term as hydroelectric plants. But this technology is site specific and not all areas can use the technology. According to metrological data of the area, the site lacks potential wind speeds that can be used to generate electricity of 80 MW. The technology is also at its nascent stages of development in Kenya.

The Government of Kenya should look into the possibility of using nuclear energy to generate electricity. This is a long term consideration.

8.4 Interconnection Alternative

Kenya has had experience in regional power interconnection with Uganda. This option has worked for some time when Uganda had surplus electric power from its Owen falls. However this situation has changed with Uganda experiencing power shortage. Uganda has been supplying power to Kenya through an interconnection between the two countries, which has been in existence for a number of years; via a 132 kV double circuit line from the Owen Falls hydropower plant before the Uganda power crisis. The line has a capacity of carrying 80MW.

This option would mean that the potential adverse and impacts of the project would be forgone. More extension infrastructure would be put in place to support this option as there already exist high voltage pylons from Uganda to Kenya. Also the fact that the region is far from the border of Uganda would make it hard for this option to work well with minimal transmission loses. This option would abate greenhouse emissions to the country and the region.
Interconnections in the region have the potential for significant environmental and economic benefits. Potentials for electricity sharing between Kenya and Tanzania exist through a 350 km and a 400 km long 220 kV interconnection between Arusha and Nairobi and between Dar es Salaam and Mombasa respectively. The Arusha - Nairobi interconnection could also be used to interconnect electric power between Tanzania and Uganda (wheeling through Kenya) via a 500 km long 220 kV line from Kampala to Nairobi. Another option is a 500 km 220 kV line from Kenya to Tanzania (Olkaria - Mwanza). The other alternative is the construction of a 400KV from Ethiopia. This would take a long time to implement considering the urgency for the current proposed project.

8.5 Alternative Processes and Materials
The process materials that are consumed by the proposed project are, Fuel Oil, water for cooling the generators and lubricants.

There is no alternative for water for plant cooling. So the task was to assess alternative water sources for the project. The study had four alternatives sources, piped Municipal water, groundwater and rainwater. Groundwater quality and recharge in the area is very poor, making it less viable for any firm to venture into groundwater extraction. However the cooling water is often recycled.

Surface water from streams and rivers is not a viable option for the plant as the area has no nearby river. But this would be costly and uneconomic in an MSD case like this. Tapping rainwater would also be an option but it would require the project proponent to have a large roof catchment surface which is not the case. Nairobi City water supply from Ndakaini dam in Thika is thus the only viable option for the project based on the steady supply and quantities that would not impact other water users.

Another material input for the project that was assessed for sustainable alternative was fuel for running the generators. While the proponent proposed Heavy Fuel Oil (HFO), other alternatives to this including other petroleum products and coal were analyzed.

8.6 Combined Cycle Project
Another alternative for the project is Combined Cycle Plant. Combined-cycle plant produces electricity from two sources of energy instead of one. Fuel is used as a fuel in a combustion turbine, similar to a jet engine. Exhaust from the combustion turbine also is used to generate steam in a heat recovery steam generator. Both sources of energy then drive turbines and electric generators to produce electricity. Integrating combustion turbine and steam turbine technology provides extremely efficient electricity production process. Combined cycle is about 30 percent more efficient than a traditional steam plant.

A combined cycle project would operate cleaner and more efficiently than the fuel-powered units. As a result, air emissions will be significantly reduced. However the project being an MSD plant and the duration and costs of installing a combined cycle would not be feasible for the project objective. Some advantages of combined cycle plant over the proposed project include; higher thermal efficiency, lower fuel consumption, lower emission of NOx, no SO2 and particulate matter emission, no solid waste generated such as coal ash.
8.7 No Project Alternatives

A no project scenario was also looked into in this study. The forgone costs of not having the project could result in economic losses in terms of power cuts to industrial operations, agriculture and agro industries, domestic operations among other targeted socio-economic activities of the proposed project. The no-project scenario will mean the status quo of the area remains and no occurrence of adverse impacts as well as positive impacts posed by the project implementation.

The no project option will have the forgone costs and benefits including

- The targeted consumers will forgo improved electricity supply
- Generation of employment opportunities through expansion of business activities that would have been spurred by availability of electric power will not occur
- The expansion programme, rural electrification programme and economic growth in general will suffer.

8.8 Analysis of Alternative Construction Materials and Technology

The proposed Thika Road MSD Power Plant will be constructed using modern, locally and internationally accepted materials to achieve public health, safety, security and environmental aesthetic requirements. Equipment that saves energy and water will be given first priority without compromising on cost or availability factors. The concrete pillars and walls will be made using locally sourced stones, cement, sand (washed and clean), metal bars and fittings that meet the Kenya Bureau of Standards requirements.

Beautiful and durable re-enforced concrete roofs with tile profile will be used because they are good in heat insulation as compared to the iron sheet roofs, and afford more security. This will ensure that the rainwater harvested will be used in the plant operations and landscaping. Heavy use of timber during construction is discouraged because of destruction of forests. The exotic species would be preferred to indigenous species in the construction where need will arise.

8.9 Solid waste management alternatives

The proposed Thika Road MSD Power Plant will generate some of solid wastes. The proponent will give priority to reduction at source of the materials. This option will demand a solid waste management awareness programme in the management and the residents. Solid wastes shall be disposed off in a manner that is acceptable to NEMA and National/International Environmental Regulations.
CHAPTER 9: ENVIRONMENTAL MANAGEMENT PLAN (EMP)

9.1 Significance of an EMP

Environmental Management Plan (EMP) for development projects provides a logical framework within which identified negative environmental impacts can be mitigated and monitored. In addition the EMP assigns responsibilities of actions to various actors and provides a timeframe within which mitigation measures and monitoring can be done. EMP is a vital output of an Environmental Impact Assessment as it provides a checklist for project monitoring and evaluation. The EMP outlined below has addressed the identified potential negative impacts and mitigation measures of the proposed Thika Road MSD Power Project during its construction, operational and decommissioning phases, based on the Chapters on Environmental Impacts and Mitigation Measures of the expected Negative Impacts. Rough estimates of the costs of mitigation measures have been proposed.

9.2 Construction phase EMP

Environmental Management Plan for the construction phase is as shown on the Table 6 below.
Table 6: Environmental Management Plan during CONSTRUCTION PHASE of Thika Road MSD Power Project

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Minimize extraction site impacts and ensure efficient use of raw materials in construction</td>
<td>1. Source building materials from local suppliers who use environmentally friendly processes in their operations.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>Demand of Raw material</td>
<td>2. Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td>3. Ensure that damage or loss of materials at the construction site is kept minimal through proper storage.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4. Use at least 5%-10% recycled refurbished or salvaged materials to reduce the use of raw materials and divert material from landfills.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>2. Minimize vegetation disturbance at and or around construction site</td>
<td>1. Ensure proper demarcation and delineation of the project area to be affected by construction works.</td>
<td>Contractor, Resident Project Manager</td>
<td>1 month</td>
<td>3,000</td>
</tr>
</tbody>
</table>
## Expected Negative Impacts

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Specify locations for vehicles and equipment, and areas of the site which should be kept free of traffic equipment, and storage.</td>
<td>Civil Engineer and Resident Project Manager</td>
<td>1 month</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>3. Designate access routes and parking within the site.</td>
<td>Civil Engineer and Resident Project Manager</td>
<td>1 month</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td>4. Introduction of vegetation (trees, shrubs and grass) on open spaces and around the project site and their maintenance.</td>
<td>Architect &amp; Landscape specialist</td>
<td>Monthly to Annually</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>5. Design and implement an appropriate landscaping programme to help in re-vegetation of part of the project area after construction.</td>
<td>Architect &amp; Landscape specialist</td>
<td>2 months</td>
<td>10,000</td>
<td></td>
</tr>
</tbody>
</table>

### 3. Reduce storm-water runoff and soil erosion

| Increased storm water, runoff and soil erosion                | 1. Surface runoff and roof water shall be harvested and stored in reservoirs so that it can be used for wetting and/or cooling purposes. | The Civil Engineer, Mechanical Engineer, and Resident Project Manager | 2 months            | 10,000     |
|                                                              | 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 will be designed. | The Civil Engineer, Mechanical Engineer, and Resident Project Manager | 1 month             | 10,000     |
### Expected Negative Impacts

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Apply soil erosion control measures such as levelling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil.</td>
<td>Use soil erosion control measures such as levelling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil.</td>
<td>The Civil Engineer, Mechanical Engineer and Resident Project Manager</td>
<td>1 months</td>
<td></td>
</tr>
<tr>
<td>4. Ensure that construction vehicles are restricted to use existing graded roads</td>
<td>Ensure that construction vehicles are restricted to use existing graded roads</td>
<td>Contractor</td>
<td>Throughout construction period</td>
<td></td>
</tr>
<tr>
<td>5. Ensure that any compacted areas are ripped to reduce run-off.</td>
<td>Ensure that any compacted areas are ripped to reduce run-off.</td>
<td>Contractor</td>
<td>2 months</td>
<td></td>
</tr>
<tr>
<td>6. Site excavation works to be planned such that a section is completed and rehabilitated before another section begins.</td>
<td>Site excavation works to be planned such that a section is completed and rehabilitated before another section begins.</td>
<td>Resident Project Manager</td>
<td>Throughout construction period</td>
<td></td>
</tr>
<tr>
<td>7. Interconnected open drains will be provided on site.</td>
<td>Interconnected open drains will be provided on site.</td>
<td>Civil Engineer</td>
<td>Throughout construction period</td>
<td></td>
</tr>
<tr>
<td>8. Roof catchments will be used to collect the storm water for some office uses.</td>
<td>Roof catchments will be used to collect the storm water for some office uses.</td>
<td>Civil Engineer</td>
<td>Throughout construction period</td>
<td></td>
</tr>
<tr>
<td>9. Construction of water storage tanks to collect storm water for office and plant uses.</td>
<td>Construction of water storage tanks to collect storm water for office and plant uses.</td>
<td>Civil Engineer</td>
<td>Throughout construction period</td>
<td></td>
</tr>
</tbody>
</table>

### 4. Minimize solid waste generation and ensure efficient solid waste management during construction

| Increased solid waste generation | Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Reduction at source 2. Recycling 3. Reusing 4. Incineration 5. Sanitary landfilling. | Responsible Party & Contractor | Throughout construction period | 10,000     |
## Expected Negative Impacts

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Through accurate estimation of the dimensions and quantities of materials required.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>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</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>12,000</td>
</tr>
<tr>
<td>5.</td>
<td>Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at site</td>
<td>Resident Project Manager, Mechanical Engineer &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>Dispose waste more responsibly by contracting a registered waste handler who will dispose the wastes at designated sites or landfills only.</td>
<td>Resident Project Manager, Mechanical Engineer &amp; Contractor</td>
<td>Throughout construction period</td>
<td>10,000/month</td>
</tr>
<tr>
<td>8.</td>
<td>Waste collection bins to be provided at designated points on site</td>
<td>Resident Project Manager, Mechanical Engineer &amp; Contractor</td>
<td>Throughout construction period</td>
<td>40,000</td>
</tr>
</tbody>
</table>

### 5. Air Pollution

<table>
<thead>
<tr>
<th>Dust emission</th>
<th>1. Ensure strict enforcement of on-site speed limit regulations</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>5,000</td>
</tr>
</tbody>
</table>
### Expected Negative Impacts

<table>
<thead>
<tr>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Avoid excavation works in extremely dry weather</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>3. Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>30,000 per month</td>
</tr>
<tr>
<td>4. Personal Protective equipment to be provided to employees and worn</td>
<td>Resident Project Manager</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
</tbody>
</table>

### Exhaust emission

<table>
<thead>
<tr>
<th>Expected Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Vehicle idling time shall be minimised</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>2. Alternatively fuelled construction equipment shall be used where feasible equipment shall be properly maintained</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td>3. Sensitise truck drivers to avoid unnecessary revving engines of stationary vehicles and to switch off engines whenever possible</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
</tbody>
</table>

### Minimization of Noise and Vibration

<table>
<thead>
<tr>
<th>Expected Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sensitise construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>Routine site operation</td>
</tr>
<tr>
<td>2. Sensitise construction drivers to avoid revving of vehicle engines or hooting</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>Routine site operation</td>
</tr>
<tr>
<td>3. Ensure that construction machinery are kept in good condition to reduce noise generation</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>10,000</td>
</tr>
</tbody>
</table>
### Environmental Impact Assessment Project Report

#### Expected Negative Impacts

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4. Ensure that all generators and heavy duty equipment are insulated or placed in enclosures (containers) to minimize ambient noise levels.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Trees to be planted around the site to provide some buffer against noise propagation</td>
<td>Resident Project Manager &amp; all site foreman</td>
<td>Throughout construction period</td>
<td>4,000</td>
</tr>
<tr>
<td></td>
<td>6. The noisy construction works will entirely be planned to be during daytime when most of the neighbours will be at work.</td>
<td>Resident Project Manager &amp; all site foreman</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Minimization of Energy Consumption

<table>
<thead>
<tr>
<th>Increased energy consumption</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Ensure electrical equipment, appliances and lights are switched off when not being used</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2. Install energy saving bulbs/tubes at all lighting points instead of incandescent bulbs which consume higher electric energy</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td>3. Plan well for transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>4. Monitor energy use during construction and set targets for reduction of energy use.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>5,000</td>
</tr>
<tr>
<td>Expected Negative Impacts</td>
<td>Recommended Mitigation Measures</td>
<td>Responsible Party</td>
<td>Time Frame</td>
<td>Cost (Ksh)</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------</td>
<td>-------------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>9. Minimize water consumption and ensure more efficient and safe water use</td>
<td>1. Water to be brought in from the City Water and Sewerage Company</td>
<td>Mechanical Engineer and Resident Project Manager</td>
<td>Throughout construction period</td>
<td>5,000 per unit</td>
</tr>
<tr>
<td></td>
<td>2. Harness rainwater for office &amp; gardening</td>
<td>Mechanical Engineer and Resident Project Manager</td>
<td>Throughout construction period</td>
<td>5,000 per unit</td>
</tr>
<tr>
<td></td>
<td>3. Install water conserving taps that turn-off automatically when water is not being used</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>40% more than price of ordinary taps</td>
</tr>
<tr>
<td></td>
<td>5. Promote recycling and reuse of water as much as possible</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>6. Install a discharge meter at water outlets to determine and monitor total water usage</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>7. Promptly detect and repair of water pipe and tank leaks</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>1,000 per month</td>
</tr>
<tr>
<td></td>
<td>8. Sensitise construction workers to conserve water by avoiding unnecessary toilet flushing etc.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>9. Ensure taps are not running when not in use</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Throughout construction period</td>
<td>1,000</td>
</tr>
<tr>
<td>10. Minimize release of liquid effluent</td>
<td>1. Provide means for handling/treating sewage generated at the construction site</td>
<td>Mechanical Engineer &amp; Resident Project Manager</td>
<td>One-off</td>
<td>30,000</td>
</tr>
</tbody>
</table>

**High Water Demand**
### Environmental Impact Assessment Project Report

#### Expected Negative Impacts

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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</td>
<td>Mechanical Engineer &amp; Resident Project Manager</td>
<td>Throughout construction period</td>
<td>2,000/month</td>
</tr>
<tr>
<td></td>
<td>3. Monitor effluent quality regularly to ensure that the stipulated discharge rules and standards are not violated</td>
<td>Mechanical Engineer &amp; Resident Project Manager</td>
<td>Throughout construction period</td>
<td>2,000/month</td>
</tr>
</tbody>
</table>

#### 11. Minimize occupational health and safety risks

<table>
<thead>
<tr>
<th>Statutory Requirements</th>
<th>Worksite Safety and Health Hazards to employees</th>
<th>Provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure compliance with The OSHA (Building Operations and Works of Engineering Construction Rules), L.N. 40 of 1984</td>
<td>Ensure compliance with the Occupational Safety and Health Act (OSHA) 2007 provisions e.g. employees to be provided with appropriate PPE</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>During the construction period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5,000</td>
</tr>
</tbody>
</table>

#### 12. Minimize Oil Spills

<table>
<thead>
<tr>
<th>Oil spills</th>
<th>Provisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install oil trapping equipments in areas when there a likelihood of oil spillage such during the maintenance of construction equipment. Soil in such an area will be well protected from contamination</td>
<td>Resident Project Manager</td>
</tr>
</tbody>
</table>
9.3 Operational Phase 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 operational phase of proposed 80 MW in Thika Road MSD Power Project, are outlined in this section.

Table 7 below indicates the operational phase EMP.
<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Provide solid waste handling facilities such as rubbish bags and skips</td>
<td>Resident Project Manager</td>
<td>One-off</td>
<td>20,000</td>
</tr>
<tr>
<td></td>
<td>3. Ensure that solid wastes generated at the plant are regularly disposed of appropriately at authorised disposal sites</td>
<td>Resident Project Manager</td>
<td>Continuous</td>
<td>15,000/month</td>
</tr>
<tr>
<td></td>
<td>4. Ensure that wastes generated at the plant are efficiently managed through recycling, reuse and proper disposal procedures.</td>
<td>Resident Project Manager</td>
<td>Continuous</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5. A private company to be contracted to collect and dispose solid waste on regular intervals</td>
<td>Resident Project Manager</td>
<td>Continuous</td>
<td>30,000 per month</td>
</tr>
<tr>
<td>2. Minimise risks of sewage release into environment</td>
<td>1. Provide adequate and safe means of handling/treating sewage generated at the plant</td>
<td>Resident Project Manager &amp; Mechanical Engineer</td>
<td>One-off</td>
<td>40,000</td>
</tr>
</tbody>
</table>
## Expected Negative Impacts

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Conduct regular inspections for sewage pipe blockages or damages and fix appropriately</td>
<td>Resident Project Manager &amp; Mechanical Engineer</td>
<td>Continuous</td>
<td>500 per inspection</td>
</tr>
<tr>
<td></td>
<td>3. Ensure regular monitoring of the sewage discharged from the project to ensure that the stipulated sewage/effluent discharge rules and standards are not violated</td>
<td>Resident Project Manager &amp; Mechanical Engineer</td>
<td>Continuous</td>
<td>500/parameter</td>
</tr>
</tbody>
</table>

## Minimize energy consumption

### High demand for energy

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Switch off electrical equipment, appliances and lights when not being used</td>
<td>Resident Project Manager</td>
<td>Continuous</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2. Install occupation sensing lighting at various locations such as storage areas which are not in use all the time</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>10-40% higher than ordinary lighting</td>
</tr>
<tr>
<td></td>
<td>3. Install energy saving fluorescent tubes at all lighting points within the plant instead of bulbs which consume higher electric energy</td>
<td>Resident Project Manager &amp; Occupants</td>
<td>One-off</td>
<td>10-40% higher than ordinary lighting</td>
</tr>
<tr>
<td></td>
<td>4. Monitor energy use during the operation of the project and set targets for efficient energy use</td>
<td>Resident Project Manager</td>
<td>Continuous</td>
<td>2,000/month</td>
</tr>
<tr>
<td></td>
<td>5. Sensitise the plant workers to use energy efficiently</td>
<td>Resident Project Manager</td>
<td>Continuous</td>
<td>500/month</td>
</tr>
</tbody>
</table>
## Expected Negative Impacts

### High water demand

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Minimize water consumption and ensure more efficient and safe water use</td>
<td>1. Promptly detect and repair of water pipe and tank leaks</td>
<td>Resident Manager &amp; Mechanical Engineer</td>
<td>Continuous</td>
<td>2,000/month</td>
</tr>
<tr>
<td></td>
<td>2. Plant workers to be sensitized on water conservation techniques.</td>
<td>Resident Manager &amp; Mechanical Engineer</td>
<td>Continuous</td>
<td>500/month</td>
</tr>
<tr>
<td></td>
<td>3. Ensure taps are not running when not in use</td>
<td>Resident Manager &amp; Mechanical Engineer</td>
<td>Continuous</td>
<td>500/month</td>
</tr>
<tr>
<td></td>
<td>4. Install water conserving taps that turn-off when water is not being used</td>
<td>Resident Manager &amp; Mechanical Engineer</td>
<td>One-off</td>
<td>40% more than ordinary taps</td>
</tr>
<tr>
<td></td>
<td>5. Install a discharge meter at water outlets to determine and monitor total water usage</td>
<td>Resident Manager &amp; Mechanical Engineer</td>
<td>One-off</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>6. Create water conservation awareness</td>
<td>Resident Manager &amp; Mechanical Engineer</td>
<td>Continuous</td>
<td>2,000</td>
</tr>
</tbody>
</table>

## 5. Minimization of health and safety impacts

<table>
<thead>
<tr>
<th>Increased health and safety impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Implement all necessary measures to ensure health and safety of the plant workers and the general public during operation of the MSD Power Plant as stipulated in the Occupational Safety and Health Act, 2007</td>
<td>Resident Manager, Mechanical Engineer, &amp; Developer</td>
<td>Continuous</td>
<td>0</td>
</tr>
</tbody>
</table>
### 6. Ensure the general safety and security of the MSD Power Plant and surrounding areas

<table>
<thead>
<tr>
<th>Increased general safety and security impacts</th>
<th>Ensure the general safety and security at all times by providing day and night security guards and adequate lighting within and around the premises.</th>
<th>Security Officer, Resident Project Manager &amp; Police</th>
<th>Continuous</th>
<th>10,000/month</th>
</tr>
</thead>
</table>

### 7 Increased Pressure on Infrastructure

| 1. Coordinate with other planning goals and objectives for region | Architect, Project Manager, and the Developer | Continuous | |
| 2. Upgrade existing infrastructure and services, if and where feasible. | Architect, Project Manager and the Developer | Continuous | 40,000 |

### 8 Air Pollution

| 1. Suitable wet suppression techniques need to be utilized in all exposed areas | Site Safety Officer | Continuous |
| 2. Enforce low speed limits for vehicles moving within the site | Site Safety Officer | Continuous | 20,000 |
| 3. Use of low sulphur fuel to run the engines to be encouraged | Resident project manager | Continuous |
| 4. The stack chimney of the generators will be increased from its normal height of at least 30 metres | Site Safety Officer, Architect, Project Manager, and the Developer | Continuous | 5,000 per month |
| 5. Annual air sample analysis | Project Operator | Annually | 200,000 |

### 9 Noise pollution

| 1. Installation of silencers on the generators | Site Safety Officer, Architect, Project Manager, and the Developer | Continuous |
| 2. Provision of personal protective equipment for workers in | | |
| 3. Do annual noise measurements. | | |
| 4. Do employee medical examination | | |
9.4 Decommissioning Phase EMP

In addition to the mitigation measures provided in the above two tables, it is necessary to outline some basic mitigation measures that will be required to be undertaken once all operational activities of the proposed MSD Power Plant Project in Thika Road 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 MSD power plant project are outlined in the Table 8 below.
### Table 8: Environmental management/monitoring Plan for the decommissioning phase of MSD Power Plant Project.

<table>
<thead>
<tr>
<th>Expected Negative Impacts</th>
<th>Recommended Mitigation Measures</th>
<th>Responsible Party</th>
<th>Time Frame</th>
<th>Cost (Ksh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. All machinery, equipment, structures and partitions that will not be used for other purposes must be removed and recycled/reused as far as possible or they be taken to a licensed waste disposal site</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>0</td>
</tr>
<tr>
<td>2. Rehabilitation of project site</td>
<td>1. Implement an appropriate re-vegetation programme to restore the site to its original status</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>2. Consider use of indigenous plant species in re-vegetation</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>One-off</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3. Trees should be planted at suitable locations so as to interrupt slight lines (screen planting), between the adjacent residential area and the development.</td>
<td>Resident Project Manager &amp; Contractor</td>
<td>Once-off</td>
<td>0</td>
</tr>
</tbody>
</table>
Annex I

Land Sale Agreement
Annex II

Public Consultation Forms
Annex III

ENVIRONMENTAL SAMPLES ANALYSIS REPORTS
1. Air Quality Monitoring Survey Report
2. Noise Survey Report
3. Soil Test Results
Annex IV

Site Photographs
Environmental Impact Assessment Project Report

Plate 1: Nairobi-Nanyuki railway line at the proposed project site

Plate 2: Existing coffee plantation at the proposed site

Plate 3: The existing Thika road as seen from the proposed site

Plate 4: Bushy section of the railway reserve at the proposed site

Plate 5: Old Thika road, now owned by individuals

Plate 6: Rocky section on the proposed site.