PROPOSED SOUTH GEM SUGAR FACTORY

Environmental and Social Impact Assessment Study Report

Picture showing a cross section of the project site

Location:	Kanyilaji Village, West Gem Location, Wagai Division, Gem Sub-County, Siaya County.
Plot Nos:	South Gem/Wagai/541
Site GPS Coordinates:	Latitude: 00º 00‘ 27.60’’N, Longitude: 34º26’20.91” E

PROJECT PROPONENT:
South Gem Sugar Company Ltd
P O Box 2297 – 40100
KISUMU, Kenya
Tel: +2545733614247

EIA LEAD EXPERT:
George Adhoch
EIA/EA Lead Expert
NEMA Reg. No. 2356
Box 425 – 40100 Kisumu
Tel: 0725237189

May, 2017

Certification

This Environmental and Social Impact Assessment (ESIA) Study Report was prepared in accordance with the Environmental Management and Coordination (Amendment) Act, 2015 and the Environmental Impact Assessment and Audit Regulations 2003 for the proposed the proposed South Gem Sugar Factory Ltd of Kanyilaji Village, Wagai Division of Siaya County. I, George Adhoch, confirm that to the best of my knowledge, the contents of this report are an accurate and truthful representation of all findings as relating to the project.

Lead EIA/Audit Expert

Mr. George Adhoch

NEMA Registration: ……2356

Signature ……..

Date ……

Project Proponent

Name of Proponent/Proponent's Representative ……..

Signed ……

Date ……

Participating Experts

Mr. George Adhoch	**Lead Expert** Environmentalist NEMA Reg. No. 2356
Ms Jackob Owiti Oduk	**Associate Expert** Environmental Management NEMA Reg. No. 6672
Mr. Willis Opiyo	**Associate Expert** BSc Environmental Sciences (with Information Technology) NEMA Reg. No. 7633
Eng. Gabriel Olale	**Civil Engineer**
Eng. Jared OketchOkumu	**BSc (Hons) Civil Engineering**

Acronyms

CBD	Convention on Biodiversity
CBO	Community Based Organizations
CDM	Cleaner Development Mechanism
CITES	Convention on International Trade on Endangered Species
EA	Environmental Audit
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act 1999
EMP	Environmental Management Plan
EMS	Environmental Management Systems
ESA	Ecologically Sensitive Areas
ETP	Effluent Treatment Plant
EU	European Union
FAO	Food and Agriculture Organization
HIV	Human Immune Virus
IFAD	International Fund for Agricultural Development
IRPTC	International Register for Potentially Toxic Chemicals
KP	Kenya Power
KWS	Kenya Wildlife Service
MOH	Medical Officer of Health
MW	Mega Watt
NEAP	National Environmental Action Plan
NEC	National Environmental Council
NEMA	National Environmental Management Authority
NET	National Environment Tribunal
NETF	National Environment Trust Fund
NGO	Non-Governmental Organizations
PCC	Public Complaints Committee
SERC	Standards and Enforcement Review Committee
SGSCL	South Gem Sugar Company Limited
SOP	Standard Operating Procedures
TOR	Terms of Reference
UNEP	United National Environment Program
WRMA	Water Resources Management Authority

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ACKNOWLEDGEMENTS

We, the consultants, would like to register our sincere appreciations to all those who made the entire Environmental and Social Impact Assessment (ESIA) study a success. In this regard, we would extend our thanks to the proponent, South Gem Sugar Company Limited, for appointing us to develop this detailed ESIA Report for the proposed Sugar Mill. Special thanks go to the area provincial administration especially the area Chief, Mr. Michael Owiti and Assisstant Chief, Mrs. Eunice Ayuoyi for the support they gave us in mobilizing the community for public meeting and during the study period.

We would like to appreciate the contribution of all the stakeholders and the general public for their contributions during public meeting and consultations.

EXECUTIVE SUMMARY

Introduction:

This is an ESIA study report for proposed establishment of a 1000 tcd sugar cane milling factory at Kanyilaji Village in West Gem, Wagai Division of Siaya County to be developed by South Gem Sugar Company Limited. The proponent carried out an ESIA Project and Study Reports in 2011/2012 and submitted to NEMA under Ref **Number NEMA/EIA/5/2/893.** The study report review process stalled due to breakdown of communication between NEMA and client. Due to this there was a time lapse and the proponent was therefore advised to reapply.

Pursuant to this, the proponent contracted Mr. George Adhoch, EIA Expert to carry out an ESIA Study for the proposed project. This Environmental Impact Assessment (EIA) Study Report study was undertaken pursuant to the requirements stipulated by the National Environmental Management Authority (NEMA) under the Environmental Management and Coordination (Amendment) Act (2015) that requires all development projects listed under Schedule II (8) (c) of the Act, to undergo an EIA Study to determine its potential adverse impacts and thereby devise appropriate mitigation measures. The EIA/EA Lead expert has prepared a Terms of Reference for the Study which will be submitted to NEMA.

Project Proponent

The Proponent, South Gem Sugar Factory Ltd is under the proprietorship of Mr. Surendra Patel. Mr. Patel is also the proprietor of Foam Mattress Ltd in Kisumu, and various other businesses. He is a Kenyan, borne and bred in Kisumu whose parents started business in a small kiosk in Kisumu selling groceries. The business has grown and now he is a prolific businessman who has built up the Tuffoam brand of mattresses with a regional market in east and central Africa. His businesses include manufacturing and sales of mattresses, PVC pipes, tanks and barbed wire, chain link and other steel products. He has a form mattress factory in Nairobi and is a well known industrialist with vast properties in Kisumu and other parts of the country. He is currently undertaking the construction of a large scale commercial mall in Kisumu CBD among various other investments. Mr. Patel has noted the gap in sugar production in the country and is intending to invest in a sugar processing factory in Siaya County which has no sugar factory at present but has a huge capacity of land lying idle that can be utilized for sugar cane production and that can provide a cash crop for the local community.

Current site status and land use

The site is currently an open inhabited field with scattered homesteads in the neighbourhood. A barbed wire fence had been erected around the project site. The entire plot is covered by grasses, forbs, herbs and few trees that will be cleared to allow for the construction.

ESIA Process Approach and Methodology

A comprehensive ESIA was undertaken because of the magnitude and complexity of the issues associated with the proposed sugar factory project. The general steps followed during the assessment included:-

- Environment screening, during which the proposed sugar factory project was identified as among those requiring to be subjected to the ESIA process as stipulated

under Schedule 2 of Kenya Gazette Supplement No.74 (Acts No. 5) EMCA amendment, 2015,

- Environmental scoping that provided the key environmental issues to be considered,
- Desktop studies and documentary review of relevant reports, legal, institutional and policy frameworks,
- Physical inspection and assessment of the proposed factory site,
- Analysis of project alternative options,
- In-house consultative meetings with the proponent,
- Comprehensive baseline field environmental assessment,
- Intensive stakeholder engagement and consultations,
- Comprehensive project impact analysis,
- Impact mitigation planning,
- Environmental management planning and preparation of an ESMP,
- EIA report writing.

Project Description

The sugar factory, to be located on Plot LR. No 541 at Kanyilaji Village in West Gem Location, Wagai Division, Gem District of Siaya County. The proponent has acquired a total land area of 8.8ha. Its objectives include the installation of a 1000 tcd vacuum pan sugar processing mill for the production of 2.5 tons of milled sugar per day; encourage the outgrowers to produce sugar cane by providing assistance in land preparation, seed and fertilizers at cost and to produce ethanol. The project will create employment and business opportunities.

The project will generate income from the purchase and milling of cane from the outgrowers and the nucleus farm for the production of brown and mill white sugar, and molasses. It will utilize approximately 48,000 ltrs of water from River Yala per day which it will pump and treat in its own water treatment plant. The water will be used for process and for administrative and domestic purposes. The effluent will be treated in two large lagoons after which it will be passed through an artificial wetland before being discharged into the River.

The proposed sugar unit of 1000 TCD will require 7,000- 8,000 hectares area under sugar cane cultivation with the expected average yield of 60 M.T./ha., so that, the mill can crush a minimum of 0.16 millions tonnes of cane every year allowing the rest for seed, feed, chewing and Jaggery or other uses. Presently there is no sugar factory in the near by area and hence no problem is fore seen in getting the adequate quantity of sugar cane once it is developed.

Capital Cost Estimate

The capital cost estimate for the project is approximately KShs 800m

Baseline Environmental Status

The proposed project is situated within Siaya County in Gem Subcounty. However, the environmental details were collected from a radius of 10Km of the project site. The proponent has contracted an agronomist who has carried out a crop study and soil type information is available along with varieties of seed and husbandry for the use of farmers and agricultural workers in the catchment area.

Water sample was collected from one location respectively upstream of the project site. The parameters of the water samples were collected, analyzed and recorded. In the project site, the parameters of water are within the norms. Water quality test results are attached herewith.

Legislative And Environmental Setting

Various Laws and regulatory policies have been established by the relevant authorities for the control and regulations of sugar processing factories. These are considered and elaborated on within the EIA Project Report for South Gem Sugar Company Ltd. They are as mentioned hereunder:

The EMCA Act (Amendment 2015),
The Water Act, 2002;
The Public Health Act, Cap. 242;
The Physical Planning Act Cap 268,
The County Government Act, 2012
The National Construction Authority Act, 2011
The Registered Land Act, Cap 300;
The Land Control Act Cap 302
The Government Lands Act Cap 280
The Forest Act Cap 385
The Wildlife Conservation and Management Act Cap 376
The Agriculture Act, Cap 318;
The Seed and Plant Varieties Act Cap 326
Suppression of Noxious Weeds Act Cap 325
Lakes and Rivers Act Cap 409
Fertilizers and Animal Feeds Act Cap 345
Pest Control Products Act Cap 346

The proponent is advised to acquaint himself with the various Acts and regulations and adhere to them in the construction and operations phase of this project.

Prediction of Impacts

The potential impacts on the environment due to the proposed activity are identified based on the nature and extent of the various activities associated with the project implementation and operation as well as the current status of the environmental quality at the project site. Both beneficial and adverse impacts are considered. The sources of air pollution, water pollution and solid waste generation are identified and the impacts due to the above are superimposed on the existing baseline environment. Impacts such as fire hazards, increase in population and traffic, ambient noise, drainages and stormwater management, air emissions, security, environmental health and safety and occupational health and considered and measures to reduce and mitigate them are provided for in the project report.

Positive impacts

- ✓ There will be Direct and indirect employment opportunities,
- ✓ Gains in the County and national economy,
- ✓ Increased Industrial development in Siaya County,

- ✓ Attraction of premises in the factory area,
- ✓ Improved area road network,
- ✓ Improved security in the neighbourhood,
- ✓ Improved living standards,
- ✓ Corporate social responsibility (CSR) benefits.

Key potential negative impacts and recommended mitigation strategies

From the project assessment, the anticipated adverse negative impacts and recommended mitigation measures are summarized as follows:

Table 1: Impacts and mitigation measures table

Anticipated negative impact	***Recommended mitigation measures***
Increased demand of raw materials	• Construction materials will be sourced from licensed quarries and local suppliers who use environmentally friendly processes in their operations; • Accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered and to ensure that the amount of construction materials left on site after construction is kept minimal; • Ensuring that damage or loss of materials at the construction site is kept minimal through proper handling;
Generation of construction and domestic wastes	• 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; • Construction waste will be recycled or reused to ensure that materials that would otherwise be disposed of as waste are diverted for productive uses; • Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements; • Consider the use of recycled or refurbished construction materials where feasible; • On operation, the developer shall provide adequate domestic waste receptacles on site and ensure safe transportation to designated disposal sites by licensed waste handlers; • An Effluent Treatment Plant has been proposed to manage all liquid wastes from the premises, and • Contract registered waste disposal expert to transport and dispose waste from site.
Dust and air pollution	• Watering all active construction areas as and when necessary to lay dust; • A speed limit of 10km/hr shall apply to all construction

Anticipated negative impact	*Recommended mitigation measures*
	vehicles on the site; • Rehabilitation of disturbed areas once completed; • Materials transport equipment will be cleaned on a regular basis; and • Planting appropriate trees, shrubs and flowers to compensate for emissions.
Noise and vibrations	• Restriction of the work hours during the construction phase from 7 am to 6 pm Monday to Saturday; • All machinery used during construction shall be maintained in a sound mechanical condition; • Limit pick-up trucks and other small equipment to a minimum idling time and observe a common-sense approach to machine use, and encourage workers to shut them off whenever possible;
Increased vehicular along Wagai-Aluor road	• Construction vehicles to enter and leave the site through designated paths only; • Posting traffic warning signs on both approaches to the construction site to warn other road users of traffic risks; • Strict adherence to speed limits near the construction area of 10 km/hr; and • Clearly marking parking spaces, installation and maintenance of traffic guide signage.
Increased energy demand	• Sensitisation of staff to conserve non-renewable fossil energy by switching off machinery and equipment when they are not being used; • Proper planning of transportation of materials to ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts unnecessarily; • Monitoring energy use during construction/welding and operation and setting targets for reduction of energy use; and • Installation and use of energy efficient welding and lighting equipment during construction and operation respectively.
Occupational and public hazards and accidents	• Provision of appropriate Personal Protective Equipment (PPE) to construction workers; • Safety education and training for workers; • Barricading the construction area appropriately and posting public warnings; • Provision of appropriate onsite sanitary convenience for workers; • Establishing emergency procedures against hazards and

Anticipated negative impact	*Recommended mitigation measures*
	ensuring the workers stay aware/educated on following them and commensurate to the magnitude and type of emergency, by conducting regular drills and involving the neighbouring business people. • Adherence to the Occupational Health and Safety rules and regulations stipulated in the Occupational Safety and Health Act, 2007. • Providing fire fighting equipment and in easily accessible areas as well as ensuring site personnel are well trained to use them as well as maintaining them regularly.
Increased Water demand	• Employing water conservation techniques and only using the required amounts of water to prevent wastage. • Implementing water conservation techniques such as having faucets with dead man tap openers
Soil disturbance and erosion	• Levelling the disturbed site areas to reduce run-off velocity and increase infiltration of rain water into the soil; • Construction vehicles will be restricted to designated paths to avoid soil compaction within the proposed Project site; • stockpiling materials shall not be done along the road.
Food insecurity	• The proponent will ensure that sugarcane farming does not replace maize farming which is the main food crop in the area. This will be done in collaboration with relevant county government departments
Use of improper cane seeds	• The proponent will provide short maturing and high yield sugar varieties to enable farmers get their financial benefits in a short time
Improper land preparation	• The proponent will sensitize the farmers on the most appropriate methods of good land preparation including soil conservation
Cane spillage	• Sensitization of sugarcane loaders on proper sugarcane loading to avoid inconvenience other road users. The proponent will also institute measures of collecting all the spilled cane on the feeder roads
Influx of factory workers	• Employment priority will be given to the local people within the factory area
HIV/AIDS	• The proponent in partnership with the Ministry of health and county government will undertake sensitization campaigns against the spread of HIV/AIDS among the factory works and with local community members

Environmental Management Plan

Environmental Management Plan includes the protection, mitigation and enhancement measures to be implemented to reduce the adverse impact on the environment. The EMP will be a baseline document that will be utilized in the management of the environment during the construction phase, the operational phase and the decommissioning phase. Its purpose is to ensure the sustainable use of the environment and it takes into consideration mitigation measures indicated in the above chapter and provides responsibilities and approximate costs. It is important that the proponent include this within his operating budgets from the outset in order to comply with the requirements of the Law.

Conclusion

The project will play an important role in the local, county and national economy. Constant monitoring of the said aspects (impacts and mitigation) through close follow-up and implementation of the recommended Environmental Management and Monitoring Plans will also ensure its longevity and avoid conflicts between the project and stakeholders or between it and the natural world. In relation to the proposed mitigation and environmental management and planning measures that will be incorporated during construction and operation phases; and the developments' input to the proponent and the general society, the proposed project is considered beneficial and important. Major concerns should nevertheless be focused towards minimizing the occurrence of impacts that would degrade the general environment.

Considering these positive socio-economic and environmental benefits which will accrue as a result of the development, and the EIA study having found no major impacts to arise from the development, it is our recommendation that the proposed South Gem Sugar Factory in Kanyilaji Village be allowed to proceed on the understanding that the proponent and contractor will adhere to the mitigation measures recommended herein and will further still implement the proposed Environmental and Social Management and monitoring Plan (ESMP) and Environmental Monitoring Plan to the letter. NEMA should therefore issue the proponent with an EIA license as required by Kenya's environmental laws.

1. CHAPTER ONE: INTRODUCTION AND SCOPE OF STUDY

Introduction

The proponent, South Gem Sugar Company Limited under the directorship of Mr. S. M. Patel, wishes to establish a 1000 TCD sugar cane milling factory at Kanyilaji Village in West Gem, Wagai Division of Siaya County. Mr. Patel is prolific entrepreneur based in Kisumu with interests in the production and distribution of foam mattresses in the Eastern Africa Region. He has incorporated the South Gem Sugar Company Ltd for the purposes of milling sugar cane and production of sugar and ethanol from sugar processing by products molasses.

1.1 Background and Rational of the EIA Study Report

The proponent wishes to establish a sugar mill at the project site which hitherto has been agricultural. He will encourage the community to invest in sugar cane farming and will assist them with farming requirements. The area will become an industrial growth centre. The proponent carried out an EIA Project and Study Reports in 2011/2012 and submitted under Ref **Number NEMA/EIA/5/2/893.** The study report review proccess stalled due to communication breakdown between NEMA and the client. NEMA Therefore advised the proponent to reapply due to the time lapse. It is for this reason that this ESIA is carried out. This is an activity out of character with its surroundings at the proposed location and the land will have to go through change of user from agricultural land to industrial use. The development will be of a structure of a scale not in keeping with its surrounding and will encompass the establishment of an industrial estate. It is therefore included in the projects in Schedule 2 of the EMCA (Amendment 2015) that require an Environmental Impact Assessment. The proponent has contracted EIA Experts to carry out this study report.

1.2 The Need for EIA

The proposed project falls under the EIA mandatory activities listed in the second schedule of Environment Management and Coordination Act (EMCA Amendment) No 8 of 2015. The project factory constitutes a major change in land use, and will establish an industrial estate, the project will also emit raw effluent which is a waste that requires careful handling and bagasse, a solid waste that is difficult to dispose off. It will also result in air pollution that is dangerous unless well taken care of. Section 58 of EMCA, 2015, amendment requires that such projects be subjected to EIA.

1.3 Objectives of EIA

The main objective in respect to the proposed project is to guide environmentally sound decision-making. Such a decision will be on the basis of significant environmental impacts related to the project. Mitigation measures proposed will determine whether the decision to implement the project will be deferred or approved.

Specific broad objectives shall include:

i. Identification; examination and analysis of all the significant environmental and socio-economic impacts related to the proposed Sugar Factory project.
ii. Carrying out baseline surveys of the existing environmental, social and economic parameters in the project area upon which the ESIA Study is based.

iii. Identifying, examining and analyzing existing policies and institutional arrangements for effective implementation of the proposed project.
iv. Analyzing specific project alternatives in terms of site, technology, design, scale, size and extent.
v. Formulating workable, acceptable and viable environmental mitigation measures to minimize identified negative impacts.
vi. Developing an EMP specifying specific actions, responsibilities, time schedule and costs.
vii. Making appropriate conclusions and recommendations.
viii. Ensuring adequate consultation and public participation throughout the EIA process.

1.4 EIA Process

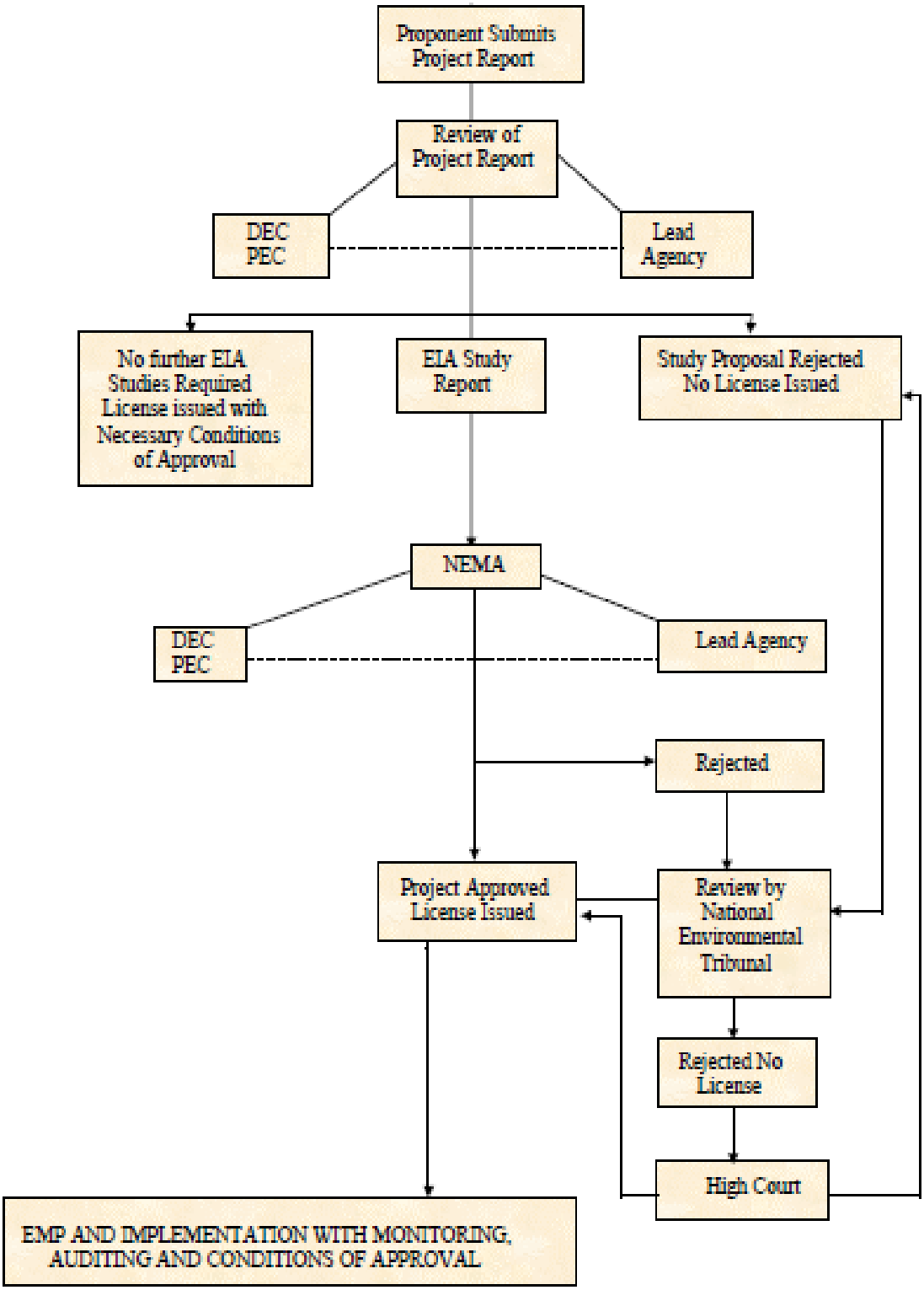
The EIA process identifies significant negative ad positive environmental impacts and proposes mitigation measures to ameliorate negative impacts. The process also provides a mechanism for auditing and monitoring and implementation of mitigation measures contained in the environmental management plan (EMP). The diagrammatic process is presented in the following flow chart.

The key steps on EIA process include:

i. Screening
ii. Scoping
iii. Identification
iv. Impact Identification
v. Assessing significant impacts
vi. Proposing mitigation measures
vii. Developing EMP

The whole process ensures effective Consultation and Public Participation (CPP). During the scoping exercise the key issues of environmental concerns were identified. A flowchart of the EIA process is illustrated here below: -

The EIA Process



1.5 Scope and Terms of Reference of the Study

1.5.1 Scope

A project proponent is required to undertake an Environmental Impact Assessment study before undertaking any project highlighted in Schedule 2 of the Environmental Management and Coorination (Amendment) Act, 2015. This study undertakes to fulfill this requirement. This report is necessary at the planning stages of the undertaking to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation, and decommissioning of the facility.

The scope of the ESIA was to undertake the following key tasks:

- Detailed desk-top review: This involves review of all existing documentation especially the EIA Project Report and then providing a concise description of the proposed sugar mill including its geographic, ecological, general layout of facilities including maps at appropriate scale where necessary information on size, capacity, facilities and services should also be provided.
- Description of the baseline environment: This involves collecting and documenting the baseline information on the environmental characteristics of the existing situation in the proposed factory site and neighborhood. This description will consider:
  - ✓ Physical environment which include topography, soils, land cover, landuse, climate, hydrology and drainage, and sound levels.
  - ✓ Biological environment comprising of flora and fauna types and diversity, endangered species, sensitive habitats.
  - ✓ Social and cultural environment present and projected population, land use, planned development activities, community social structure, social services, road networks, employment and labour market, sources and distribution of income, cultural/religious sites and properties, vulnerable groups and indigenous populations.
  - ✓ Economic activities.
- Occupational health and safety concerns: The Consultant will analyze and describe all occupational health and safety concerns brought about by activities during all the phases of the project. The Consultant was also expected to make recommendations on corrective and remedial measures to be implemented under the environmental management plan.

- Determination of impacts of project facilities and activities: From the detailed baseline environmental assessment, the Consultants will analyze and describe all significant changes brought about by each project activity. These would encompass environmental, ecological and social impacts, both positive and negative, as a result of each facility/activity intervention that are likely to bring about changes in the baseline environmental and social conditions. The Consultant will make a prioritization of all concerns identified and differentiate between short, medium, long-term and cumulative impacts during construction, operation and decommissioning. The Consultant will identify both temporary and permanent impacts.
- Legislative and regulatory framework: to identify and describe the pertinent and relevant regulations and standards for the proposed sugar factory - both local and

international, governing the environmental quality, health and safety, protection of sensitive areas, land use control at the national and local levels and ecological and socio-economic issues. The project activities that comply with the identified regulations will also be detailed.

- Development of management plan to mitigate negative impacts: The Consultant was expected to develop a comprehensive environmental management plan. The plan would recommend a set of mitigation, monitoring and institutional measures to eliminate, minimize or reduce to acceptable levels of adverse environmental impacts and/or maximize socio-economic benefits. The Consultant will provide details on the institutional, time frame and responsibility for long term environmental management of the proposed sugar mill.
- Development of an environmental monitoring plan: The Consultants will give a specific description, and technical details of environmental monitoring measures, including the parameters to be measured, methods to be used, monitoring locations, and frequency of monitoring.
- Preparation of Environmental and Social Impact Assessment Study Report in accordance with the regulatory provisions.
- The Consultant shall submit the report for approval by NEMA. The Consultant shall be responsible for making any modifications that the authorities may demand before approval of the report and issuance of an EIA License.

1.5.2 Terms of Reference

The following were the terms of reference:

i) Prepare the TOR for submission to NEMA for consideration and approval.
ii) Hold meetings with the project proponent, and other stakeholders to establish the procedures, define requirements, responsibilities and a time frame.
iii) Carry out a detailed systematic environmental assessment at the proposed project site and the surrounding area in line with established standards and laws.
iv) Provide a description of the proposed activities throughout the entire implementation process of the project with a special focus on potential impacts to the surrounding environment and facilities.
v) To provide a description of the location of the proposed development project
vi) To provide a concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
vii) To provide objectives of the proposed project.
viii) To provide a description of the potentially affected environment.
ix) To identify environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
x) To recommend a specific environmentally sound and affordable wastewater and solid waste management system.
xi) To provide alternative technologies and processes available and reasons for preferring the chosen technology and processes.
xii) To analyse of alternatives including project site, design and technologies.
xiii) To prepare an Environmental Management/Monitoring Plan proposing the measures

for eliminating, minimizing/mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.

xiv) To provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the cause of carrying out development activities.

xv) To propose measures to prevent health hazards and to ensure security in the working environment for the employees, residents and for the management in case of emergencies.

xvi) Produce an Environmental & Social Impact Assessment report that contain among other issues potential negative and positive impacts and recommendation of appropriate mitigation measures to minimize or prevent adverse impacts.

xvii) Such other matter as NEMA may require.

1.6 Methodology

After preliminary visits to the proposed site, the following were carried out in the preparation of this document:

i. Observations, discussions with stakeholders in the project area and lead agencies
ii. Documentary review of the nature of the proposed project including review of the various documents and EIAs of similar projects prepared hitherto;
iii. Policy and legal frameworks, social and environmental setting of the area;
iv. Public consultations through public meetings and questionnaire administration.
v. Checklists were prepared to identify possible environmental and human safety issues, photography, etc;
vi. Preparation of terms of reference and discussions with the proponent
vii. Identification of significant impacts and mitigation measures for each identified negative impact
viii. Preparation of Environmental Management and Monitoring framework
ix. Report writing

1.7 Reporting and Documentation

The reporting and documentation follows on the format provided by NEMA through both EMCA, 1999 (Rev. 2015) and the Environmental Impact Assessment and Audit Regulations-Legal Notice No.101 of 2003. The proponent was continually informed throughout the period of report preparation to ensure that he was aware of the issues raised and the recommendations that were likely to be made regarding the best practices to mitigate environmental impacts.

CHAPTER TWO: PROJECT DESCRIPTION AND ACTIVITIES

Project site Location

The proposed Sugar Factory site is in Kanyilaji Village, West Gem Location, Wagai Division, Gem Sub-County in Siaya County. The project site is located about 6 km from Kisumu-Siaya road at the junction of Wagai and 49 km from Mumias Sugar factory; some 20 km from Uhembo Nyalgugu Jaggery in Siaya Market, 39 km to Butere Jaggary from Yala Town. The site is on Plot No. South Gem/Wagai 541. The GPS Coordinates for the site are Latitude: 00º00'27.60''N, Longitude: 34º26'20.91" E.

A gravel access road traverses across the project site. An adjacent access road joining Wagai and Aluor was under improvement into bitumen standard at the time of this assessment.

Plate 1: Satellite image of the project area

Plate 2: Powerline traversing the site

Plate 3: Gravel road traversing the project site

2.1 Goals of the Project

The project is expected to

i. assist Kenya to meet the existing sugar deficit of 250,000 tonnes per year.
ii. reverse the current trend of continuous importation of sugar into the country thereby draining the country's foreign exchange and job exportation.

Thus, the purpose of the project is to increase Kenya's competitiveness in the sugar sector and to meet domestic sugar demand.

2.2 Project Objectives

In order to achieve these goals, the objectives of the project are as follows: -

i) Expand production of sugar cane in the nucleus farms and outgrowers fields
ii) Construct and establish a sugar processing mill;
iii) Create employment for operating the sugar processing mill by engaging professionally qualified individuals;

2.3 Justification for the Project

Gem Subcounty is endowed with suitable natural conditions for increased sugarcane production and expansion. Successful sugarcane growing requires an altitude of 110-1500masl, an average of 1500mm of rainfall and a temperature range of 20°C - 30°C.

A total of 34,400 ha of land in Gem Subcounty falls under UM1, LM1 and LM2 which are suitable for sugarcane production and largely distributed in Yala and Wagai Divisions. With an annual rainfall of 1300–2000mm, temperature range of 15°C to 30°C and altitude range between 1140 and 1420masl, cane production should gain prominence much more than it is currently in order to boost the economy toward the national level and reduce poverty levels from its current level of 58.2%. The development zone will definitely increase farm household incomes and promote sugarcane as the main cash crop.

The Government of Kenya has long identified Gem as a viable location for a sugar milling factory. A study carried out by the Ministry of Agriculture in 2011 confirmed that approximately 8,400 tons cane per day can be supplied to sugar factories in Siaya County. The proposed factory will require approximately 1000 – 1250 tcd and is so far the only sugar factory proposed for the County. In order to improve on the existing poverty level in the district, sugarcane which is a leading cash crop in the western region of Kenya should intensively be developed. Population growth is high and calls for concerted efforts towards provision of more food, housing, education, health care, security and employment. Road network and transport facilities will also be inadequate due to increased population density and will call for opening and maintaining access roads.

The labour force in the district forms 46% of the population. The DDP recommend the informal sector and agriculture as sectors to encourage creating jobs and absorbing labour. The district poor are found mainly among farmers, unemployed juakali artisans and petty traders, unskilled and semi-skilled labourers, HIV/AIDS orphans and female headed households.

The establishment of the South Gem Sugar Factory will absorb labour and provide the local community with a cash crop which the company will assist them to develop thereby giving the area potential for alleviation of poverty, increase in employment opportunities, growth and food security. It is a most desirable industry for the district.

2.4 Project Description

The company's operations will include the following: -

i) Production of sugar cane in its nucleus estate and out-growers' fields;
ii) Processing white sugar from harvested sugar cane at its sugar mill at Kanyilaji in West Gem Location;
iii) Generating electricity; and
iv) Producing ethanol and molasses.

2.4.1 Nature of the Project

The project involves a new vacuum pan plant consisting of a 1,000 tcd sugar milling plant, with possibilities of upgrading to a 2,000-tcd capacity. The vacuum pan process employs intermediate automatic technology, which is, not labour intensive, and requires no more than medium level production staff cadres for its operation and maintenance. It captures a

high percentage of sugar in molasses such that no product is wasted, thus making the project more viable and cost effective. This inevitably results in low production overheads and ultimately low pricing of products at the consumer end.

2.4.2 Project Components

i) Land

The proposed project has already procured a 8hectare parcel of land to construct the envisaged 1,000-tcd factory and at the same time for the residential premises. The same parcel, which is on the main murram road, will be used to as the main access road to the factory, incoming and out of the premises. Additional land parcels will be acquired at appropriate time for further expansion and for nucleus estates.

ii) Buildings

The total factory area is approximately 8ha and will be constructed using locally available materials including blocks, cement, ballast and timber, all obtained from nearby suppliers or from Kisumu City. The buildings to be constructed will mainly consist of the factory structures and the following: -

a) Workshops,
b) Administrative ffices,
c) Weighbridge house,
d) Cane yard,
e) Mill House,
f) Power house,
g) Sugar house,
h) Effluent treatment plant,
i) Agriculture offices
j) Staff Houses, and
k) Stores.

The factory buildings will be constructed in accordance with the machinery supplier's specifications and the architectural plans layout will be contracted locally by the proponent. All the constructions will be done under the guidance of the Project Engineer.

The construction of the new factory building shall consist of concrete stub column bases as designed in structural drawings. The factory wallings shall be fabricated from a mild steel universal beams sizes of 240mm x 240mm x 89kg/m which shall include the bracings as necessary to contain the iron sheet cladding in IT5 profile. The roof of the factory shall be of steel trusses with roof covering iron sheets in IT4 profile secured onto Z purlins.

The UC 'H' beams, wall height approximately 12meters high and shall be welded together with mounting plates drilled and bolted to RC concrete stub column bases. The factory floor shall be reinforced by BRC, A142 mesh.

The factory will be surrounded by a 7 feet high perimeter wall.

iii) Machinery & Equipment

The vacuum pan sugar plant and the additional machinery, equipment for sugarcane handling and processing are to be sourced from Saba Exports in India who has already quoted for the 1,000-tcd Plant.

The sugar processing plant will consist of

a) cane handling and preparation equipment,
b) milling tandem,
c) bagasse handling facilities,
d) vacuum pan plant
e) boiling house,
f) milling house,
g) Gantry and cane yard powerhouses,
h) sugar house,
i) boiler house,
j) crystallizers,
k) sugar hopper,
l) sugar dryer,
m) rotary filter,
n) centrifugal machines,
o) molasses storage tank of 800,000 liters
p) bagging facilities,
q) workshop,
r) laboratory equipment and
s) spares.

The equipment specification for the Plant is per Annexure of the Process flow Chart and the list of equipment.

Other equipments such as tractors, trailers, lorries and motor vehicles among other supportive components form part of the machinery and equipment for the project.

iv) Effluent Treatment Plant (ETP)

The company shall construct an effluent treatment (ETP) plant with imported equipment. It is expected to retain and treat raw effluent of about 497m^3 capacity at any given time. The ETP will include a reverse osmosis plant that will be the final process for the treated effluent to ensure that the project releases into the environment effluent that complies with the NEMA quality standards for effluent discharge.

v) Fire Fighting Equipment

The factory will install a fire ring line along the factory perimeter with risers equipped with hydrants and breakglass points holding 30m long fire hoses. The ring line will be connected to a 200m^3 water tank with an automatic pump that will be used for firefighting in case of a fire outbreak. The boiler and the bagasse yard will be equipped with fire fighting sprinklers overhead with automatic nozzles that will release powerful jets of water to quench any fires in these areas backed up by the fire ring line. Other fire fighting equipment will include a fire alarm; various types of fire fighting canisters mounted along the walls of the buildings and fire hoses with lengths of 30 meters in strategic places in the factory and the factory grounds.

vi) **Manpower Requirement**

Manpower requirements are divided into two: Permanent and casual. The number of permanent staff will be 100 and casual 150. There will be three shifts in a day and each will require 65 staff for operations. There will also be a general shift with administrative and

housekeeping staff. The actual requirement in terms of manpower will be a total of approximately 300 - 350 people.

2.5 Cane Processing

The milling of cane and the processing of sugar will generally have sequence below: -

a) Cane Handling Weighbridge

Sugar care will be received at the factory premises in trucks and trailers via the weighbridge and the weight recorded by weighbridge clerks. It will then be off loaded at the cane yard by the gantry cranes, while care taken is taken to ensure that the trash and other extraneous materials are removed from the cane, before loading the product on the cane table awaiting paddling.

During this stage care is taken to ensure that cane is kept fresh, that is for not more than 48hrs after harvesting. Laboratory tests will be carried out to establish brix, pol, etc before cane is offloaded onto the mill. Old and fibrous cane will be rejected at the cane yard.

b) Cane Preparation and Milling

After paddling, the feeder or auxiliary Carrier/ Conveyor will then transfer the cane to 1st cane cutter for preliminary cane preparation, which ensures compact feeding to the 2nd mill. The 2nd cane knife then takes over the cane preparation finally feeding into a mechanical conveyor belt where the cane fibre is levelled before proceeding to a milling tandem. Through a cane fibrizor trap (magnetic iron separator) any metallic materials, which can damage the crushers are withheld. The prepared cane then enters the 1st mill, and the process of raw juice extraction begins. Here, the prepared cane is first subjected to dry crushing. Most of the extracted raw juice called *Primary juice* is produced at this stage. However, further dry crushing would not result in a complete and efficient recovery of sugar and hence water is added both at the 1st and 2nd milling tandems for compound imbibition purposes. At the end of these stages a milling extraction rate of 93% would be achieved from good facility.

At the end of the second Mill, a *biocide* is added to the juice to kill any bacterial organisms, which might be in the juice.

c) Juice Clarification

From the 3rd mill comes out the raw juice, which is transferred to the juice screen for filtering. This process separates the clear juice from the *bagacillo*. The juice is then weighed automatically in an inbuilt scale. The by-product here is bagasse, which is transferred to the boiler house for use as fuel in the factory's combustion. The raw juice is then taken to the juice heaters or Juice Clarifiers whereby milk of lime is added in appropriate proportions for purposes of clarification.

The process of juice heating is normally carried out at a temperature of up to about 70 degrees Celsius. From here, the juice is then taken to next stage by feeding it into the juice sulphitation tanks, where Sulphur dioxide is added in right proportions.
During the process of liming and Sulphitation some of the impurities in the juice such as organic acids and albuminoidal matters are removed. This process also precipitates part of the pectin and colouring matters. Sulphitation also reduces some salts in the juice to colourless compounds. The precipitates formed also assist in entrapping the suspended impurities in the juice.

The juice from the flash tanks is fed to the settling tank, whereby the suspended particles precipitate to the bottom and the clear juice overflows and is pumped to the Sugarhouse into the vacuum boiling tanks. The juice is then pumped through a rotary vacuum filter whereby all the residual sugars from the mud is also removed by incorporating the bagacillo from the cyclone hopper to facilitate the extraction. The clear juice concentrate is then taken to a settling tanks which enables not only the removal of residual gases from the juice but also ensures the feeding of juice at a constant temperature to the vacuum pan, thereby avoiding disturbance of juice settling process.

The under flows of the settling tanks (muddy juice) is then pumped to the vacuum filter where by the particles are removed and the clear juice is filtered out. The clear juice from settling tanks is pumped to the evaporator vessels, whilst the mud in the form of cake is disposed off from the vacuum filter.

d) Juice Evaporation

The clear juice from settling tank is concentrated from an initial brix of about 14 – 16 degrees to a final brix of around 80 degrees in the evaporation process using closed vacuum pans and heated by steam coils from the boilers. This ensures the concentration of the juice into supersaturated syrup, which is then fed by gravity to the crystalliser tanks.

e) Crystallization Process

During the process of crystallization, syrup undergoes the following transformations

- Formation and growth of sugar crystals
- Concentration of non sugars in the residual mother liquor

The sugar production system consists of three levels that is “A”, “B” and “C” massecutes, with sugar and molasses at all these levels. Only sugar “A” is marketed for human consumption while molasses “C” being the final by-product is used for various purposes.

2.6 By-Products

i) Molasses

The final molasses shall be pumped into a Steel bulk storage tank with a capacity of around 800m^3

ii) Bagasse

The other by-product from the cane milling process is a fibre material known as bagasse. From the proposed milling process, it is expected that the bagasse content will be about 425 kg out of every 1000 kg of cane crushed in a day.

The bagasse shall be used as fuel for the boiling pans at the wet bagasse furnace for the factory process heating. Any excess amounts can be used for the purposes of making charcoal briquettes for domestic fuel.

iii) Press Mud

The final by product of the process will be press mud from the rotary vacuum filtration area 36m^2 section of the plant; this may be used as manure for the cane fields.

There shall be continuous cane mud filter complete with bagasse silo blower mud mixer tank with drive cyclone separator. Entertainment catcher, condenser vacuum pump, filtration receiving bottle, hot water tank.

2.7 Provision for Waste Disposal and Pollution Reduction Facilities

Waste Disposal

Liquid wastes from the rotary vacuum filtration section and any other areas shall be passed through an effluent treatment works with a design capacity of about 497 m^3. The works shall consist of a screening chamber, two (2) primary chambers and a secondary chamber. After being subjected to the line separation and treatment processes, the effluents shall then be treated to acceptable BOD levels among other standards prescribed by NEMA before being discharged to the River about 50 m from the factory premises.

For grey water, the factory will construct a sizeable septic tank and soak pit that will collect all sewage and kitchen sludge at a suitable location within the factory. It will ensure that the septic tank is exhausted by NEMA registered exhausters to be dumped into the county council/municipal sewage works as appropriate.

Solid wastes such as press mud and other factory wastes (up to 1,600 kg within one month of factory operation) shall be disposed off in the farming fields within the project area, as they are biodegradable and are organically rich matter. Particularly the press mud can be used to reduce the use of chemical fertilizer as it is an excellent soil conditioner. For non-bio-degradable matter, disposal will be left to NEMA registered waste collectors e.g. waste chemical and fertilizer containers, waste papers, used materials, waste packaging materials, kitchen and domestic wastes etc.

2.7.1 Aerial Pollution Control and Fuel Reduction Options

There shall be smoke produced from the Plant in the form of a mixture of some particulate matter and gases such as carbon dioxide and others like, H_2S and CO. The effect of this shall however, be minimised if discharged through two (2) high elevation steel chimneys constructed to a height of about 25m as recommended by the Factories Act.

The factory plant shall only use bagasse and firewood for furnace starter operations, hence implying minimal smoking and wood (forest) saving measures. Bagasse shall be the main source of fuel for processing, with its combustion being in a closed environment thus making it possible for complete combustion to occur and hence allowing for higher energy saving and minimal aerial discharges.

2.8 Materials Required, Sources and Quantity

2.8.1 Cane

The factory will utilise some 1000 tcd, which will be obtained from individual out growers and Co-operative Societies. The most widely grown cane varieties by the farmers in the proposed project area include; CO421, CO 945 and N14.

In this regard, data available from the Year Book of Sugar Statistics (Kenya Sugar Board, 2003) indicate that the aforesaid highland cane varieties are estimated to have higher sugar

recovery percentages (10.4 %) as compared to those of the lowland areas like the Chemelil – Muhoroni, Mumias, Nzoia and Sony region (9.4 %).

In terms of the percentage of white crystalline sugar per min.(99.5 POL), the highland cane varieties average at around 15% as compared to about 16% fibre and 80 % primary juice purity for the lowland varieties. This is good with reference to the current industry benchmark of a POL of 12.5%.

2.8.2 Water

The Yala River is a perennial surface water source of good quality water and can be used both for industrial and domestic purposes. In terms of the latter, it is seen that a number of households do also use roof catchments as an alternative water source.

The South Gem vicinity is also well endowed with springs and wells, which are largely perennial in nature. Most of these sources do supply good quality water, which can be used for domestic supply as well as industrial purposes.

An active water management proposal geared at realizing productivity and profits as well as efficient water use by the factory shall abstract some 48,000 litres of water per day from Yala river that is just adjacent to the factory site. A strategic water supply for the factory is also desirable for purposes of emergencies and maintenance and also for quality control.

i) Water Requirement

The factory will require large volumes of water from 48m^3 per day. The installation of an overhead water tank 500m^3 storage capacity shall be installed complete with all the accessories e.g. booster water pump connected in an automatic system to generate pressure of about 60 psi up to 75 psi in terms of pressure jet on horse reels ring mains and portable fire fighting equipments in emergency of fire.

The elevated water tank shall be installed at 10m tower at a strategic place which will be very necessary to store water for commercial as well as water for firefighting equipment for use in the factory.

ii) Ground Storage Tank

A steel manufactured storage tank for 60m^3 ground tank shall be installed at strategic point and clear water from the CFU 24m^3/hr which is softening mechanism for raw water from Yala river.

iii) Composite Filtration Unit (CFU 24m^3/hr)

Water will be pumped from Yala River into a concrete pond and then passed through a treatment process with chlorine and alum. The water will then be pumped into a large tank with a capacity of 200m^3 for use in the factory and the office buildings through gravity flow.

Raw water from the river shall be treated from a masonry constructed tank complete with back wash tank 10m^3 mounted on a 6m^3 height steel tower. All equipment will comprise of softening gravel pack, sand, and dosing operators necessary for water treatment as softening plant within the factory premises. Water reticulation and distribution system will include water rising mains from the river. The size of the rising mains will be 150mm (6 inches) UPVC and 150mm and steel pipes respectively installed as designed in mechanical installation drawings.

Masonry tank of 50m^3 clear water tank capacity constructed and installed downstream of the river to receive clean water from the (CFU unit) and pumped upstream to storage tank ready for use in the factory and domestic. The installation will comprise of intake sump near the river and intake pump of 40m^3/hr. There shall be two booster pumps one far the horse reels and the other water pump shall be for pumping water from clear water.

Water tank to the elevated storage water tank capacity of 50m^3 mounted on steel tower, 10m height installed on a higher ground within factory premises.

iv) Pumping Equipment Requirement

All pumping equipments shall be connected to work automatic mechanism systems with very minimal operation man power requirement except that there is need to have pump units e.g. duty pump and stand by water booster pump in the entire water reticulation all connected and wired to operate automatically such that adequate water must be available at every stage for use by factory, firefighting equipment and domestic use. All the rising mains distribution lines 4 inches (100 mm) as specified in the mechanical drawing.

2.8.3 Fuel

The factory intends to use minimal oil-based fuels and bagasse in its steam boiler of 25MCR/hr except for start-up operations. As such, the main fuel source in the factory is expected to be bagasse that is a by-product of the cane crushing translating to approximately 3,060kg per day process in the same plant.

The amount of bagasse produced by the factory is estimated to be 42.5 kg for every 100 kg of cane crushed. This quantity is estimated to be adequate to provide the amount of heat required from the boilers.

In the above regard, electric power will only be used in the factory to run machinery that only require electrical power for their operation as well as for lighting and provision of heat for the sugar dryers. This proposal is taken as an energy conservation measure.

2.8.4 Sulphur and Milk of Liming

Sulphur will be used in the sulphitation process for bleaching the raw juice. The rate of application of sulphur shall be 0.075 kg per 83 kg of raw juice.

For lime, about 1 kg of this chemical will be used for every 83 kg of raw juice in the juice clarification process. After the sulphitation and liming process the total juice weight will increase from 83 kg to 84.075 kg.

2.9 Infrastructure

Access Road

There is a main good murram road to the factory; this will have to be improved by the CDF funds within Gem Constituency to a good standard so as to serve the factory well. Cess from the transported cane should be used for the maintenance of the access roads.

Power Supply

The power supply Company, Kenya Power Co. Ltd (KPC) will also be commissioned to install a transformer to handle 650 KVA which power requirement for the factory, the power supply being obtained via a transformer from the main line traversing the project

site. This will mainly be a power backup as the factory is expected to generate sufficient power for its own needs.

Minor Infrastructure – Engineering and Agro-forestry:
The quantity of runoff water to be generated from the immediate surrounding catchment areas and within the factory premises will require the construction of cut offs and storm water drains. The following is a brief discussion of the pertinent aspects of the aforesaid structures.

a) Cut offs and Storm water drains
Large water flows coming from the farms and the factory areas have to be collected and diverted from the said areas by cut offs and storm water drains. Useful location examples here include the collection of water from a higher area and the prevention of such runoffs from flowing down terraced slopes, or the taking care of runoff water from roadside ditches. Cut off drains are only recommended where there is evidence of large water flows, which cannot be stopped through normal on farm terracing.

The construction of such structures has to be done in consultation with the farmers who will then do terracing below the said drains and maintain the channels by removing the settled sediments. The water from these drains shall then be discharged into River Yala at a reasonable distance from the water abstraction point to avoid siltation at such locations. In the design of cut off drains the following conventionally accepted tabular conversions comes in handy in order to ensure that no adverse erosion occurs in the channel ways.

b) River Bank Stabilization
The bank of the River Yala along the company project site is well stabilized and is thick with reeds and other wetland vegetation. It will not require any further planting of reeds along the river to stabilize the river bank.

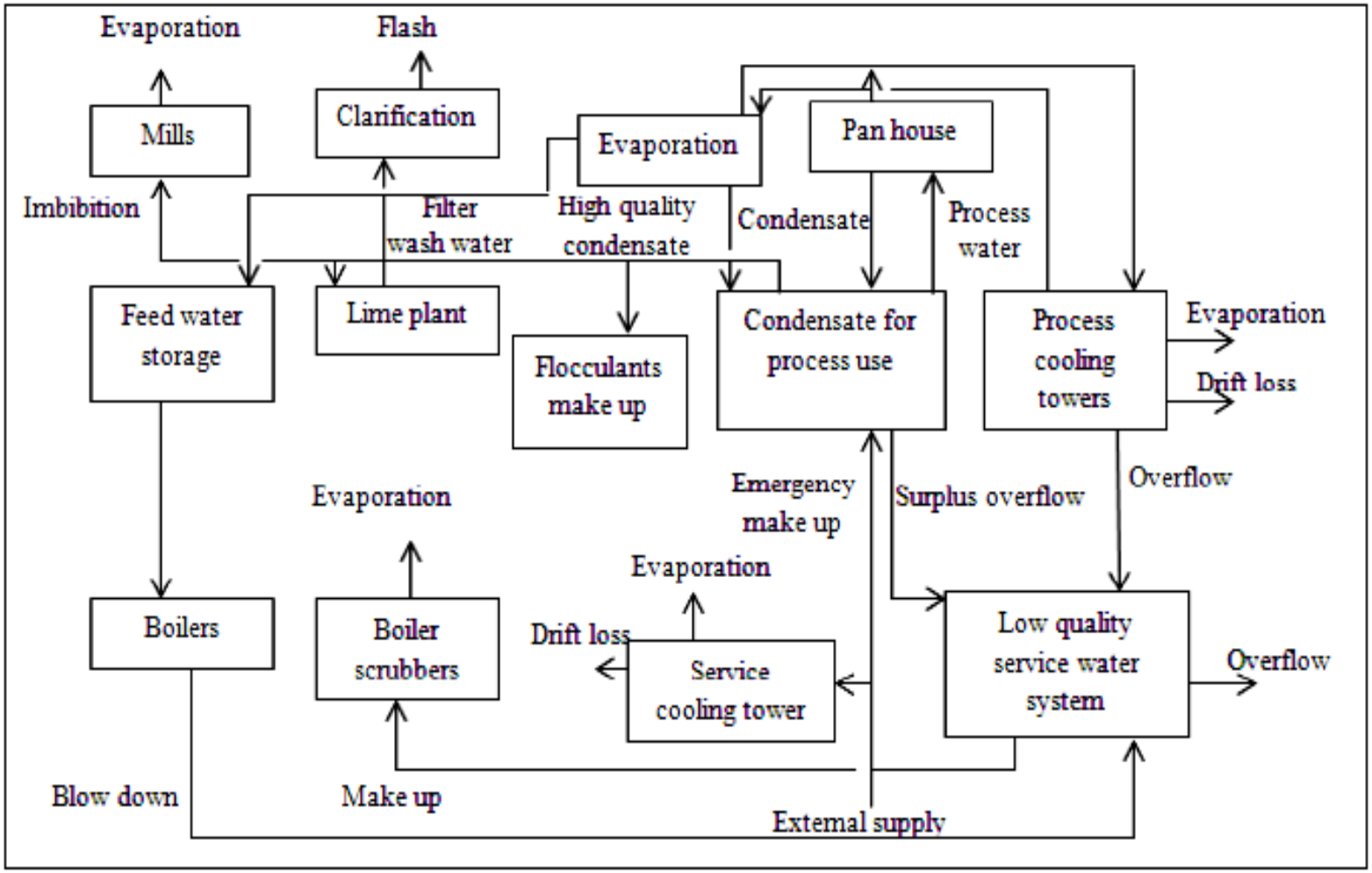


Figure 1: Layout of Areas requiring water in a Sugar processing plant

2.10 Management

The management will be led both during implementation and operations by a board of directors, which will include shareholders of SGS and the lenders. The Board will deal with policy, co-ordination as well as the monitoring and evaluation of the Project's activities.

A team of Consultants and Engineers appointed by the Board will carry out implementation management. The team will be responsible for all activities relating to factory establishment and looking after the interests of the Company and is expected to include the following: Project Manager, Site Engineer, Planning and Design Team, Process Engineer and Equipment Supplies Engineers.

Operational Management will deal with strategy implementation, technical operations, marketing, financing and accounting. The management team is expected to include a General Manager, a Factory Manager, Production Manager and a Financial Controller.

2.11 Project Cost

The estimated cost of the project including the working capital is summarized as hereunder: -

Estimated Project Costs

Table 2: Estimated Project Costs

S. No.	Item Description	Cost in KShs
1	Land Acquisition and Buildings	79,500.00
2	Computer Equipment	1,850,000.00
3	Plant and Machinery	513,618,000.00
4	Furniture and Fittings	4,632,000.00
5	Motor vehicles	7,700,000.00
6	Cane haulers transport tractors	177,000,000.00
7	Operating Capital	15,848, 300.00
	TOTAL	**800,148,300.00**

CHAPTER THREE: BASIC INFORMATION OF THE PROJECT AREA

Introduction

This Chapter introduces Siaya County, its location in the County, its total area, the main physical features and its administrative units. The chapter also highlights the county's socio- economic characteristics in addition to its profile. The information here provides a general overview of Gem Sub-county.

3.1 Position and Size

The County of Siaya borders Busia County to the North, Kakamega County to the Northeast, Vihiga County to the East, Kisumu to the South East, with Lake Victoria to the South and West Siaya County is inhabited by nine communities namely: Yimbo, Alego, Uyoma, Gem, Ugenya, Sakwa, Usonga, Asembo and Uholo. Siaya County shares the shores of Lake Victoria together with other neighbouring counties. Siaya town the capital of the county is an economic hub with massive potential for providing for the country's needs. Siaya Sub-county lies between latitude 0° 26' and 0° 18' North and longitude 33° 58' East and 34° 33' East.

3.2 Bio-physical environment

3.2.1 Climate

a) General

The climate of the study area is heavily influenced by its geographical location and altitude relative to Lake Victoria. The project area stands in the upper eastern flanks of Lake Victoria, and therefore benefiting from the convergence of the easterlies and lake winds. The climate is influenced by two main wind systems, the North Easterlies, and the south Easterlies trade winds; the passage of the Inter-tropical convergence zone (ITCZ) over the catchments which results into two seasons.

b) Rainfall

Broadly, the project area falls within the 1016 mm and 1270 mm isohyets belt as defined in the National Atlas of Kenya. The only rainfall gauging station is at the County Water Office (albeit not regularly read). The records are with lots of gaps. The average annual rainfall distribution is as shown in figure 1.

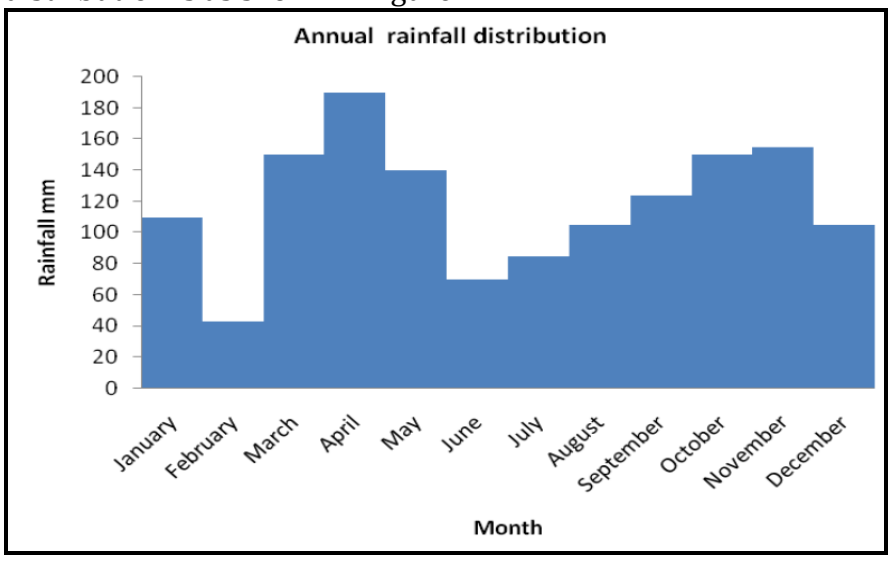


Figure 1: Mean Annual Rainfall Distribution

The histogram shows that the two main rainfall seasons are from March to May and September to November with peaks occurring in April and November. February and June are the driest months. On the whole, the rainfall is well distributed with fair amount of rainfall falling even during the driest months. The average rainfall is approximately 1434 mm.

c) *Temperature*

With an average of 22.6 °C, March is the warmest month. In July, the average temperature is 20.7 °C. It is the lowest average temperature of the whole year.

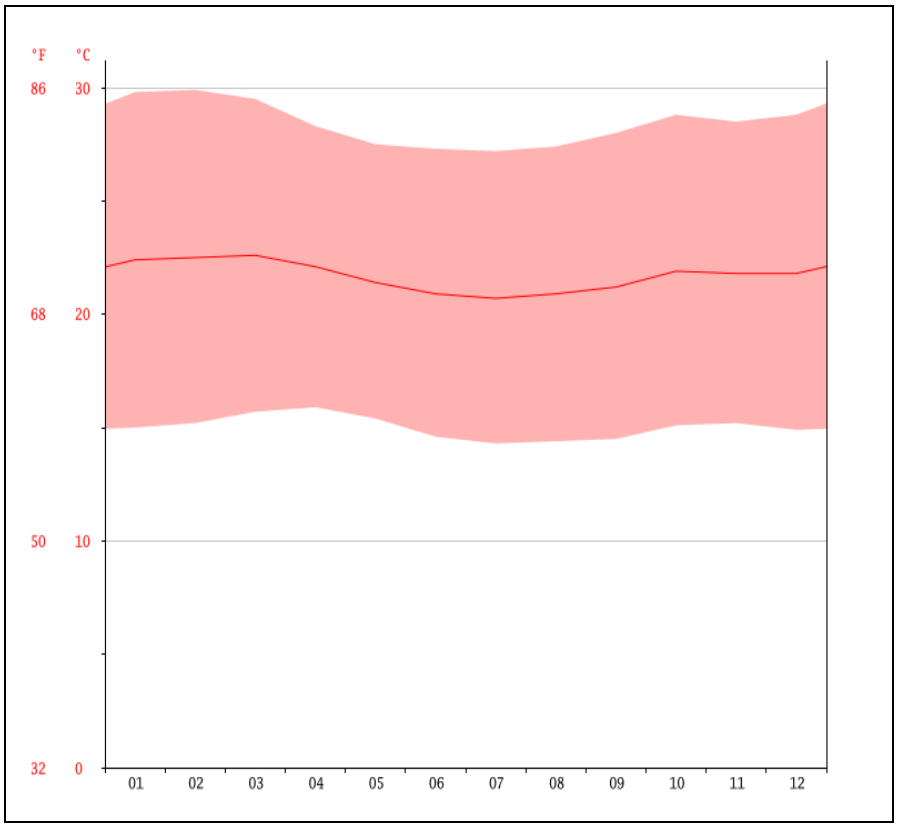


Figure 2: Annual temperature graph

d) *Evaporation*

Mean annual evaporation rate is estimated to be 1964mm. Rainfall patterns within the entire Siaya County in terms of distribution and amounts are influenced by the altitude and wind direction. The main types of rainfall are convectional and relief. The Northern parts of the County which is higher in altitude experience higher rainfall of between 1800-2000mm. The Southern parts towards the Lake Victoria experience less rainfall of below 800 mm. In the Central parts where Siaya Town lies, the rainfall ranges between 800-1600mm. Rainfall distribution is bimodal but in general terms the seasonal occurrence is continuous making it a bit difficult to distinguish the end of the short and long rains.

e) *Air Quality*

Being a rural set up air quality not deteriorated as compared to urban centres. During construction, the proponent will use vehicles and equipments that depend on fossil fuel as their source of energy during project implementation. It is recommended the requirements

of the regulation such as periodic vehicle inspection, use of clean fuels among others be implemented in order to eliminate or reduce negative air quality impacts.

f) Noise and Vibrations

Noise and vibrations will be experienced during construction works as the machines and vehicles will be on site. The project team should observe the noise regimes for the different zones especially when working in areas termed as silent zones which are areas with institutions, worship places.

3.2.2 Geology

The project area is underlain by the intrusives and the Nyanzian system rocks. The intrusive consist of granites while the Nyanzian system rocks consist of rhyolites, basalts and andesites. The Kavirondian system rocks composed of conglomerates, grits and mudstones are well developed in the area. Groundwater normally occurs in pores and interstices of various rock formations depending on the geological conditions and physiography of the area, the permeability and porosity of the rock formations, the degree and depth of weathering, fracturing of the rock formation and the tectonic historical conditions of the area. Similarly, the hydrogeology of an area is normally dependant upon the nature of the parent rock, structures weathering process, recharge mechanism and the form and frequency of precipitation.

The suitability of the formations in the investigated area to act as aquifers depend largely on the development of secondary structures mainly faults, their sub-surface extent and interconnection to other similar structure on regional scale. The larger project area can be divided into two hydrogeological units:-

- Nyanzian system.
- Granite intrusive.

On the whole, groundwater prospects in the area are poor probably due to structural and lithological limitations of the rocks stated.

3.2.3 Hydrology and Drainage

Rivers Nzoia and Yala that traverses the County towards Lake Victoria via Yala Swamp influence surface drainage in Siaya County. Other key water bodies include Lake Kanyaboli and Lake Victoria itself that also acts as moderating features for the general hydrology. The project area has red well-drained loamy soils with no incidences of water logging. The surface drainage is also efficient .The project falls within Lake Basin Catchment within River Yala and Nzoia basins that forms the major permanent rivers traversing the project area and, therefore, influencing the general local hydrology.

The area receives moderate rainfall that is not evenly distributed but mostly occurs as heavy flush events. Ground infiltration of surface runoff also occurs along fractured zones. The low lying areas influences the flow rates of the River leading to enhanced silt deposition, banks destruction and extended areas of soil saturation along the river flood plain. Effectively the river becomes slow flowing and wider towards the Lake.

3.2.4 Soils

The soils are variously distributed, but the most predominant soil in the district is mainly red lateritic soil. Sandy soils are also common in areas with valleys, they sometimes grade to black soils in the swamps and next to wet lands. In some parts of the district the soils are

capped by extensive lateritic crust which has been also exploited as building stone in the district.

3.2.5 Water resources

River Yala and River Nzoia are the major perennial rivers in the county. The proposed project site is bordered by River Yala while River Nzoia passes approximately 11 km to the north of the Project Area. Wuoraya River is a tributary of Nzoia River and passes 7 km from the project area. Uludhi and Nyamawin are tributaries of Wuoroya and pass close to the Siaya town.

Records from existing boreholes indicate that groundwater cannot be relied upon to satisfy the water needs of the people in the supply area. The yields vary from, 1.4 m^3/h to 10 m^3/h (240 m^3/day). Groundwater is therefore not an option in water supply provision to the project area.

Other sources of water in the area include rainwater due to the often-intense flash rains that characterize the area because of the lake basin. However, the area residents have not fully exploited the opportunity since only a few rainwater-harvesting installations are observed. The water sources mainly the streams are unreliable and unprotected, poses pollution, and makes them unsafe for domestic use.

3.2.6 Topography

Broadly, the project area is gently undulating and consists of broad, flat topped ridges and long gentle valley slopes. The area is erratically dissected by the tributaries of the Yala River to the South and Nzoia to the North. Most of these tributaries are seasonal and the flow occurs only during the wet seasons. The project area rises from an elevation of 1270 m.a.s.l. in the south to an elevation of 1310 m.a.s.l. around Siaya Town. It then gradually falls to 1285 m.a.s.l. at its northern most end. East to west, it falls from about 1325 m.a.s.l. around Ramba School to about 1280 m.a.s.l around Mulaha School on the road to Boro. Mbaga Hill occupies the north-western most point of the supply area rising sharply to an elevation of 1380m.a.s.l.

3.3 Socio-Economic environment

3.3.1 Administration

Gem Sub County was curved from the greater Siaya District. Gem subcounty is divided into 2 administrative divisions namely: Wagai and Yala. The proposed project area falls within Kanyilaji Village, West Gem Location, Wagai Division, Gem Sub-County, Siaya County.

3.3.2 Demographic patterns

Siaya County had a population size of about 842,304 in 2009 according to the 2009 Population Census of which are 47 % were males and 53% females living in 199,034 households. The county has a surface area of 2,530Km^2 culminating to a population density of 333 people per Km^2. The population is young with 46.1 % being between ages 0 to 14 years, 50.9 % within 15 – 64 years and eventually 3.0 % are above 65 years. There is a population density of about 310 people per Km^2. The population growth rate in the proposed project is expected to continue rising.

3.3.3 Sanitation and Hygiene

The common mode sanitation in this rural setting includes pit latrines. Every household has pit latrines within their premises. The pit latrines are shallow and some have varying seasonal water levels making it uncomfortable for use. The combination of shallow pit latrines and open defecation in the bushes poses a major risk to water quality and hence threat to public health in the areas with among infections being typhoid, cholera, diarrhea, hepatitis B, eye infections, skin diseases and other water borne diseases.

Hygiene conditions, especially in schools and household levels, are highly compromised by lack of clean water. Availability of water for efficient washing of hands, drinking and food preparation are among the key conduits to potential diseases outbreak that need to be addressed. From observation within the study area, a number of households still lack sanitation facilities (latrines, toilets) due to poverty and presence of alternative defecating areas (bushes). This constitute one of the principal pathways for infection which can kill people once the human wastes are swept by running water into the water bodies

3.3.4 Public Health Status

The main goal of the health sector is to achieve *"the highest possible health standards in a manner responsive to the population needs"*. This is done by not only expanding existing curative services, but also through shifting the emphasis in the health system from curative health care to preventive and promotive health care. In the last few years, the County's health infrastructure has improved as a result of construction and renovation of health facilities through devolved funds such as CDF and LATF as well other funds like ESP funds. The County currently has about 149 health facilities, 120 of which are public facilities (about 80 percent of total facilities). The 120 public facilities consist of one county referral hospital, six sub-county hospitals and 113 primary care facilities. In addition to the health facilities, the current 187 existing Community Health Units also provide health services in the county.

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3.3.5 Waste Management

Being a rural set up, waste is not a major challenge in waste generation and management. Domestic wastes are managed at the household levels (mainly papers, cartons, plastics and limited packaging materials. Agricultural wastes including dry plant matter decompose in the farms while livestock wastes are applied as manure in the farms.

3.3.6 Infrastructure and Communication

The Kenya Power Company supplies electricity to the project area. However, some institutions and households have opted to the installation of back-up generators and solar panels to supplement the Kenya Power supply especially in times of power outages. The proposed project area is served by dry weather road connecting it to major tarmac roads. Communication is excellent for mobile reception from Safaricom, Airtel, Orange, and Telkom Wireless.

Plate 4: Typical Access road

3.3.7 Land and Settlements

The proposed project area is in an agricultural zone. Land is mainly used for food production, commercial sugarcane growing, and settlement. Due to the continued rise in population and decline in soil fertility there has been encroachment into wetlands and river banks. This prompts the need for proper physical planning to enhance sustainable land use and environmental management.

3.3.8 Land Ownership and Land Use

Land is demarcated and owned under freehold systems. The lands have been divided to smaller portions with the increase population and demand for agricultural land. There is practice of subsistence farming and livestock. The community undertakes other economic activities to supplement income from Agriculture. Due to the continued rise in population and decline in farm productivity, there has been progressive encroachment into sensitive land areas such as wetlands in Lake kanyaboli and Dominion Farm, river flood plains and steep slopes. There is inadequate integration of land use planning principles in development projects to ensure long-term compatibility and potential conflicts.

3.3.9 Economic Activities

The major economic activities in the proposed project areas include crop farming, livestock rearing and small-scale businesses. Agricultural activities are dependent on rainfall. Crops include maize, beans and horticulture. The main cash crop grown in the proposed project area is sugarcane. Most farmers still face the challenge of marketing their produce. Business entrepreneurs licensed in the informal sector include retail shops, welding workshops, bar and restaurant among others. The informal sector is widespread in the project area and it contributes considerably to the growth of the local economy.

a) **Agriculture**

Agriculture contributes 79% to the household income in Kenya. The irrigation potential along the main rivers, Lake Kanyaboli and Lake Victoria is not fully exploited. The area is divided into four agro ecological zones namely Lower Midland Two (LM2), LM3, LM4, LM5 of which LM3 and LM4 covers 96 percent of the total area. The major farming system is mixed crop and livestock subsistence farming. The farms are 3 ha on average in size.

- Crop Growing

Food crops grown within the project area include Maize, sorghum, beans, cassava, sweet potatoes, green grams, finger and millet. Cash crops grown within the project area include Tomatoes, vegetables, groundnuts, cotton, sunflower. These crops are grown in both pure and mixed cropping systems depending on biological and socio-economic factors. The potential exists for high-income crops like groundnuts, simsim, maize and legumes through irrigation.

- Livestock Keeping

Livestock production systems the project areas vary a lot depending on the specific enterprise in question. Among the livestock features include;

i. Cattle: There are two distinct types namely indigenous, reared under free range and the exotic which tend to be under zero – grazing and/or semi – zero system.
ii. Sheep and goats: All the sheep are indigenous but there are both indigenous and exotic dairy goats. The sheep and indigenous goats are kept under free range production system, while the dairy goats are mainly reared under the zero – grazing system.
iii. Poultry: Local domestic birds including turkeys, ducks and geese are produced under free – range. Commercial birds that include layers and broilers are confined, with broilers being exclusively under deep litter system and layers divided into deep litter or slated floor production system.
iv. Pigs: About 80% of the pigs are reared under free range where the pigs scavenge for feedstuffs from garbage heaps and graze on whatever forage they can obtain. The remaining 20 % of the pigs are kept under confinement and given all the feed requirements in their sites,
v. Donkeys: All the donkeys are kept under free-range production system.
vi. Bees: Bees are kept in hives that are confined to secluded sites. However, a small number of colonies occupy non – conventional sites like chimneys, roof ceilings, trees etc.

b) Trade and Finance

Siaya town is the trade hub for the County and the neighbouring areas with high influence from as far as Kisumu city situated only about 70km to the east. Features of trade in the area include local products and those brought in other parts of the country. Fishing activities from Lake Victoria seem to dominate the key trade commodity (fish). The main species include tilapia, Nile perch, finger fish (omena) traded at the beach and major markets include Siaya, Bondo and Usenge. Other features of trade include foodstuff including vegetables, grains (maize and beans) and legumes (sweet potatoes and arrow roots being the mains ones). Most of the foodstuff is imported from outside the area from as far as Kakamega, Eldoret, Busia, Kisii and Kericho.

Housing is an important trade factor, especially in the main towns including rental shops and residential house. Rental commercial houses include general shops, eateries, posho mills, lodgings, limited offices, bars and recreation areas. Most households cook on an open fire based on three stones. The majority of rural households cannot afford the cost of purchasing fuel for the most common alternatives, namely charcoal and paraffin.

3.4 Biological Environment

3.4.1 Introduction

The survey was carried out in Kanyilaji Village and along River Yala in March, 2017 to determine the nature and extent of biodiversity and how proposed sugar factory project could impact on the ecology of the project area and the riverine ecosystem. River Yala is of great importance in development of the proposed sugar factory project since it will serve as the major source of water.

The project area was surveyed by direct observation on foot. Habitats to be affected by the proposed sugar mill project were identified and mitigation measures were proposed for the loss of habitats. Photographs of habitats (terrestrial and aquatic) and ecological features of special importance were taken. Surveys of animals were conducted by active searching in the proposed project site and in the riparian areas during daytime.

3.4.2 Vegetation

The natural biological environment of the project area has been considerably changed due to encroachment into riparian areas and land fragmentation. Wood lots, mixed open woodland, grasslands and glades, dominate the project area in the section covered by the proposed sugar mill project. The vegetation survey focused on the grasses, forbs, shrubs, and trees was carried in the proposed sugar mill site and along Yala River. Vegetation cover form important wildlife habitats in addition to serving other ecological and economic functions. The following are the major plant species found growing within the project area. The most dominant grass species found to be growing in almost the entire proposed project site is known to the local people as *Osinde.*

Plate 5: Cymbopogon nardus growing on site

Table 3: Forbs, shrubs and grasses

Botanical name	Common/local name (Luo)
Digitaria scalarum	Ombugu
Cymbopogon nardus	Osinde
Hyparrenia lintonii	Apuoyo
Ocimum suave	Mieny
Solanum incanum	Ochok

Indigofera erecta	Raywe
Tithonia diversifolia	Akech
Leonitis mollissima	Nyanyodhi
Carissa edulis	Ochuoga
Lantana camara	Atek
Teclea nobilis	Ondati
Psidium guajava	Mapera
Grewia similis	Powo
Rhus natalensis	Sangla

Source: field assessment

a) Tree species observed in the project area

The survey found out that much of the Yala riparian vegetation had been destroyed by the local residents partly to create farmlands and to get wood for burning charcoal. The identified woody tree species were scattered with some riparian section completely devoid of natural vegetation other than grass. The local people have extended their farming activities to riverbanks thereby causing massive erosion and siltation. The most dominant species observed are listed in the table below.

Table 4: Tree species in the project area

Botanical name	**Common/local name (Kuria)**
Albizia gummifera	Ober
Erythrina abyssinica	Orembe
Euphorbia candelabrum	Bondo
Makhamia lutea	Siala
Melia azedarach	Dwele
Ficus thoningii	Bongu
Acacia abyssinica	Alii

Source: field assessment

b) Farmland Vegetation

The main socio-economic activities in the project area comprise subsistence farming. Sugarcane is also grown as a cash crop. Horticulture is also practiced in the project area.

Table 5: Farmland vegetation in the project area

Botanical name	**Common name**
Musa spp	Banana
Brassica oleracea var capitata	Cabbages
Brassica oleracea acephala	Kales
Ipomoea batatas	Sweet potation
Mangifera indica	Mango
Phaseolus vulgaris	Beans
Pennisetum glaucum	Millet
Vigna unguiculata	cowpea
Elesine coracana	Finger millet
Zea mays	Maize
Allium cepa	Onions
Manihot esculenta	Cassava
Sacharrum spp	Sugarcane

Source: field assessment

c) Riparian wetland vegetation

The Yala riverine vegetations are characterized by rooted herbaceous and glasslike plants largely consisting of papyrus (*Cyperus papyrus*), reeds (*Phragmites sp*.) and hippo grass (*Vossia cuspidata*). These swamp systems are complemented by shrubland systems dominated by perennially green shrubby vegetation. This vegetation has various ecological and economic functions. In addition to their ecological contribution as riparian wetland habitats, especially for various birds, the riparian vegetation also provides a filter for sediments in water entering the streams. However, due to the substantial clearance of this vegetation, soil erosion including at the river bank level is noticeably high in the area and heavy siltation of the streams is conspicuous.

d) Invasive Alien Species

Invasive alien species are important agents of biodiversity loss and represent a global threat to freshwater habitats and biodiversity because they suffocate, replace and often result in the extinction of indigenous species. The Wildlife (Conservation and Management) Act of 2013 has a list of nationally declared Invasive Alien Species. Invasive alien species have a tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems.

Invader and weed species must be controlled to prevent further infestation and it is recommended that all individuals of the invader species be removed and eradicated. The common invasive alien species as declared by the Wildlife Act noted within the project area *Lantana camara* (Tick berry)

3.4.3 Fauna

The proposed project area has modified natural environment and is predominantly a rural settlement. The area therefore lacks major terrestrial wild fauna of influence. The survey established that the numerous vegetation, especially the riparian support many faunal species. The wetlands are also home of many insects including the *Chaoboridae, Chironomidae, Ephemeroptera, Odonata and Trichoptera* as well as many invertebrates. Further, *Gastropoda, Hirudinea and Oligochaeta* are found abundantly in wetlands. Some invertebrates found in the project area ecosystem include *lepidopterans* (butterflies) and *coleopterans* (beetles). Domesticated animals in the area include cattle, goats, pigs, chickens and various pets. Wild animal species confirmed within the project area during this survey are discussed under the following classes.

a) Mammals

Surveys of mammals were conducted by active searching in the project area. A few mammal species were confirmed for the study area and were common across the riparian, wetland and grassland areas. These include African hare (*Lepus capensis)*, Rats (*Rattus norvegicus)*, Mongoose (*Mungos mungo),* and Jackal (*Canis mesomelas)*,

b) Reptiles and amphibians

Reptiles are cold-blooded vertebrates. They serve as both predator and prey within an ecosystem depending on their size and exist within various habitats. Reptiles that were confirmed include, Monitor Lizard **(***Varanus salvator)* Frogs, Chameleons *(Pogona vitticeps),* Black and green mambas and lizards

c) Fishes

River Yala within the project area support some fish species especially in stagnant areas. The community within the project area has not invested much in fish farming. Fish species harvested from the rivers include the African Catfish. These are benthopelagic and potamodromous, migrating between upstream and downstream sections of the river. When water levels recede, catfish hibernate in mud, only coming out when there is sufficient water levels. Most of the fish species within the project area are known to spawn at sheltered sections of the river with calm waters e.g. at meander points.

d) Avifauna

The riparian vegetation, woodlots, grasslands and swamplands form good habitats for avifauna. Several bird species were observed during the site survey. Notable species observed within the project area during the ecological assessment is presented in the table below:

Table 6: Avifauna species identified in the project area

Common name	**Scientific name**
Heron	*Ardea spp*
Hamerkop	*Scopus umbretta*
Sunbird	*Nectarinia mariquensis*
Hadada ibis	*Bostrychia hagedash*
Speckled Mouse birds	*Colius striatus*
Doves	*Streptopelia spp*
Swallow	*Hirundo spp*
Weavers	*Ploceus spp*
Cattle egret	*Bubulcus ibis*

Source: field assessment

Plate 6: Hadada ibis (*Bostrychia hagedash)* in a swamp along River Yala

CHAPTER FOUR: LEGISLATIVE, POLICY AND REGULATORY FRAMEWORK

4.0 Introduction

Kenya has a policy, legal and administrative framework for environmental management. Under the framework, the National Environment Management Authority (NEMA) is responsible for ensuring that environmental impact assessments (EIAs) are carried out for new projects and environmental audits on existing facilities as per the Environmental Management and Co-ordination (Amendment) Act, 2015.

EIAs are carried out in order to identify potential positive and negative impacts associated with the proposed project with a view to taking advantage of the positive impacts and developing mitigation measures for the negative ones. The guidelines on EIAs are contained in Sections 58 to 67 of the Act. According to Section 68 of the Environmental Management and Coordination (Amendment) Act (EMCA) 2015, The Authority will be responsible for carrying out environmental assessments and audits on all activities that are likely to have a significant effect on the environment.

The government has established regulations to facilitate the process on EIAs and environmental audits. The regulations are contained in the Kenya Gazette Supplement No. 56, Legislative Supplement No. 31, and Legal Notice No. 101 of 13th June 2003.

In the past, the government has established a number of National policies and legal statutes to enhance environmental conservation and sustainable development. *The proponent will need to observe the provisions of the various statutes that are aimed at maintaining a clean, healthy and sustainable environment***.** Some of the policy and legal provisions are briefly presented in the following sub-Sections.

4.1 Legislative Framework

4.1.1 The Constitution of Kenya

Promulgated on the 27th of "August 2010, the constitution of Kenya in its preamble declares that the people of Kenya are respectful to the environment, which is their heritage and they are determined to sustain it for the benefit of future generations. The constitution which is based on the bill of rights as its backbone, states in article 42 that every person has a right to a clean and healthy environment and subsection 1 adds that this includes the right to protect environment for the benefit of present and future generations through legislative and other measures. Article 43 follows declaring economic and social rights of every Kenyan and they include in subsections: (a) the right to the highest attainable standard of health, which includes the right to health care services, including reproductive health care and (d) the right to clean and safe water in adequate quantities. Section 2 of article 43 adds that no one shall be denied emergency medical care.

The constitution also endorses the national land policy and chapter 5 which deals with land and environment states principally in article 60 that land in Kenya will be held, used and managed in a manner that is equitable, efficient, productive and sustainable. The principles are outlined in subsections of article 60 and article 61 declares that all land in Kenya belongs to the people of Kenya collectively and subsection 2 classifies land to be as either public, community or private and thus it's important to establish in which of these the

project lies. The national land commission is established in article 67 and its main function is to manage land on behalf of national and county governments.

Part 2 of chapter 5 deals with the environment and natural resources and article 69 section (1) subsection (a) states that the state will ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits. The following subsections give regulations in terms of forest cover, biodiversity, cultural resources, indigenous knowledge, systems for environmental impact assessment and prevention of activities that may harm the environment. Section 2 states that every person has a duty to cooperate with state organs and other persons, to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources. Article 70 deals with enforcement of environmental rights and everyone who feels their right to a clean and healthy environment has been denied has the obligation to go to court to seek redress. Article 71 and 72 deal with agreements relating to natural resources and legislation relating to the environment respectively, where parliament is given this authority.

4.1.2 Environmental Management and Co-ordination (Amendment) Act, 2015

Environmental Management and Co-ordination Act No. 8 of 1999 has hither to been providing a legal and institutional framework for the management of the environmental related matters. It is the framework law on environment, which was enacted on the 14th of January 1999 and commenced in January 2002. The Act has since been amended and replaced by Environmental Management and Co-ordination (Amendment) Act, 2015 which was enacted into a law on 3rd January, 2015.

Section 58 of the Second schedule of the Act require proponent of project to submit project reports to NEMA before financing, commencing, proceeding with, carrying out, executing or conducting projects. The Second Schedule to the Act specifies the projects for which an EIA and EA must be carried out. According to Section 68 of the Act, all projects listed in the Second Schedule of the Act must undertake an environmental audit, keep accurate records and make annual reports to NEMA or as NEMA may, in writing, require.

The main objectives of the Act are to:

- Provide guidelines for the establishment of an appropriate legal and institutional framework for the management of the environment in Kenya;
- Provide a framework legislation for over 70 statutes in Kenya that contain environmental provisions; and
- Provide guidelines for environmental impact assessment, environmental audit and monitoring, environmental quality standards and environmental protection orders.

In addition, the following regulations to the Act are also relevant to the proposed development.

Under EMCA Amendment, 2015, there are a number of regulations geared towards sustainable development. The applicable regulations to the proposed Sugar Factory project are discussed below:

a) Environmental Management and Coordination (Environmental Impact Assessment and Audit) Regulations, 2003

Environmental Impact Assessment (EIA) is a critical examination of the effects of a project on the environment. The goal of an EIA is to ensure that decisions on proposed projects and activities are environmentally sustainable. An EIA is conducted in order to identify impacts of a project on the environment, predict likely changes on the environment as a result of the development, evaluate the impacts of the various alternatives on the project and propose mitigation measures for the significant negative impacts of the project on the environment.
The Project proponent pays for the entire EIA process. Environmental Audit (EA) is the systematic documentation, periodic and objective evaluation of activities and processes of an on-going project. The goal of EA is to establish if proponents are complying with environmental requirements and enforcing legislation. The purpose of EA is to determine the extent to which the activities and programs conform to the approved environmental management plan.

This Report complies with the requirements of the Environmental Regulations in the coverage of environmental issues, project details, impacts, legislation, mitigation measures, management plans and procedures. The Proponent shall be required to commit to implementing the environmental management plan laid out in this report and any other conditions laid out by NEMA.

b) Environmental Management and Coordination (Water Quality Regulations of 2006)

Water Quality Regulations apply to water used for domestic, industrial, agricultural, and recreational purposes; water used for fisheries and wildlife purposes, and water used for any other purposes. Different standards apply to different modes of usage. These regulations provide for the protection of lakes, rivers, streams, springs, wells and other water sources. The objective of the regulations is to protect human health and the environment. The effective enforcement of the water quality regulations will lead to a marked reduction of water-borne diseases and hence a reduction in the health budget.

The regulations also provide guidelines and standards for the discharge of poisons, toxins, noxious, radioactive waste or other pollutants into the aquatic environment in line with the Third Schedule of the regulations. The regulations have standards for discharge of effluent into the sewer and aquatic environment. While it is the responsibility of the sewerage service providers to regulate discharges into sewer lines based on the given specifications, NEMA regulates discharge of all effluent into the aquatic environment. Everyone is required to refrain from any actions, which directly or indirectly cause water pollution, whether or not the water resource was polluted before the enactment of the Environmental Management and Coordination (Amendment) Act (EMCA) Gazetted in 2015. It is an offence to contravene the provisions of these regulations with a fine not exceeding five hundred thousand shillings.

c) Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations, 2009

General prohibitions of the Act provide that no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others in the environment. Of importance in determining nuisance, the time of day, proximity to residential area, recurrence or intermittence of the noise, level and intensity of the noise and whether the noise can be controlled without much effort or expense to the person making the noise.

The regulations also provide that no person shall cause or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others in the environment, or cause to be made excessive vibrations which exceed 0.5 centimetres per second beyond any source property or 30 meters from any moving source.

Vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others in the environment, or cause to be made excessive vibrations which exceed 0.5 centimetres per second beyond any source property or 30 meters from any moving source.

Table 8 below indicates the maximum allowable noise levels for given zones.

Table 7: Permissible outdoor noise levels for residential and other areas

Zone	Sound level limit dB(A) Leq, 14h)		Noise Rating Level (NR) (leq, 14h)	
	Day	Night	Day	Night
Residential indoor	45	35	35	25
Residential outdoor	50	35	45	25
Places of worship	40	35	30	25
Silent zone	40	35	30	25
Commercial	60	35	55	25
Mixed residential (with some commercial and places of entertainment)	55	35	50	25

Day: 6:01 am – 8:00 pm; Night: 8:01 pm – 6:00 am

The regulations however exempt the emission of noise for the purpose of alerting persons to the existence of an emergency.

Through the contractor and tenants to the proposed facility, the proponent shall ensure strict adherence to these regulations during the construction and operation phases respectively. Annual environmental audit of the facility will also be carried out to monitor observation of these regulations.

d) Environmental Management and Coordination (Air Quality Regulations, 2008)

This regulation is referred to as "The Environmental Management and Coordination (Air Quality) Regulations, 2008". The objective is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources, including as mobile sources (e.g. motor vehicles) and stationary sources (e.g. industries) as outlined in the Environmental Management and Coordination (Amendment) Act, 2015. It also covers any other air pollution source as may be determined by the Minister in consultation with the Authority. Emission limits for various areas and facilities have been set. The regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas. The following operations (provided they are not used for disposal of refuse), are exempt from these regulations:

- Back-burning to control or suppress wildfires;
- Firefighting rehearsals or drills conducted by the Fire Service Agencies
- Traditional and cultural burning of savannah grasslands;
- Burning for purposes of public health protection;

e) Environmental Management and Coordination (Waste Management) Regulations, 2006

Part II, 4 (1) of the Regulations states that no person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated receptacle. Regulation 4 (2) further states that a waste generator shall collect, segregate and dispose such waste in the manner provided for under these regulations. Regulation 5 (1) provides for cleaner production methods. It states that a waste generator shall minimise the waste generated by adopting the following cleaner production methods:

a) Improvement of production process through:

- Conserving raw materials and energy;
- Eliminating the use of toxic raw materials; and
- Reducing toxic emissions and wastes.

b) Monitoring the product cycle from beginning to end by:

- Identifying and eliminating potential negative impacts of the product; and
- Enabling the recovery and re-use of the product where possible.

c) Incorporating environmental concerns in the design and disposal of a product.

The proponent shall adopt appropriate waste management system throughout the life cycle of the proposed project including hiring services of licensed waste collectors and transporters and disposal at licensed sites.

4.1.3 The Traffic Act, 2012

The Traffic Act, 2012 gives provisions and guidelines that govern the Kenya roads transport sector. These guidelines are essential to private, public and commercial service vehicles in ensuring safety and sanity on the roads hence ensuring the environment; the human being a component is safeguarded. In section 41 The Act demands for installation and certification of speed governors for the commercial vehicles ferrying goods adjusted to the loading condition of such vehicles to a limit of 80 KPH, registration and competence of drivers. Moreover, the owner of commercial vehicles or trailer shall ensure clear markings on their vehicles in English language on the right side of the vehicle showing ownership details, tare weight of vehicle and maximum authorized weight.

Section 26 and 27 of the same discourages engines that emit exhaust gases to the atmosphere without passing via a silencer or expansion chamber. In ensuring safety of all the persons in transit section 56 encourages that every public and commercial vehicle be fitted with inspected and first class first aid box and fire extinguisher. In ensuring compliance to this Act the contractor and developer shall ensure that all site drivers and all material suppliers to the site satisfy the provisions as stipulated in Act.

4.1.4 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 as waste pipes, sewers, drainers or refuse pits in such state, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to health.

4.1.5 Water Act, 2002

The Water Act in section 3 vests every water resource in the state subject to any rights granted by or under the water Act or any other written law. The Act in Section 25 provides that a permit shall be required for any use of water from a water resource, especially where there is abstraction and use of water with the employment of works. Permits are also required for the drainage of any swamp or other land; and the discharge of a pollutant into any water resource. Section 26 of the act gives exclusions for which no permit is required like for the abstraction or use of water, without the employment of works, from or in any water resource for domestic purposes by any person having lawful access thereto. Section 7 of the Act establishes Water Resources Management Authority (WRMA) whose powers and functions as far as the administration of the Act is concerned, are stated in section 8.

The Water Act, 2002 also provides for establishment of 3 levels of institutions for the provision of services. These are:

- Water Services Regulatory Board (WSRB);
- Water Services Boards (WSB); and
- Water Service Providers (WSP).

The proponent will source water from a licensed water service provider, Homa Bay County Water and Sanitation Company.

4.1.6 The Land Act, 2012

This is an ACT of Parliament to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land based resources, and for connected purposes. The Land Act of 2012 subsection (1) states that 'any land may be converted from one category to another in accordance with the provisions of this Act or any other written law.' it continues to state in subsection (2) that Without prejudice to the generality of subsection (1)

a) Public land may be converted to private land by alienation
b) Subject to public needs or in the interest of defence, public safety, public order, public morality, public health, or land use planning, public land may be converted to community land
c) private land may be converted to public land by
   i. Compulsory acquisition;
   ii. Reversion of leasehold interest to Government after the expiry of a lease; and
   iii. Transfers; or
   iv. Surrender.

d) Community land may be converted to either private or public land in accordance with the law relating to community land enacted pursuant to Article 63(5) of the Constitution.

It is important to note that any substantial transaction involving the conversion of public land to private land shall require approval by the National Assembly or county assembly as the case may be.

Part I of the same Act states that title to land may be acquired through—

a) allocation;
b) land adjudication process;
c) compulsory acquisition;
d) prescription;
e) settlement programs;
f) transmissions;
g) transfers;
h) long term leases exceeding twenty-one years created out of private land; or
i) any other manner prescribed in an Act of Parliament.

Part viii of this ACT provides procedures for compulsory acquisition of interests in land. Section 111 (1) States that if land is acquired compulsorily under this Act, just compensation shall be paid promptly in full to all persons whose interests in the land have been determined. The Act also provides for settlement programmes. Any dispute arising out of any matter provided for under this Act may be referred to the Land and Environment Court for determination.

4.1.7 The Land Registration Act, 2012

The Land Registration Act is place to revise, consolidate and rationalize the registration of titles to land, to give effect to the principles and objects of devolved government in land registration, and for connected purposes. This Act applies to Subject to section 4, this Act shall apply to:

Registration of interests in all public land as declared by Article 62 of the Constitution;

- Registration of interests in all private land as declared by Article 64 of the Constitution; and
- Registration and recording of community interests in land.

Section 24 states that: (a) the registration of a person as the proprietor of land shall vest in that person the absolute ownership of that land together with all rights and privileges belonging or appurtenant thereto; and (b) the registration of a person as the proprietor of a lease shall vest in that person the leasehold interest described in the lease, together with all implied and expressed rights and privileges belonging or appurtenant thereto and subject to all implied or expressed agreements, liabilities or incidents of the lease.

4.1.8 The Environment and Land Court Act, 2011

This Act is in place to give effect to Article 162(2) (*b*) of the Constitution; to establish a superior court to hear and determine disputes relating to the environment and the use and occupation of, and title to, land, and to make provision for its jurisdiction functions and powers, and for connected purposes.

This Act shall of great essence to the proponent, public, interested or affected party that may want to litigate against the development on settlement issues, location of project or even effects of the project to the public

4.1.9 The National Land Commission Act, 2012 (No. 5 of 2012)

Section 5 of the Act outlines the Functions of the Commission, pursuant to Article 67(2) of the Constitution as follows 5(1):-

- to manage public land on behalf of the national and county governments;
- to recommend a national land policy to the national government;
- to advise the national government on a comprehensive programme for the registration of title in land throughout Kenya;
- to conduct research related to land and the use of natural resources, and make recommendations to appropriate authorities;
- to initiate investigations, on its own initiative .or on a complaint, into present or historical land injustices, and recommend appropriate redress;
- to encourage the application of traditional dispute resolution mechanisms in land conflicts;
- to assess tax on land and premiums on immovable property in any area designated by law; and
- To monitor and have oversight responsibilities over land use planning throughout the country.

4.1.10 Building Code 2000

The building code under Septic and conservancy tanks, section 202 allows for installation of septic tanks where a sewer system has not been provided that the proponent abides with the provisions under the set table. The area where the project is to be located is not supported by a sewer line. The proponent has designed a effluent treatment plant to serve the factory.

4.1.11 Occupational Safety and Health Act (OSHA 2007)

Before any premises are occupied, or used a certificate of registration must be obtained from the chief inspector. The occupier must keep a general register. The Act covers provisions for health, safety and welfare.

Health

The premise must be kept clean, daily removal of accumulated dust from floors, free from effluvia arising from any drain, sanitary convenience or nuisance and without prejudice to the generality of foregoing provision. A premise must not be overcrowded, there must be in each room 10 meters of space for each employee, not counting space 14 feet from the floor and a 9 feet floor-roof height. 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.

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.

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. Section 42 stipulates that 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.

Section 45 states that 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. Section 55B 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.

4.1.12 Physical Planning Act (Cap 286)

An Act of Parliament to provide for the preparation and implementation of physical development plans and for connected purposes enacted by the Parliament of Kenya Under this Act, no person shall carry out development within the area of a local authority without a development permission granted by the local authority under section 33. The local authority concerned shall require the developer to restore the land on which such development has taken place to its original condition within a period of not more than ninety days. If on the expiry of the ninety days' notice given to the developer such restoration has not been effected the concerned local authority shall restore the site to its original condition and recover the cost incurred thereto from the developer. The developer has ensured this is affected and enforced at the initial stage.

4.1.13 Employment Act No 11 of 2007

The Act is enacted to consolidate the law relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratization of trade unions and employers organizations and federations. Its purpose is to promote sound labour relations through freedom of association, the encouragement of effective collective bargaining and promotion of orderly and expeditious dispute the protection and promotion of settlement conducive to social justice and economic development for connected purposes. This Act is important since it provides for employer – employee relationship that is important for the activities that would promote management of the environment within the housing sector. The developer, the contractor and the employees' relationship during the construction and later phases of this project shall be guided by this Act.

4.1.14 Penal Code Cap 63

Section 191 of the penal code states that if any person or institution that voluntarily corrupts or foils water from 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 neighbourhood or those passing along public way, commit an offence.

4.1.15 The Factory and Other Places of Work Act Cap 514 of 2005

This act governs noise prevention and control and in section 4 (1) it sets limits of how much noise a worker may be exposed to (a) as the continuous equivalent of ninety dB (A) in eight hours within any twenty four hours duration; and (b) one hundred and forty dB (A) peak sound level at any given time. Section (3) adds that where noise is intermittent, noise exposure shall not exceed the sum of the partial noise exposure equivalent continuous sound level of ninety dB (A) in eight hour duration within any twenty four hours duration. It also places the duty of ensuring an effective noise control and hearing conservation programme on occupiers in section 5, which the act states in subsection 5 (2) to include:

a) Noise measurement;
b) Education and training;
c) Engineering noise control;
d) Hearing protection.
e) Posting of notices in noisy areas;
f) Hearing tests; and
g) Annual programme review.

The act places responsibility of recording noise levels at workplaces and reporting to the Director of Occupational Safety and Health on occupiers and in Section 10 (1) it states that machinery or plant in the workplace should be installed in such a way that the lowest possible noise is emitted when the machine is in operation. In section 12 it states that where measures to segregate noisy areas (beyond 90 dB(A)) are not feasible then occupiers should provide workers with adequate PPEs.

4.1.16 The National Construction Authority Act, 2011

This act establishes the national construction authority, a state corporation under the Public Works Ministry. The authority is mandated to regulate and aid development of the construction industry through registration and accreditation of contractors, skilled construction workers and construction site supervisors and regulate their activities. It is also mandated to monitor the construction process as detailed in the Physical Planning Act. The proponent shall ensure that any hired contractors are registered by this authority.

4.1.17 County Governments Act, 2012

This Act vests responsibility upon the County Governments in planning of development projects within their areas of jurisdiction be it projects of importance to the local County government or those of national importance. Section 102 of the Act provides the principles of planning and development facilitation which include integration of national values in county planning, protect the right to self-fulfillment within the county communities and with responsibility to future generations, protection of rights of minorities and marginalized groups and communities, promotion of equity resource allocation, among

others. Section 103 of the Act outlines the prime objective of county planning which aligned to the bill of rights and the constitution of Kenya.

Section 114 and 115 indicate and give guidelines in planning of projects of national significance and instill the aspect of public participation in every aspect of the planning process through that: clear strategic environmental assessments; clear environmental impact assessment reports; expected development outcomes; and development options and their cost implications. Each county assembly is tasked with the role to develop laws and regulations giving effect to the requirement for effective citizen participation in development planning and performance management within the county. The project proponent has initiated the process of County Government engagement in the initial project planning through application of essential development approvals from Siaya County.

4.2 Policy Framework

4.2.1 Environmental policy framework

The Kenya Government's environmental policy is geared towards sound environmental management for sustainable development. This is envisaged in the principle of prudent use, which requires that the present day usage should not "compromise the needs of the future generations".

The policy emphasis is on environmental protection in order to ensure sufficient supplies for the present and future generations. The policy envisages the use of the "polluter pays principle", where one is expected to make good any damage made to the environment.

The Kenya Government's environmental policy aims at integrating environmental aspects into national development plans. The broad objectives of the national environmental policy include:

- Optimal use of natural land and water resources in improving the quality of human environment;
- Sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of future generations;
- Integration of environmental conservation and economic activities into the process of sustainable development; and
- Meet national goals and international obligations by conserving bio-diversity, arresting desertification, mitigating effects of disasters, protecting the ozone layer and maintaining an ecological balance on earth.

4.2.2 Kenya's Vision 2030

Kenya Vision 2030 is the country's new development blueprint covering the period 2008-2030. It aims to transform Kenya into a newly industrialising, ''middle income country providing a high quality life to all its citizens by the year 2030''. The vision was developed through an all inclusive and participatory stakeholder consultative process, involving Kenyans from all parts of the country

The Vision 2030 is based on 3 key pillars; Economic Pillar, Social Pillar, and Political Pillar. The economic, social and political pillars of Kenya Vision 2030 are anchored on the following foundations: macroeconomic stability; continuity in governance reforms; enhanced equity and wealth creation opportunities for the poor; infrastructure; energy; science, technology and innovation (STI); land reform; human resources development; security and public sector reforms.

The 2030 goal for equity and poverty elimination is to reduce the number of people living in absolute poverty to the tiniest proportion of the total population. The initiative aims to expand access across different social and political dimensions, including: widening coverage of "essential health care"; equitable distribution of water, sewerage and sanitation services; improvements in public transport; and attaining gender parity and fairness in the delivery of justice. Reducing social inequalities, in short, cuts across all the economic and social initiatives proposed by Vision 2030.

4.2.3 The National Land Policy

The National Land Policy adopted by the cabinet as Sessional Paper No. 3 of 2009, acknowledges environmental problems faced by Kenya. These include degradation of natural resources such as forests, wildlife, water, marine and coastal resources as well as soil erosion and the pollution of air, water and land. In its section 129 the policy provides for ecosystem protection, urban environment management, environmental assessment and audits to be undertaken to conserve and manage the environment.

4.3 Institutional and administrative framework

The environmental institutional and administrative frameworks have been established by EMCA 2015 Amendment and include the following.

4.3.1 National Environment Management Authority (NEMA)

The responsibility of the National Environmental Management Authority (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment. In addition to NEMA, the Act provides for the establishment and enforcement of environmental quality standards to be set by the Cabinet Secretary in consultation with the Authority, which will govern the discharge, limits to the environment by the proposed project.

4.3.2 National Environmental Tribunal

The National Environment Tribunal (NET) is created under Section 125 of the Environmental Management and Coordination Act (EMCA) of 1999. Its functions are:

- To hear and determine appeals from NEMA's decisions and other actions relating to issuance, revocation or denial of Environmental Impact Assessment (EIA) licences or amount of money to be paid under the Act and imposition of restoration orders;
- To give direction to NEMA on any matter of complex nature referred to it by the Director General.

4.3.3 Land and Environment Court

This is established as a superior court to hear and determine disputes relating to the environment and the use and occupation of, and title to, land, and to make provision for its jurisdiction functions and powers, and for connected purposes. Section 13 (2) (b) of the Land and environment Court Act outlines that in exercise of its jurisdiction under Article 162 (2) (b) of the Constitution, the Court shall have power to hear and determine disputes relating to environment and land.

4.3.4 County Government of Siaya

It constitutes various developmental approvals departments such as the planning department. The project proponent presented the project drawings and plans to the department for approval prior to the project implementation. This had been done by the time this report was going to the print.

4.3.5 Ministry of Agriculture, Livestock and Fisheries

The overall function of the ministry is to enhance production of crops, livestock and fisheries, marketing and processing. The Ministry has also the mandate to provide development and extension services to smallholder farmers through its extension department.

The functions of the ministry are as follows:

- Formulate, implement and monitor legislations, regulations and policies;
- Provide extension services;
- Support research and promote technology delivery;
- Facilitate and represent agricultural state corporations in the government;
- Develop, implement and coordinate programmes in the agricultural sector;
- Regulation and quality control of inputs, produce and products from the agricultural sector;
- Management and control of pests and diseases;
- Promote management and conservation of the natural resource base for agriculture; and
- Collect, maintain and manage information on the agricultural sector.

4.3.6 Kenya Sugar Board (Kenya Sugar Act (2001)

The KSB acts as a technical unit to advise the Ministry in promoting all aspects of producing, processing and marketing of sugar cane, sugar and molasses. The KSB also advises on pricing and necessary legislation for the industry. Kenya Sugar Board (KSB) is a public body set up by the Sugar Act of 2001 under the Ministry of Agriculture. The Board succeeded the Kenya Sugar Authority, now defunct, and is mandated to:

- regulate, develop and promote the sugar industry
- co-ordinate the activities of individuals and organizations within the industry
- facilitate equitable access to the benefits and resources of the industry by all interested parties

A sugar development levy of 7% of the market price is charged by the Kenya Government on all sugar sales. This levy is collected by the Kenya Revenue Authority and is managed by KSB. The levy comprises the following:

- Cane Development 2%
- Infrastructure 1%
- Factory Rehabilitation 3%
- Grants to Research 0.5%
- KSB Administration 0.5%

The setting up of a single regulatory body, the Kenya Sugar Board (KSB) ensures that investors get a single source of investment advice on the sector. The sugar companies operate under the umbrella of the Kenya Sugar Board, which is a public body charged with the responsibility of promoting and fostering the effective and efficient development of

sugar cane for production of white sugar. KSB is also charged with the mandate of regulating the sector and ensuring the country is self sufficient in white sugar production.

4.3.7 The Wildlife Conservation and Management Act, 2013

This Act became operational on 10 January 2014. One of its guiding principles is the devolution of conservation and management of wildlife to landowners and managers in areas where wildlife occurs, through in particular the recognition of wildlife conservation as a form of land-use, better access to benefits from wildlife conservation, and adherence to the principles of sustainable utilization. Section 25 of the act provides for compensation for injuries and damages caused by wildlife (species listed in its third schedule) to humans and their properties respectively. Such compensation claims are to be reviewed and awarded by County Wildlife Conservation and Compensation Committees at the ruling market rates: provided that no compensation shall be paid where the owner of the livestock, crops or other property failed to take reasonable measures to protect the properties from damage by wildlife or land use practices are incompatible with the ecosystem-based management plan for the area.

The act in its sixth schedule list various animal and tree species that are nationally considered as critically endangered, vulnerable, nearly threatened and protected. It also lists in its seventh schedule, national invasive species for which control is required.

Section 48 restricts activities involving the above listed species without a permit from KWS. KWS can make recommendations to the responsible cabinet secretary, to prohibit carrying out of any activity which: is of a nature that may negatively impact on the survival of species listed in sixth schedule; or is specified in the notice or prohibit the carrying out of such activity without a permit issued by KWS.

Part IX of the act deals with the management of human-wildlife conflicts. It provides for handling of problem animals by land owners/occupiers or their agents.

Relevance: Any critically endangered, vulnerable, nearly threatened or protected species found within the project area will have to be managed in line with this Act. Further, management of any human-wildlife conflicts arising from the project implementation will also be guided by this act

4.3.8 Agriculture, Fisheries and Food Authority Act, No. 13 of 2013

This is an Act of Parliament to repeal the agriculture Act, Cap 318 to align with the new constitution. The Act abolishes some of the institutions created under the repealed agriculture act like KEPHIS and PCPB. It has replaced them with Agriculture, Fisheries and Food Authority. The Authority shall, in consultation with the county governments, perform the following functions:

- Administer the Crops Act, and the Fisheries Act in accordance with the provisions of these Acts;
- Promote best practices in, and regulate, the production, processing, marketing, grading, storage, collection, transportation and warehousing of agricultural and aquatic products excluding livestock products as may be provided for under the Crops Act, and the Fisheries Act.
- Collect and collate data, maintain a database on agricultural and aquatic products excluding livestock products, documents and monitor agriculture

through registration of players as provided for in the Crops Act and the Fisheries Act;
- Be responsible for determining the research priorities in agriculture and aquaculture and to advise generally on research thereof;
- Advise the national government and the county governments on agricultural and aquatic levies for purposes of planning, enhancing harmony and equity in the sector; and
- Carry out such other functions as may be assigned to it by this Act, the Crops Act, the Fisheries Act and any written law while respecting the roles of the two levels of governments.

Relevance: This piece of legislation is practical in this project since it will be subject to management and operational decisions made by the ministry of Agriculture, Livestock and Fisheries and the newly established Agriculture, Fisheries and Food Authority.

4.3.9 The Pest Control Products Act (Cap 346)

This is an Act of Parliament that regulates the importation, exportation, manufacture, distribution and use of products used for the control of pests and of the organic functions of plants and animals and for connected purposes. It also regulates against use of pest control products without due analysis from a certified analyst and inspection from an appointed inspector, in addition to granting due guidance on the licensing of use and storage of the said products.

Section 2 of the Act refers to "pest control product" as " a product, device, organism, substance or thing that is manufactured, represented, sold or used as a means for directly or indirectly controlling, preventing, destroying, attracting or repelling any pest and includes-

a) any compound or substance that enhances or modifies or is intended to enhance or modify the physical or chemical characteristics of a pest control product to which it is added; and
b) any active ingredient used for the manufacture of a pest control product;"

Relevance: Since the sugarcane farming will be aimed at improving the quality, quantity and variety of output from the project area, there are bound to be numerous sugarcane crop enhancement and protection activities by the proponent and farmers through use of pesticides and other soil-enriching chemicals. The relevant provisions in the Act will thus play an integral role in regulating the use of such products during operational phase of the project. It is therefore, vital that this legislation is granted requisite attention in the entire course of the project

4.4 International Conventions

4.4.1 The 1985 Vienna Convention for the Protection of the Ozone Layer

Intergovernmental negotiations for an international agreement to phase out ozone depleting substances concluded in March 1985 with the adoption of the Vienna Convention for the Protection of the Ozone Layer. This Convention encourages intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production, and the exchange of information. The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in

September 1987, and was intended to allow the revision of phase out schedules on the basis of periodic scientific and technological assessments. The Protocol was adjusted to accelerate the phase out schedules. It has since been amended to introduce other kinds of control measures and to add new controlled substances to the list.

4.4.2 The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer

This Protocol was drawn to cut down on the production and consumption of ozone depleting substances in order to reduce their abundance in the atmosphere, and thereby protect the earth's fragile ozone Layer. The Parties to the Montreal Protocol have amended the Protocol to enable, among other things, the control of new chemicals and the creation of incentive measures to enable developing countries to comply. The project envisages use air conditioning equipment. Coolants used should be those of none ozone depleting components as required by NEMA

4.4.3 The 1992 United Nations Framework Convention on Climate Change (UNFCCC)

The primary purpose of the convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases. The UNFCCC was adopted on 9th May 1992and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994. NEMA is the focal point for the Convention. The fuel used by the power back-up generator should be friendly to the environment and approved by the energy regulatory body, Energy Regulatory Commission (ERC).

5.0 CHAPTER FIVE: PROJECT ALTERNATIVES

The Proposed Alternatives

Due to the various negative repercussions of sugar processing industries on man and the environment, it is not possible to set up such facilities anywhere. To be economically viable, the preselected sites must combine the following:

i) Abundant resources, available all year long and the possibility of sustainable production;
ii) Existing water supply all year long in acceptable quantity and quality;
iii) Existing transportation facilities or possibilities to create them at a reasonable cost; and
iv) Existing energy supply.

The following checklist was prepared for the site selection process: -

Table 8: Checklist for site selection process

QUESTIONS	YES	NO
Is the water supply sufficient all year long?	Yes	
Is the water supply of good quality?	Yes	
Are there sufficient raw material resources in this area?	Yes	
Is a sustainable management of these resources possible?	Yes	
Are there resources sensitive to the proposed exploitation scheme?		No
Are there threatened species in this area?		No
Are there sensitive biotopes like rain forest, mangrove, coastal zone, wetland?		No
Is the transport infrastructure sufficiently developed?	Yes	
If no, is there negative impact linked with the transportation framework to be built?		
Is the energy supply assured?	Yes	
If no, will the energy supply have negative impact?		
Will the plant emissions have negative impact on the environment?	Yes	
Are there affected groups?		No
Will the project destroy important man made patrimony?		No
Does the project imply resettlements?		No
If yes, are there sufficient land resources in the area to allow a correct resettlement?		
Are there particular risks attached with this area?	Yes	
Is there positive impact of the project in the area ? (to detail)	Yes	
Other (to be mentioned)?		

5.1 Site alternative

The criteria kept for candidate sites included:

- Availability of industrial land
- Availability of Sugar Cane
- Proximity and purity of sugar cane
- Ease of conveyance of sugar cane
- Dispatch facilities
- Topography of site
- Availability of power and water supply
- Maximizing capacity utilization

The proponent wishes to ensure the maximum use of land in the area for the production of sugar cane. Hitherto, farmers have been concerned about the transport cost of cane all the way to a jiggery in Uhembo or Yala and therefore, have either stopped production or reduced it to minimal production on their lands. It is necessary that sufficient land is brought into production of cane in order to supply sufficient cane to the factory. The establishment of a sugar mill in the area will encourage the community to resume production.

The proposed project site is well connected by road, so that the finished products can be easily transported to the market. There is easy access for the farmers to supply their cane as the project site is right in the centre of the cane catchment area. The access roads are well maintained and will be kept in good condition by the proponent with the assistant of the Sugar Development Levy.

5.2 Raw Materials

The raw materials to be used here are the following: -

i. Sugar cane
ii. Sulphur
iii. Bagasse for power generation

The sugar cane can be easily accessed once it is planted and due to the site's proximity to the local community lands, assisting them in cane production will be very convenient and economical.

5.3 Alternatives to Technology

The sugar factory will connect to KP for energy apart from using its own by-product bagasse as fuel. Alternatives like utilizing diesel for generator or solar power for manufacturing are too expensive while at the same time, KP is basically a producer of GHG emissions and environmentally not recommended. Solar power can be utilized for the housing estate for the provision of hot water and security purposes.

It is also recommended that the factory harvest rain water from the roofs both in the factory and the residential estates for sugar processing and domestic use respectively. This will reduce costs of pumping water from Yala River.

5.4 Treatment Alternatives:

The sugar industries effluent is characterized by oil and grease, BOD, COD, suspended solids and pH requiring treatment. Unlike distilleries, the BOD level is not high and is about 1000-1500 mg/1. The factory will use the activated sludge process, extended aeration, aerobic lagoon, anaerobic treatment alone e.g. upflow or anaerobic sludge blanket (UASB) or diphasic anaerobic reactor or UASB followed by aerobic lagoon for the treatment of factory effluents.

Though this system is very effective in the treatment of wastewaters, require large tracts of land and release serious odors. An alternative would be to install a modern Effluent Treatment Plant with a final Reverse Osmosis that will produce high quality of treated wastewaters and avoids serious odors. Reverse Osmosis and Microfiltration technologies for treatment of industrial raw water are better, both in terms of quality and quantity of treated water, when compared to the more conventional lagoon technologies.

5.5 "No Project" Alternatives

The Government of Kenya's policy is to encourage investment in the industrial sector. In this option, it is required to be considered as to whether it is more advantageous to the Nation not to invest in this project at all. Poverty in the larger Siaya County is high, and the way to mitigate it is to invest in industry to provide employment both direct and indirect. Further the District does not have an appreciable cash crop and mainly practices subsistence farming. Wagai Division of Gem Sub-county is seriously disadvantaged as there is no cash crop in the area, it is landlocked and there are no industries. The community holds large parcels of land but these are mostly used for subsistence farming and the vast majority of fertile lands lies idle, further exacerbating poverty in the region.

An additional rationale would be the diversification strategy in light of the anticipated lifting of the COMESA restriction on sugar imports in December 2011. COMESA countries produce sugar cheaply than local sugar. To this end, the Kenya Sugar Board is pushing two agendas; co-generation and ethanol production of the local sugar firms to curb against effects of the lift of this restriction, which will open up the market to sugar imports.

It is noteworthy that the activity now proposed will support this cause of national productivity, of saving the foreign exchange, of providing employment and in an environmentally friendly manner. It will also produce organic bio-compost fertilizer, which is much in demand in place of chemical fertilizers, the latter of which is currently very expensive and costing the Government of Kenya a lot in terms of subsidy to farmers. This project is also one of the directions to go to ensure Kenya sugar millers are not made irrelevant when the COMESA market is open to importation of cheap sugar from outside the country. The local farmers may be the hardest hit due to the expensive sugar cane farming in the country.

This project, aims at sustainable development. Environmentally, it will lead to zero-discharge of harmful effluents into the environment and sustainably manage the environment utilizing all by products and waste products from sugar milling in a highly productive manner. 'No-Project' option is adopted only in an extreme last step of negative listing and is not warranted at all in the present case.

CHAPTER SIX: PUBLIC CONSULTATION

6.0 Government's policy on community consultation and participation

The Government of Kenya policy on community consultation and participation is to involve communities in policy formulation and implementation at the local level. More specifically, the Community Action Planning Programme's objective is to put in place a durable system of intra-community co-operation through collective action, which creates communal discussion forums for the implementation of development activities.

The Kenya government has enshrined the need for human societies' involvement in project development in the Constitution. This has been also set out in the EMCA, Amendment 2015 and Environmental (Impact and Audit) Regulations, 2003. Community consultation and participation ensures that communities and stakeholders are part and parcel of the proposed developments and in so doing assures the sustainable use of resources. It has also demonstrated successfully that projects that go through this process will acquire high level of acceptance and accrue benefits to a wider section of the society.

Public consultations form a useful component for gathering, understanding and establishing likely impacts of projects determining community and individual preferences and selecting alternatives. Furthermore, through public participation, it is possible to enhance project designs and ensure sustainability of the projects.

6.1 Objectives of the public consultation

The objective of the Consultation and Public Participation (CPP) as required in EMCA, Amendment 2015 was to:-

1. Disseminate and inform the public and other stakeholders about the proposed sugar factory project with special reference to its key components, location and anticipated impacts.
2. Create awareness among the public on the need for the EIA for the proposed project.
3. Gather comments, concerns and suggestions of the interested and, would be affected/interested parties.
4. Ensure that the concerns of the interested and, would be affected/interested parties were known to the decision-making bodies and the proponent at an early phase of project development planning.
5. Establish a communication channel between the interested, would be affected/interested parties, the team of consultants and the Government.
6. Incorporate the information collected in the study by EIA Expert.

The purpose for such a process was to identify the positive and negative impacts of the project and subsequently suggest mitigation measures. It also helped in identifying other miscellaneous issues which may bring conflicts during project implementation phase.

6.2 Key informants

During the study period, the study team conducted several visits to the study area in order to collect information on the biophysical and socio-economic environment. Key informants included the local community residents, sugarcane farmers, key sub county officials from the department of agriculture, and provincial administration. Open ended questionnaires were administered to key stakeholders in the month of November, 2016. Copies of the administered questionnaires are attached in Annexes of this project report.

The Study team together with the area provincial administration held a meeting at Kotoo Primary School to present and discuss the project with stakeholders and area leaders. The meeting was held on 21st November, 2016 and included the EIA Lead Expert and his team accompanied by the proponent's representative. The meeting was well attended and though the community raised concerns which they requested the proponent to look into including employment of locals, weighing of cane at the weighbridge and maintenance of access roads, they were eager to see the project begin. The minutes and list of attendance of the meeting is attached in the annexes of this report.

Plate 7: Area chief addressing the meeting

Plate 8: Area Assisstant Chief addressing the meeting

Plate 9:Gem Sub-county Agricultural Officer addressing the meeting

Plate 10: Gem West Ward Agricultural Officer addressing the meeting

Plate 11: Participants at the meeting

Plate 12: Participants at the meeting

Plate 13: A participant commenting during the meeting

Plate 14: A participant giving a comment during the meeting

6.3 Conclusion

From the various public consultations undertaken by the EIA study team, it is obvious that the project is very welcome in the region. The local community stand to gain from the project as most of their land is lying idle and it has high potential for cane production. The establishment of the factory will provide them with much needed jobs and the petty thuggery perpetrated by the youth in search of money would now be a thing of the past as they would be employed in sugar cane production and as workers in the factory. The establishment of a weighbridge to ensure the tonnage supplied was of utmost importance to the local farmers who had undergone a very painful time under the owners of the jaggeries who short-changed them at the supply of cane. Infrastructure development and road maintenance in the region would open it up for further economic development and it was the feeling of the community interviewed that this would be a great boost to the economy of the area.

There was no objection from any of the interviewees against the establishment of the factory.

Plate 15: The public raise hands in acceptance of the proposed project

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

7.0 Introduction

The Government is committed to encouraging sustained development of industries along with the maintenance of ecological and environmental balances. The cultivation and processing of sugarcane impacts the environmental through the loss of natural habitats, intensive use of water, heavy use of agro-chemicals, discharge and run-off of polluted effluent and air pollution. This leads to the degradation of wildlife, soil, air and water within sugar belts and also in downstream ecosystems.

Land clearance for cane cultivation results in substantial loss of wetlands in cane growing regions resulting not only in the direct loss of species and habitats, but also negative impact on a wider range of ecosystem functions, including changes to hydrology and increased soil erosion.

Perhaps the most significant impact from cane processing is related to polluted effluent. In some countries with weak environmental laws, when sugar mills are annually cleaned, a tremendous amount of matter is released. This is usually discharged straight into streams. Cane mill effluents tend to be relatively rich in organic matter compared to other sources, and the decomposition of this matter reduces the oxygen levels in the water, affecting natural biochemical processes and the species inhabiting those freshwater systems. Potential pollutants in these effluents include heavy metals, oil, grease and cleaning agents.

There is evidence that sustained pre-harvest burning of sugarcane can contribute to a decrease in soil quality, by causing a decline in soil microbial activity and the physical and chemical properties of the soil; pre-harvest burning may be responsible for as much as 30% of the annual nitrogen removal in a cane crop. Also cane burning can reduce the quality of sugar recovered from the cane as well as reduce the quantity of cane retrieved by as much as 5%.

Kenyan Sugar factories often pollute water bodies with factory effluents. Other major sources of pollution are the agrochemicals such as fertilizers, insecticides and herbicides that are added annually to the environment during sugarcane production. These chemicals find their way to water bodies where they are consumed by aquatic life-forms and taken in by humans as part of domestic water.

The problem of environmental pollution entails:

i. Pollution of water bodies by factory effluents, agrochemicals (fertilizers, herbicides and insecticides)
ii. Pollution of air by factory exhaust fumes and dust
iii. Noise pollution
iv. Sedimentation of water bodies by soils eroded from steep slopes

7.1 Impact Identification and Analysis

The environmental impact assessment and analysis was done using a number of methods and tools. While identifying impacts, a checklist was used. This indicated all possible impacts that would accrue from implementation of this project. A weighted matrix was used to examine the level of impact for each particular impact.

7.2 Checklist and Significant Matrix

The impacts are examined under two categories i.e. negative environmental impacts and positive environmental impacts. The various impacts in these two categories are then examined in order of their level of importance and significance. They are also examined in categories of their time of occurrence (construction or operational phase).

Table 9: Checklist identifying potential impacts from the project

Identified Impacts	Project stage			
	Design	Construction	Operation	Decommissioning
Air				
Pollution-dust, hydrocarbons		-	-	-
Odour		-	-	-
Increased noise		-	-	-
Ambient temperatures		-	-	
Soil				
Soil loss		-	-	-
Soil Contamination			-	-
Bio-diversity				
Loss of flora		-	+	
Loss of fauna		-	-	
Habitat alteration		-		-
Population				
Employment		+	+	+
Quality of life		+	+	+
Infrastructure		+	+	+
Water				
Surface flow		-	+	
Water balance		-		
Site drainage		-	+	+
Water Pollution			-	-
others				
Landscape		-	+	+
Cultural				
Economy		+	+	+
Aesthetics		-	+	+
Wastes		-	+	+

Note: - A symbol denoting negative impact
+ A symbol denoting positive impact

The above checklist identifies potential impacts from the proposed projects' different phases

7.3 Significance Matrix

The weightings of significance within the table below range from 0-3 whereby 0 represents no significance; 1 represents low significance; 2 means there will be some significant effect; and 3 represents high environmental significance.

Seven (7) environmental attributes were considered against the project activities. A total score of 0-7 on any row will represent an activity with negligible or no significance. A score of 8-14 will represent activities with significant impacts that will require some intervention to avoid adverse impacts. Aspects ranging from 15-21 will have high significance and these would have detrimental effects on the environment if left unchecked.

The matrix below conveys the negative impacts of the project activities against identified environmental attributes.

Table 10: Matrix showing significance of impact identified

Impact matrix	**Environmental Attributes**							
Weighting 0= not significant 1= low significance 2= significant 3= high significance	flora	fauna	population	soil	air	hydrology	landscape	Totals
Project Activities								
Design phase								
Planning and design	0	0	0	0	0	0	0	0
Impact assessment	0	0	1	0	0	0	0	0
Construction phase								
Ground clearing	1	1	0	1	1	1	1	6
Excavation	1	1	0	1	1	0	1	5
Civil works	1	1	0	1	1	0	1	6
Mechanical works	0	0	2	1	2	0	1	6
Materials transfer	1	0	1	1	1	0	1	5
Waste handling	1	1	1	1	1	0	1	6
Operation phase								
Sugar Process	0	0	0	0	1	0	0	1
Molasses spills	0	0	1	0	2	2	0	5
ETP	2	0	0	2	2	0	0	6
Human movement	0	0	1	2	1	1	0	5
Waste generation	1	1	1	2	3	2	2	12
Traffic flow	1	1	2	2	2	0	0	8
Total	11	7	12	15	20	5	8	

The horizontal sum totals represent the significance level of the project activities on the environment. Not much emphasis will be placed on activities with low or no significance score that are less than 7.

The vertical totals depict environmentally sensitive environments. With 7 activities on each column, each attribute can have a maximum score of 21. The maximum score would represent a very sensitive attribute that will require some intervention to curb adverse

impacts. There are however some positive impacts of the project with regard to economic gains, viz: employment creation, market for goods, tourism attraction, increased accommodation and conference facilities, etc.

7.4 Positive Impacts

Pre-construction phase

- Education and awareness on sugarcane growing and farming
- Assissting farmers in land preparation and provision fo seeds and fertilizers

Construction phase

- **Employment opportunities**
  The construction workforce is estimated at over 80 people. It is envisaged that employment at the proposed sugar mill will have an indirect injection of money into the local economy, with persons working on the project spending some of their wages in the local area. This in turn will encourage business activities for local entrepreneurs supplying goods to such persons.
- **Gains in the local and national economy**
  The construction stage will bring a need to for goods and services and local entrepreneurs should position themselves to provide such goods and services. Construction materials such as sand, ballast, rocks, cement, metal, fuel and among others will be sourced from various parts of the county. The consumption of these materials will attract taxes which will be payable to the government.

Operation Phase

- **Competition in the sugar sub-sector**

The proposed South Gem Sugar Factory is expected to reduce the monopolistic tendencies in the sector and allow farmers to choose where to sell their crop and thus provide them an improved platform to negotiate with respective factories as mutually interdependent partners. This will contribute to fair prices in sugar products

- **Improvement in the livelihoods of the sugar farmers**

The area farmers will gain from prompt payment of sugacane produce. Payment from the proponent is also expected to be competitive hence the farmers will be able to pay for the education of their children, acquisition of additional property notably land and construction o descent family shelter in Gem area and beyond.

- **Improved Infrastructure**

The area road network will be improved and maintained by the proponent. Apart from necessitating easier access to farms, the improved road network will help the community in their various transport activities. Road improvement will be done through partnership between the project proponent, national government through the Kenya Sugar Board and Kenya Roads Board and the County Government of Siaya.

- **Employment opportunities**

The operation workforce is estimated at up to 400 people. The empoyment will have an indirect injection of money into the local economy, with persons working on the project spending some of their wages in the local area. This in turn will encourage business activities for local entrepreneurs supplying goods to such persons. Apart from casual labour, semi-skilled and skilled employees are also expected to obtain employment during the construction period. The proponent has agreed with the local people that it will ensure that high priority for employment will be given to the local people. Employment will also lead in disposable income.

- **Improvement in local business**

There is a likelihood of different types of businesses being set up in Kanyilaji area and environs. Such businesses will include housing, transport, hotels, restaurants and shops, among others. In addition, since the area will open up, there is a high possibility of more investments including educational tours to see the factory which eventually could boost the local ecotourism sector in a significant way. The influx of population will require accommodation in the vicinity as well as food stuff therefore creating demand for agricultural produce.

- **Industrial development in Siaya County**

The success of this project will offer other diverse benefits to Siaya County including the upgrading of its industrial sector as an important economic and employment sector in the country. This is also in line with the Vision 2030 economic development agenda of refurbishing and expanding the manufacturing industries in Kenya.

- **Enhancement conservation**

The proponent will ensure spectacular landscaping which will uplift the general aesthetic outlook of the area. The proponent will also support reforestation and agro-forestry in the area as part of proposed CSR program so as to provide adequate supply of wood and timber for local uses through working with relevant stakeholders especially the area WRUAs.

7.5 6Negative Impacts During Construction

Vegetation Loss

Impact:

Construction of the sugar mill will require all the vegetation to be removed from the site to pave way for the construction of buildings, roads, walkways and other facilities.

Mitigation Measure:

However, the vegetation loss is set to be confined to the project location and will mainly consist of grasses and weeds as the ground has hitherto been used for sugar cane farming.

Solid Waste

Impact:

The project will result in solid wastes during construction such as timber, metals, nails, wires, glass, plastic piping, excavated soil and rocks, packaging materials and containers e.g. paint pails, cement bags, metallic straps, etc. During decommissioning phase, the expected wastes are debris such as concrete and sand, nails, metal scraps and cutoffs, building blocks and waste timber, excess roofing tiles and floor and wall tiles, wires, pipings, etc. If not properly disposed, these wastes will result in the pollution of soil, ground water and air (paint). Materials consisting of chemicals e.g. paints, cement and thinners will alter the chemical composition of these regimes. Waste generated during the operational stage from the offices, and accessory services if not properly managed, may cause direct impact to the surrounding environment.

Mitigation Measures during Construction

i) During the construction period an area will be specifically designated for solid wastes. These will be segregated and categorized into re-usable, those for re-sale and those that cannot be used again. Reusable material will be recovered so as to reduce wastage and cost of raw materials.

ii) The waste designated area will be well protected from the elements to ensure reduced chances of them being carried away by wind or rain.

iii) Surplus material that cannot be reused in any way will be removed from site by licensed waste handlers.

Mitigation Measures – During Decommissioning Phase

i) Solid wastes will be sorted for its different components. There shall be different waste bins for emptying at dry garbage and wet garbage areas.

ii) They will be stored at a central transfer point strategically located on site and channeled to licensed companies specialized in carting away of such wastes. These wastes will invariably be sent to official landfills or to recycling depots by NEMA registered waste disposers.

Dust Emissions

Air emissions result from construction activities such as excavation, earthmoving and land filling, stone cutting and concrete processing as well as the loading and unloading of construction material and waste. Impacts include increased dust and airborne particulates caused by grading, filling, removals and other construction activities. After construction is complete, dust levels are expected to return to near non-existing conditions. Air quality impacts may also result from emissions from construction equipment and possibly from traffic stopped at the entrance of the building site to deliver materials.

This might lead to an increase in respiratory problems and incidences of flu among children in the neighborhood.

Other air pollutants include the following:-

i) Carbon Monoxide

Carbon Monoxide (CO) is almost exclusively emitted by motor vehicles. This pollutant binds the oxygen-carrying protein in blood to hemoglobin, reducing the amount of the oxygen reaching the heart and brain. Exposure to CO, even at low levels, can endanger people with coronary artery disease. It can also cause headaches, fatigue, and slow reflexes, even among healthy people.

ii) Ozone

Ozone (O_3) is the primary constituent of photochemical smog. It is not emitted directly into the atmosphere, but is produced through a complex series of chemical reactions involving hydrocarbons (HC) and oxides of nitrogen (NOx) in the presence of sunlight. Vehicle exhaust emissions contribute slightly less than half of the pollutants that form ozone. The project location is however, devoid of large traffic and therefore such concentrations are very minimal.

iii) Small Particulates (PM-10)

Such particles are so small that, individually, they would not be visible. The fine particles are a threat to health, however, because they penetrate deep into the lungs during

breathing and lodge there. (Large particles, by contrast, are filtered out in the upper respiratory passages, or are cleared by coughing, sneezing, etc.)

iv) Oxides of Nitrogen

Nitrogen oxides (NOx) are produced by motor vehicles (particularly heavy duty vehicles) and high-temperature industrial operations, but have not posed a known health problem in the project area.

v) *Volatile Organic compounds (VOCs)*

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands.

This impact is short term and will last with the construction process of the project. The construction of this facility shall take all precautions to minimize dust.

Mitigation Measures:

i) The soil surface shall be kept humid through water spraying to control the level of dust during excavation works.
ii) In the event of strong winds on site, clearing works must stop;
iii) Ground should be wetted prior to clearing;
iv) Provide dust masks to construction staff working in dusty areas
v) Routine watering of the construction site and access roads to the site
vi) Utmost care to be taken while handling cement and rock sand product
vii) Construction materials must be properly stacked
viii) The site should be appropriately screened;
ix) Labour intensive methods of construction should be used;
x) A sense of environmental responsibility should be inculcated in the work force
xi) Monitor air regularly to ensure no hazardous gases escape into the air
xii) Dispose of debris from the construction site by licensed waste trucks to authorized dumping sites
xiii) Trucks carrying construction waste shall be covered during their trip from the construction site to the final disposal location.
xiv) Vehicles operating in the project will have to be compliant with international standards on exhaust emissions.

Population increase

Impacts

i) Development in general results in the influx of population. The magnitude of the population influx is directly related to size, type and location of development. This particular development will require both skilled and unskilled labour during both construction and operation phases.

ii) The area is not densely populated and any sudden influx of people will impact negatively on the use of facilities like toilets, and water, security of the premises, noise, etc. The sugar mill is expected to employ over 100 during construction phase and over 600 during operations. There will be suppliers and other such like people visiting the sugar mill during operations. It is therefore, expected that the population within the area will increase over time and enterprising individuals who

will construct housing for staff will also attract larger population outside the complex. Rapid population increase in an area also brings with it insecurity in most cases.

Mitigation Measures

i) The sugar mill will source almost all of its unskilled labour from the local communities in order to reduce an influx of population from outside the area;
ii) Requirements by the facility will be made in an organized manner from the surrounding communities; thereby reducing occurrence of opportunistic hawking that could result in a myriad of vices such as drug use and peddling, petty crime, alcohol abuse and harboring of criminals.
iii) During construction phase close monitoring of workers will be undertaken to ensure that unwanted characters are not absorbed.
iv) In addition, activities will be undertaken in a closed environment and food and other requirements will be provided within to reduce traffic in and out of the building site.
v) Security will be enhanced in and around the project site to reduce cases of material theft and any other uncalled for occurrences.
vi) Security agencies will be requested to beef up the current small police post in the area.

Noise

Impacts:

The construction site is more than 30 feet from Noise Sensitive Receptors (NSP) viz road users, and homes. A substantial temporary increase in ambient noise levels would occur if exterior noise levels at sensitive receptor locations would exceed 60 dBA during daytime construction activities.

The construction of the facility will cause a substantial temporary or periodic increase in ambient noise levels in the vicinity above levels existing without the project. During the construction phase of the development the increase is expected due to machinery and other construction activities, such as powered mechanical equipment (PME). For many construction works, concreting is required, i.e. concrete lorry mixer, vibratory poker and crane, compactor and roller, etc. These are usually in the PME list. Dump trucks are also required for disposal of excavated materials offsite, delivery of filling materials or asphalt concrete etc. For installation of the sugar mill, a lot of welding works will be undertaken. For some of the noise sources, there are no mitigation measures available that would reduce the impact to less than significant or substantially reduce the level of impact. However, the following measures can be used to mitigate the noises that can indeed be mitigated:-

Impacts of Noise

1. The nuisance caused by the noise levels produced during this phase will depend on the duration of the construction phase, the time of day when activities are undertaken, the attitude of the contractor and the receivers to the noise.
2. Considering that permissible continuous exposure to noise in a residential area is not more than 60 dBA for 8 hrs per day.
3. Visitor traffic along roadways to site access points may also increase noise levels.

However this impact is short term and will be experienced only during construction phase when heavy equipments will be used on site. More importantly, the nearest receptors will not be disturbed by noise during the day. However, at night, noise tends to carry and it would be cause of serious interruption to the nearby users.

Mitigation Measures
During the construction phase a number of actions will be taken to reduce noise levels from operations within the site.

i) Activities will only be undertaken during daylight hours as during the night it would disrupt sleep of neighbors and create a nuisance.
ii) Workers at site will be issued with ear muffs to protect their hearing from any high noise levels.
iii) Heavy machinery will not be a regular feature of the construction as materials will be brought into site only periodically.
iv) A noise barrier around the construction site viz plywood, corrugated iron sheets will be erected.
v) The DG Set should be housed in a sound proofed building to eliminate excessive noise
vi) All applicable Occupational Safety and health Administration regulation requirements will be followed.
vii) Construction equipment will possess properly working mufflers and will be kept properly tuned to reduce backfires.
viii) During the operational phase of the proposed project, when utilized, backup generators will create noise levels up to 75 dBA. To minimize noise levels, generators will be equipped with appropriate sound muffling devices.
ix) It is likely that there will be no measurable increase in noise levels from increased traffic at sensitive receptors along roadways leading to the site.

Implementation of these measures will reduce the expected short term noise impacts to a manageable level in and around the construction site.

Worker and Public Safety

Impacts:
During construction, there will be heavy equipment like concrete mixers, pockers, and vibrators, overhead cranes for lifting heavy materials to high levels, hoisting equipments, etc. There will be industrial gas cutters and welding equipment. The finishing of mechanical installation must be polished with hand grinding equipment which has a lot of steel spillage during the works. All these pose danger to workers and care must be taken for their safety.

Mitigation Measures:
Within the construction period, the project management will integrate a number of measures to maintain safety of both workers at site and the public around.

i. Movement of vehicles and machinery will be strictly restricted to slow speeds both within the project site and around with particular attention to populated areas outside to and from the site.

ii. Provision of PPE like goggles, ear muffs, hand gloves, boots, and dust masks must be provided. There will also be requirements for safety belts for high level work along with helmets.

iii. Signage will be posted within the project site and outside along the transportation route to warn people of large vehicle movement and turning as well as on increased traffic. Such signage will be clear and easily visible.

Environmental Impacts during Operations

Sugar industry is basically seasonal in nature and operates only for 120 to 200 days in a year. A significantly large volume of waste is generated during the manufacture of sugar and contains a high amount of pollution load particularly in terms of suspended solids, organic matter, and press mud, bagasse and air pollutants.

Wastewater Sources

Sources and Impacts

Mill house: Mill house wastewater is derived from continuous gland cooling and intermittent floor washing and contains high amounts of oils and grease and sugar from spills and leaks.

Boiler Blow-down: Boiler blow-down is fairly clean water except that it contains high dissolved solids and phosphates.

Rotary filter: Filter cloth is periodically washed and constitutes a source of wastewater.

Condensates: The vapours from the last effect evaporator and pan boiling are separately cooled in barometric condensers and the condensate goes to the pond. A part of the cooled water from the pond is recycled into the sugar mill, but a large portion is discharged as wastewater. If the mill operates without overloading, the evaporator and vacuum pan condensate is quite clean and the entire quantity can be reused. But many a times, overloading and poor operating conditions can lead to significant sugar losses in the condensates through entrainment and thus polluting the water.

Occasional Spills and Leaks: Leaks from pumps and pipes in the evaporators and centrifuge house, along with periodical floor washings, constitute another source of wastewater. Although the flow is intermittent and volume discharged is not large, it represents the most polluting fraction of sugar mill wastewater.

Condensate Washings: Evaporators, juice heaters, pans, etc are cleaned once in 20 days for removal of deposited scales. Caustic soda, sodium bicarbonate and hydrochloric acid are used for scale removal. Normally the caustic soda washings are stored and reused for cleaning operations. However, in India, most of the sugar mills discharge these chemicals into the drains. After the equipment is boiled with caustic soda and rinsed with fresh water, it is cleaned with dilute hydrochloric acid using an inhibitor. The wastewater is discharged into the drains, as the recovery of the chemicals may not prove to be economical. It is seen that the wastewater has small organic load but inorganic content may be high to pose a shock-load to wastewater treatment facility (occasional discharge, once in fortnight). It is suggested to have a holding tank and mix this wastewater gradually to the final effluent to avoid shock loading on the treatment plant.

Sulphur and Lime Houses: The washings of sulphur and lime house would contain a considerable amount of inorganic solids, which include carbonates and sulphates. The effluents from these two units when combined would give neutral pH value of waste. This wastewater does not contribute to organic pollution but can be characterized as inorganic wastewater.

a) Wastewater parameters

BOD: - This is the measure of the oxygen consuming capabilities of organic matter. During decomposition, organic effluents exert a BOD that can deplete oxygen supply. BOD is generally measured and expressed in parts per million or milligrams per litre. The effluents from a raw sugar factory can vary between hundred to several thousands mg/l.
Dissolved Oxygen: - This is water quality constituent. It is measured and expressed as parts per million or mg/l.
Total Suspended Solids (TSS): - Suspended solids when they settle form sludge on the stream, lakebed and they are most damaging to the life in water.

Mitigation Measures:
SGSC will direct wastewaters to the lagoons to be constructed on the lower end towards the south of the project site. There will be aerobic and anaerobic treatment before the treated waters are passed through an artificial wetland to be constructed as the last cleansing stage. The artificial wetland will have various plants that have a high capacity to absorb nutrients such as alfalfa, papyrus,

The different modes of disposal of wastes are:

i. Disposal into water bodies (River/ stream)
ii. Evaporation in open pits
iii. Disposal into ocean
iv. Press mud for fertilizer
v. Bagasse for paper and pulp and fibre
vi. Bagasse for power generation

b) Solid Wastes

Bagasse: It is estimated that bagasse contributes to 33.3% residue of the total cane crushed. It has a calorific value of about 1920 kcal/kg and is mainly used as fuel in boilers for steam generation.
Press Mud: It contains all non-sucrose impurities along with $CaCO_3$ precipitate and sulphate. Press mud from double sulphitation process contains valuable nutrients like nitrogen, phosphorous, potassium, etc, and therefore used as fertilizer. The press mud from double carbonation process is used for land filling and is not used as manure.

c) Air Pollutants

The bagasse, on burning, produces particulates, viz., unburnt fibres, carbon particles and gaseous pollutants like oxides of nitrogen, water vapour and other organic compounds. Of the particulate waste, the heavier particles slowly settle down in the surrounding area. Such dust fall leads to the problems of cleaning, reduction in property value, effect on vegetation, etc. The main gaseous pollutants are CO, which is altogether not measured by any unit, and CO_2 is reported to be in the range of 12 – 14%.

Wastewater Reduction and By-Product Recovery:
The following areas are important to economize the usage of water.

(A) Cooling Water

Mainly used for condenser, bearing cooling, sulphur/lime houses and crystallizer for formation of crystal. In condenser, water gets mixed with vapour. However, adjusting pH along with make-up water to keep dissolved solids in check can recycle it.

Evaporator cooling water contains entrained sugar and acid because of excess of SO_2 and can be recycled. Improvement in the designs of evaporator/pan boiler can reduce the loss. Losses will also be due to evaporation, splashing and percolations.

Keeping the temperature of incoming water between 30^o and 35^oC can reduce losses due to evaporation. Splashing and percolation can be checked by proper maintenance.
Cooling water for bearings, power generation, etc., can be reused safely.

(B) Process Water

Sugar mill employs both hot and cold water for its various processes such as maceration, filter cake washing, lime preparation, dilution for lowering brix, dilution in evaporators and pans, massecuite, magma making and crystal washing in centrifugals.

Water requirement before evaporator storage is about 1/5 to ¼ of steam used while that used after evaporator requires approximately equal amounts, as for steam. Careful attention is required after evaporator stage to control water usage. Hot water can be used in place of cold water to reduce the quantity of steam required.

It is preferable to use 18 – 20% maceration by equally adjusting it from the top and the bottom of bagasse bed feeding to the last mill at a pressure of 7 – 14 kg/cm2 rather than merely pouring the same at 25 to 30% of cane (about 5 – 7% water can be saved). If maceration is high enough, there will not be any need of dilution water for juice. To reduce water quantity, light molasses can be used for magma making.

Washing Water: Wash water may contain sugar and therefore requires treatment and should not be recycled. Periodic cleaning results in high BOD and it also contain caustic soda and weak acids.
Testing Water: This water is safe for returning it to the service water tank.
Oil and Grease: providing suitable oil and grease traps can eliminate this.
Chemical Reuse: The stored and settled supernatant can be reused with a little addition of fresh caustic soda for next cleaning operation.
Molasses Handling: It is necessary to store molasses in RCC tanks or steel tanks above ground level. Otherwise, there is a possibility of ground water contamination. The high BOD of molasses may cause pollution problems due to mishandling.

C) Sludge Treatment and Disposal

Recommended methods for the treatment of sludge from wastewater treatment include the following:

i. Aerobic stabilization or anaerobic digestion. Anaerobic stabilization improves the sludge applicability to agriculture;
ii. Gravity thickening;
iii. Sludge dewatering on drying beds for small-scale facilities and dewatering using belt presses and decanter centrifuges for medium- and large-scale facilities;
iv. Using sludge from concentrated sugar juice prior to evaporation and crystallization (known as press mud) to produce organic manure and soil amendment for agricultural applications.

(D) Product Recovery

The by-products available from sugar mills are bagasse, furnace ash, molasses and filter mud. The uses of these byproducts are given below. If all the byproducts are used for transformation into value added products, (resource recovery), it will minimize the pollution to large extent.

Bagasse: These are used for steam, power, sugar production, pulp and paper.
Molasses: These are used for production of ethanol (power alcohol).
Filter mud: For fertilizer.
Boiler ash: For mixing with filter mud.

Cleaner production Methods of Wastewater Production

These include:

- waste segregation to enable dry handling of fly ash;
- recycling bagasse for use in absorbing grease and oil spills;
- recycling clarified water from ash settling pond and condensate tank overflow for cleaning purposes;
- housekeeping measures such as monitoring oil spills, repair of leaking pumps, removing debris from canals.

Considering that water is a critical concern of the facility, an ultrasonic flowmeter should be installed in order to monitor sudden surges in the volume of the wastewater, immediately identify the cause of the rise in volume, and implement remedial measures.

Through waste minimization, it is possible to minimize water consumption by almost 80%. As a result, abstraction from the surface water source (a river) is reduced thus conserving water resource. This also makes it very easy to comply with government standards and regulations on effluent discharge. With regard to reduced consumption of lead sub-acetate, the benefits from reduced lead pollution are significant.

Reduced Soil Quality Due To Hazardous Materials Spills

Wastes that are considered hazardous in Kenya are defined as those that are listed in the fifth schedule of the National Environment (Waste Management) Regulations (1999). Hazardous materials include substances, if released, may pose risks to the environment or to the health and safety of people or wildlife. Hazardous materials to be used at the factory will include the following:

i) Process Chemicals - kept in the main store where housekeeping and storage conditions are considered adequate. The floor will be concrete, preventing surface contamination and most chemicals are kept on pallets, which keeps them dry.
ii) Sulphur (Lime)
iii) Caustic soda and washing soda
iv) Talocide (antibacterial spray applied in vicinity of milling equipment)
v) Phosphoric acid
vi) Seperan/Flocculant
vii) Sodium hydrosulphite
viii) Fuels - petroleum storage tanks

Other Hazardous Materials –
Other hazardous materials to be used will include various types of lubricating oils. Empty waste oil drums etc.

Impacts
A hazardous materials spill may occur from inadequate storage, fuelling activities, or as a result of a vehicle accident. Depending on the location of the spill, impacts to surface water, groundwater, and/or soil could result.

Mitigation Measures
The following mitigation measures are proposed to decrease the potential risk of decreased environmental quality due to spills of hazardous materials:

i) Develop a spill prevention plan.
ii) Ensure that chemical containers are labeled and documentation regarding safe handling or first aid measures (i.e. MSDS) are accessible from each storage and use location.
iii) Make spill clean-up equipment readily available in chemical storage areas.
iv) Ensure that chemical containers are stored in a safe fashion to reduce the potential for containers falling over and spilling.
v) Storage of fuels and other hazardous materials will be conducted in designated locations only
vi) Work will be monitored during construction to ensure there are no releases of deleterious substances.
vii) Re-fuelling and maintenance of equipment will be conducted in designated locations only.
Viii) Workers who handle the chemicals will be provided training in chemical safety and adequate personal protective equipment. Occupational exposure of workers during handling of toxic powdered chemicals such as caustic soda and sulphur, is a particular concern. Emergency showers or eyewash stations in areas where some chemicals are handled are in place.

Safety

Impact
Sugar in boiler feed water causes water to foam, which will lead accidents. If not present in large quantity. It is decomposed by heat into products that are detrimental to the tubes and shells of boilers causing pitting and overheating. If sugar is present in small amounts their traces will be eventually accumulated on the boiler tubes as a harmful and dangerous carbonaceous deposit. The break down of sugar also forms harmful organic acids.

Mitigation Measures:
To prevent this, lime is added to feed water to maintain pH = 8.0. A pronounced odour develops in the steam if boiler water contains sugar. Under such conditions the contaminated feed water is turned to sewer and the boilers are blown off.

To prevent these hazards tests are conducted to determine amount of sugar traces in water. The most commonly used tests are Naphthol test and Arsenomohydate test.

Increased Traffic

Impact
During operations, there shall be additional vehicles supplying materials and collecting the finished product. There will also be heavy and light vehicles moving in and out of the compound supplying various materials or bringing in staff. The additional traffic, estimated

between almost 100 vehicles per day may cause an impact on the access road to site and particularly on the access road connecting Wagai and Aluor.

However, the above estimated increase in traffic density is within acceptable limits and should not cause any undue hindrance to the free flowing traffic in the area. Moreover, most of this traffic will occur during the daytime.

Mitigation Measures

i) There should be speed bumps on the road to slow down speeding vehicles that may cause accidents when vehicles wish to turn into the site;
ii) The sugar mill management should set up a common transport system for her employees with a view to encourage mass transport.
iii) Signs should be posted 100 meters before and after the entrance of the sugar mill indicating that vehicles may be turning off the road.

Fire Hazards

***Impacts*:**

Fire may present a very real potential danger for the sugar mill and its amenities. The principal potential hazard is bagasse and fires from the boiler. This derives from its inherent quality of high flammability. Such an occurrence will inevitably have an environmental bearing on the atmosphere. A fire is a combustion which develops in a totally uncontrolled manner with respect to time and space. It produces tremendous quantities of heat, smoke and polluting and even toxic gases. The energy generated further favors the spreading of the fire.

Impact on humans

1. Smoke and gases such as CO_2, CO, H_2S
   They present the following hazards:
   i. Temperature (internal burns by inhalation of hot gasses)
   ii. Opacity (which obstructs the view for evacuation)
   iii. Asphyxiation through lack of oxygen (the oxygen concentration in ambient air is 21%, during a fire this concentration is drastically reduced).
   iv. Ozone depletion
2. Flames and Heat

The flames reach temperatures of 600^{o}C to 1200^{o}C and burns immediately result from any human contact with them. The flames also constitute a hazard for the human eye.

Impacts on the Mill and neighboring homes

i. The destruction of the buildings and their contents
ii. Costs associated with the damages caused
iii. The destruction of the entire sugar mill

Mitigation Measures

Mitigation measures will be taken at the design and operational phases of the project to minimize this risk and concurrently, to provide security to the project and its users. A major ecological impact may result from any of the amenities of the facility catching fire on a normal operational day. The following measures will be taken to firstly reduce such a risk to a minimum and secondly to initiate immediate fire-fighting response measures in the case of a fire outbreak:

i. Smoke detectors will be installed at strategic locations in the site
ii. A fire alarm system comprising of break glass call points, fire detectors, sirens and a control indicator panel will be installed within the premises
iii. Hose reels systems with a permanent connection to a pressurized water supply will be installed running along the perimeter wall
iv. Portable firefighting equipment in compliance with the current standards and requirements the relevant authorities will be provided at conspicuous locations viz, storage tanks, loading and unloading system, generator room etc.
v.` Speedy evacuation plans will be included in the building plans for the eventuality of a fire and evacuation signs (exit) will be placed at strategic locations in the building. Fortunately, there is ample open space around the facility to act as a retreat in case of a fire emergency
vi. Sprinklers and connection to pressured water supply to be installed in the bagasse shed to douse any fire outbreaks in this area
vii. Procedures to follow in case of fire will be displayed along corridors, individual offices and in public ways to ensure safe and speedy evacuation of personnel and visitors.
viii. A fire escape must be provided with wide open escape routes to allow speedy exit in case of fire. The fire escape must be fitted with ladders on the outside of the building and mechanically fabricated in steel format comprising of chequered plates and handrails.
ix The staff will be trained on fire fighting and fire drill and first aid.
x. A 200,000 litres water tank connected to water sprinkler system supplying water to the piping around the perimeter wall to fight fire outbreak will be constructed underground.

All guidelines, norms, specifications and conditions likely to be imposed by the Government will be strictly compiled with.

Ambient Noise

The expected major source of noise in the sugar factory will be the boiler, but other processes can also be noise generators. Use of control rooms is an effective engineering control. Noise abatement measures should achieve either the levels given below or a maximum increase in background levels of 3 decibels (measured on the A scale) [dB(A)]. Measurements are to be taken at noise receptors located outside the project property boundary.

	Maximum allowable log equivalent (hourly measurements), in dB(A)	
	Day	**Night**
Receptor	**(07:00–22:00)**	**(22:00–07:00)**
Residential, institutional, educational	55	45
Industrial, commercial	70	70

Monitoring and Reporting

Monitoring of air emissions should be on an annual basis, with continuous monitoring of the fuel used. Only fuels with acceptable levels of ash and sulfur should be used. Monitoring of the final effluent for the parameters listed in this document should be carried out at least

daily, or more frequently if the flows vary significantly. Effluents should be sampled annually to ensure that biocides are not present at significant levels.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. The results should be reported to the responsible authorities and relevant parties, as required.

Mitigation Measures:

i. Noise reduction options that should also be considered include:
ii. Selecting equipment with lower sound power levels · Installing silencers for fans
iii. Installing suitable mufflers on engine exhausts and compressor components
iv. Installing acoustic enclosures for equipment causing radiating noise
v. Improving the acoustic performance of constructed buildings, apply sound insulation
vi. Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective
vii. Installing vibration isolation for mechanical equipment
viii. Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas, and limiting the number of equipment operating simultaneously, where the noise level exceeds ambient levels of 70 dB by more than 20 dB.
ix. Re-locating noise sources to less sensitive areas to take advantage of distance and shielding
x. Siting permanent facilities away from community areas if possible
xi. Taking advantage of the natural topography as a noise buffer during facility design
xii. Reducing project traffic routing through community areas wherever possible
xiii. Developing a mechanism to record and respond to complaints
xiv. Monitor noise levels during construction
xv. Equipment and vehicles will not be left idling for longer than 10 minutes at a time.
xvi. Provide hearing protection to staff.
xvii. Clear warning signs indicating high level noise areas and emphasis of noise protection equipment in those areas
xviii. Noise levels will be monitored semi-monthly. Monitoring events will be conducted during operation of the boilers.
xix. If off-site noise levels are greater than 70 dBA for extended periods of time, SGSC will investigate the Installation of sound barriers such as trees or earth barns to reduce off-site noise levels. Noise monitoring will allow corrective measures to be applied. The residual effect of noise disturbance during operation will be of low consequence.

Stormwater Management

Stormwater includes any surface runoff and flows resulting from precipitation, drainage or other sources.

Impacts:

Typically stormwater runoff contains suspended sediments, metals, petroleum hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), coliform, etc. Rapid runoff, even of uncontaminated stormwater, also degrades the quality of the receiving water by eroding stream beds and banks.

Mitigation Measures:

In order to reduce the need for stormwater treatment, the following principles should be applied:

i. Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge
ii. Surface runoff from process areas or potential sources of contamination should be prevented
iii. Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff
iv. Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should be reduced (e.g. by using vegetated swales and retention ponds);
v. Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present;
vi. When water quality criteria allow, stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility;
vii. Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas.
viii. Sludge from stormwater catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.

Sanitary Wastewater

Sanitary wastewater from industrial facilities may include effluents from domestic sewage, food service, and laundry facilities serving site employees. Miscellaneous wastewater from laboratories, medical infirmaries, water softening etc. may also be discharged to the sanitary wastewater treatment system. Recommended sanitary wastewater management strategies include:

i. Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g. septic system which can only accept domestic sewage);
ii. Segregation and pretreatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into sewer systems;
iii. Sludge from sanitary wastewater treatment systems should be disposed of by a licensed NEMA Registered Waste disposal management entity.

Residuals from Wastewater Treatment Operations

Sludge from a waste treatment plant needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste and managed accordingly as described in the Waste Management section of this document.

i) Occupational Health and Safety Issues in Wastewater Treatment Operations

Wastewater treatment facility operators may be exposed to physical, chemical, and biological hazards depending on the design of the facilities and the types of wastewater effluents managed. Examples of these hazards include the potential for trips and falls into tanks, confined space entries for maintenance operations, and inhalation of VOCs, bio-aerosols, and methane, contact with pathogens and vectors, and use of potentially hazardous chemicals, including chlorine, sodium and calcium hypochlorite, and ammonia.

Detailed recommendations for the management of occupational health and safety issues are presented in the relevant section of this document. Additional guidance specifically applicable to wastewater treatment systems is provided in the EHS Guidelines for Water and Sanitation.

ii) Monitoring

A wastewater and water quality monitoring program with adequate resources and management oversight should be developed and implemented to meet the objective(s) of the monitoring program. The wastewater and water quality monitoring program should consider the following elements:

Monitoring parameters: The parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements;

Monitoring type and frequency: Wastewater monitoring should take into consideration the discharge characteristics from the process over time. Monitoring of discharges from processes with batch manufacturing or seasonal process variations should take into consideration of time-dependent variations in discharges and, therefore, is more complex than monitoring of continuous discharges. Effluents from highly variable processes may need to be sampled more frequently or through composite methods. Grab samples or, if automated equipment permits, composite samples may offer more insight on average concentrations of pollutants over a 24-hour period. Composite samplers may not be appropriate where analytes of concern are short-lived (e.g., quickly degraded or volatile).

Monitoring locations: The monitoring location should be selected with the objective of providing representative monitoring data. Effluent sampling stations may be located at the final discharge, as well as at strategic upstream points prior to merging of different discharges. Process discharges should not be diluted prior or after treatment with the objective of meeting the discharge or ambient water quality standards.

Data quality: Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose. Sampling and Analysis Quality Assurance/Quality Control (QA/QC) plans should be prepared and, implemented. QA/QC documentation should be included in monitoring reports.

Table 15: Indicative Values for Treated Sanitary Sewage Discharges

Pollutants	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coli form bacteria	MPNb / 100 ml	400a

Notes:

a Not applicable to centralized, municipal, wastewater treatment systems

b MPN = Most Probable Number

Additional engineering controls may be required to contain and neutralize nuisance odors.

Management of industrial wastewater and examples of treatment approaches are regulated in the EMC (Waste Management) Regulations 2006. Through use of these guidelines and good practice techniques for wastewater management, facilities should meet the Guideline Values for wastewater discharge as indicated in the relevant table of Part III of this industry sector document.

Sugar manufacturing requires considerable quantities of high quality water for raw material cleaning, sugar extraction, final sugar washing, and cooling and cleaning equipment. Steam is essential to the evaporation and heating of the various process steps in sugar processing. Cane raw materials also contain high percentages of water, which can be recovered and reused during processing.

Additional industry-specific measures applicable to sugar manufacturing include:

- Recycle process water and apply to the washing of incoming raw material;
- Use closed loops for intensive solid generating washings, (e.g. cane and beet wash) and flue gas scrubbers.

Emissions to Air

Air emissions in sugar manufacturing are primarily related to particulate matter generated from bagasse-fired steam boilers, dust from unpaved access roads and areas, and sugar drying or packing activities. Inadequate cleaning of the raw material may result in fermented juice, which will also create a foul smell.

i) Particulate Matter and Dust

Recommended measures to prevent or control particulate matter include the following:

i. Typical control methods include boiler modifications or add-on controls, (e.g. flue gas cyclones, fabric filters, or electrostatic precipitators, wet scrubbers and local recirculation systems) to capture the ash and recycle the water to prevent the emission of particulate;
ii. Use wet scrubbers to remove dust from drying and cooling of sugar;
iii. Reduce fugitive dust from roads and areas by cleaning and maintaining a sufficient level of humidity;

iv. Install ventilation systems with filters on transport systems for dry sugar and on sugar packing equipment.

ii) Exhaust gases

Exhaust gas emissions produced by the combustion of organic materials in boilers for power and heat generation can be the most significant source of air emissions in sugar processing activities. Air emission specifications should be considered during all equipment selection and procurement.

Reduced Air Quality Due to Dust Generation during Bagasse Handling, Storage and Disposal

While not a hazardous material, bagasse creates nuisance dust and is thus damaging to the environment. The proponent proposes to generate power for use in the sugar mill. However, he may not utilize all the

Mitigation Measures

The following mitigation measures are proposed to decrease dust generation during bagasse handling, storage and disposal:

i) The company will develop a bagasse handling management plan to manage bagasse supply and demand to the boilers and to ensure bagasse quality is maintained during storage.
ii) Repair leakages in bagasse and bagacillo chutes to reduce dust releases.
iii) Ensure an enclosed bagasse shed to keep the dust enclosed.
iv) Provide Personal Protective Equipment and training to personnel working directly with dust-generating materials.

Air Quality Deterioration Due to Fossil Fuel Emissions

It is unlikely that air quality will be affected by fossil fuel emissions generated during project activities. Although carbon monoxide, carbon dioxide, nitrogen oxides, sulphur oxides, methane, and ground ozone levels may be slightly affected locally during times of construction using diesel or gas powered equipment, the changes in air quality due to project activities are expected to be minor. Although the potential emissions produced during construction activities are low, there is a continual effort to decrease worldly emissions; therefore, mitigation is required in the project study area.

Mitigation Measures

The following mitigation measures are proposed to reduce emissions from vehicle and equipment use:

1. SGSC will ensure that vehicles and equipment are inspected and maintained. A poorly maintained engine and under-inflated tires can increase fuel consumption by up to 10% and 4 to 8%, respectively.
2. Vehicles and equipment will not be left idling when not in use.
. No ozone depleting substances will be used or generated from equipment during construction.

Ensuring a high standard of inspection, maintenance, and operational practices is an effective method of controlling excess emissions. This will reduce the magnitude and probability of gaseous and particulate emissions from vehicle and equipment use to an

acceptable level. The residual effect of decreased air quality due to fossil fuel emissions was evaluated to be of low consequence in the project study area.

Occupational Health and Safety during Operations

Occupational health and safety hazards for sugar manufacturing facilities are similar to those of other industrial facilities and recommendations for the management of these issues can be found in the OSHA 2007. In addition, occupational health and safety issues that may be specifically associated with sugar manufacturing operations can be found in the World Bank EHS Guidelines and include the following:

i. Physical hazards
ii. Exposure to dust and biological hazards
iii. Exposure to chemicals (including gases and vapors)
iv. Exposure to heat and cold and radiation
v. Exposure to noise and vibrations

Physical hazards

The most severe injuries in this sector are often attributable to the failure of lockout – tag-out systems. Robust lockout – tag-out procedures should be implemented.

Recommended measures to prevent, minimize, and control general physical hazards (e.g. trips, falls, and materials handling hazards) include:

i. Install catch platforms under conveyors that cross passageways or roadways;
ii. Quickly clean up spills;
iii. Use non-skid walking surfaces that allow drainage;
iv. Install guard rails on walkways adjacent to production lines or at height, and clearly mark traffic lanes for vehicles and pedestrians;
v. Equip mobile equipment with roll-over protection.
vi. Establish routines to ensure that heavy loads are not moved by crane over personnel;

ii) Bagasse dust

Exposure to bagasse dust is a potential concern in the bagasse handling area of sugar mills.

Recommended measures to prevent, minimize, and control dust include:

i. Enclose and ventilate saws, shredders, dusters, and bagasse conveyors;
ii. Consider enclosed chip storage;
iii. Avoid use of compressed air to clear dust and waste paper;
iv. Enclose and ventilate areas where dry, dusty additives are unloaded, weighed, and mixed, or use additives in liquid form;
v. Regularly inspect and clean dusty areas to minimize dust explosion risk.

iii) Confined Spaces

Operation and especially maintenance work may include confined space entry. Examples include: boilers, dryers, degreasers, digesters, blow pits, pipeline pits, process and reaction vessels, tanks, and vats.

A confined space is defined as a wholly or partially enclosed space not designed or intended for human occupancy and in which a hazardous atmosphere could develop as a result of the contents, location or construction of the confined space or due to work done in or around

the confined space. A "permit-required" confined space is one that also contains physical or atmospheric hazards that could trap or engulf the person.

Confined spaces can occur in enclosed or open structures or locations. Serious injury or fatality can result from inadequate preparation to enter a confined space or in attempting a rescue from a confined space.

Recommended management approaches include:
Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.

Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space should provide ample room for emergency and rescue operation

vi) Noise and Vibrations
Noise and vibrations result from a variety of sources (e.g. internal and external transportation, flow in pipelines, lime milling, rotating machinery, ventilators, turbines, and compressors). The Excessive Noise and Vibrations Regulations 2009 are in force and have recommended noise levels above which the industry should not operate based on its character, site and neighboring location.

vii) Community Health and Safety
Community health and safety impacts during the construction, operation, and decommissioning of sugar manufacturing plants are common to those of other industrial facilities

Recommended measures for worker and public safety include the following:

i. Signage will be posted within the project site and outside along the transportation route to warn people of large vehicle movement and turning as well as on increased traffic. Such signage will be clear and easily visible
ii. Workers at site will be adequately provided with Personal Protective Equipment (PPE). Equipment to be provided will include worker's boots, helmets, dust masks, gloves, safety harnesses, goggles and ear muffs
iii. There will be adequate first aid kits placed at easily accessible points
iv. The upper floors of the sugar mill must be fitted and equipped with chequered plate hand rails wherever possible
v. All pipes should be colour coded and steam pipes will be properly installed and indicated where necessary
vi. OSHA Act and WIBA should be strictly adhered to by the management
vii. SGSC should consider Public Liability Insurance in case of accidents to visitors

Security

Impact
Security within the premises is a major issue that must be addressed as lack of security can be an environmental hazard to the staff within the institution. The aim of a security system is to ensure the safety and security of the staff, clients and visitors to the facility, to protect the property of SGSC against any hostile activity e.g. theft, vandalism etc, to maintain public order and proper behavior in the plant and to allow the users of the facility a quiet

environment and privacy. It will also enable a fast and efficient response in case of any accident which requires interaction with external authorities such as police, emergency, first-aid, etc. Security also guarantees the proper, fitful and honest behavior of all employees.

Mitigation Measures

i. 24 hours security should be provided within the premises and at the entrance to the facility by:
ii. Installation of an entrance and exit security check. This requires a proper gate and gate house, and security system to check those entering and exiting;
iii. Procedures to leave items such as cigarettes, matchsticks, lighters, mobile phones, etc at the gate as a security measure to be put in place
iv. Well trained security officers from a reputable company to patrol the grounds
v. The company should install an internal surveillance system that will monitor the plant at all times.

Environmental Health and Safety

An Health, Safety, and Environmental Management Manual should be prepared to clearly define the responsibilities and procedures to be implemented throughout project preparation and operation of the facilities. Adequate risk assessment and emergency response plans and procedures to handle unforeseen risks and emergencies must be incorporated in the HSE manual. As part of its community environmental plan, SGSC will undertake periodic monitoring and consultation with the local communities during operation of the facilities to identify any major impacts and implement appropriate actions to mitigate the adverse impacts.

Traffic Safety

Impact

Traffic accidents have become one of the most significant causes of injuries and fatalities among members of the public worldwide. Traffic safety should be promoted by all project personnel during displacement to and from the workplace, and during operation of project equipment on private or public roads. Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of project workers and of road users, including those who are most vulnerable to road traffic accidents.

Mitigation Measures:

Road safety initiatives proportional to the scope and nature of project activities should include:

i. Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include:
ii. Emphasizing safety aspects among drivers
iii. Improving driving skills and requiring licensing of drivers
iv. Adopting limits for trip duration and arranging driver rosters to avoid overtiredness
v. Avoiding dangerous routes and times of day to reduce the risk of accidents
vi. Use of speed control devices (governors) on trucks, and remote monitoring of driver actions

vii. Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

Where the project may contribute to a significant increase in traffic along existing roads, or where road transport is a significant component of a project, recommended measures include:

i. Minimizing pedestrian interaction with construction vehicles
ii. Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns)
iii. Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents
iv. Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic
v. Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions.

CHAPTER EIGHT: ENVIRONMENTAL HEALTH AND SAFETY

8.0 Health and Safety

South Gem Sugar Company will implement a Health and Safety Program as an integral component of operations. The company will be committed to the health and safety of its employees and ensure compliance to the OSH Act (2007). Several components of the health and safety program will consist of the following:

1. Establishment of a Health and Safety Committee
2. Training for all employees and especially the Environmental Health and Safety Officer and Committee Training will be a continuous process.
3. Monitoring of the effectiveness of training programmes for all categories of employees.
4. Provision of a higher weighting to OSH issues in senior and junior staff assessments.
5. Continued enforcement of OSH policies and procedures by the Estates' Management and employees.

The impacts on health and safety will be mitigated by:

a) Establishing a program to identify and eliminate, all shallow pools and ponds in the Project area.

b) Use of pesticides that are non-toxic to humans, fish and livestock for habitat and vector control. A mosquito control program will be implemented to minimize breeding areas by proper drainage and periodic flushing of stagnant channels.

During the operation of the facility emphasis will be placed on providing a safe and healthy environment for the workers. A health and safety plan will be implemented to enforce compliance with the regulations of the OHS Act 2007. Occupational Safety and Health plans will be implemented in the following areas:

- Industrial accident prevention and management
- Occupational hygiene.
- Illness and infectious disease prevention and management.
- Sewage and waste disposal.

8.1 Industrial Accident Prevention and Management

Industrial accident prevention and management will be effected via a safety program. This will commence during the construction phase of the new sugar mill and last through the operating phase. The program will include the following:

- Hazard identification and control.
- Monitoring and reporting of industrial accidents.
- Training or education of employees in industrial first aid.
- Industrial Accident Protocol.
- Fire Safety and Preparation.

8.2 Hazard Identification and Control

The Table below lists the potential hazards in different phases of the operations of the facility and the preventative and remedial activities necessary for their elimination and

control. Hazard identification and reporting will not be limited to the initial phases of the operation but will constitute an ongoing activity in which the employees' participation will be considered an integral part of his work functions. The OHS Act 1997 clearly stipulates the responsibilities of employees and supervisor/management in this regard. The supervisor/manager has the obligation to:

- Inspect all machines and equipment for the existence of potential hazards and maintain them in working order.
- Inform the worker of any hazards present.
- Instruct the employees in the correct safe work procedure and audit compliance with those instructions
- Provide the necessary safety protective gear when required.

The employee on the other hand has the obligation to:

- Cease work once a hazard is perceived.
- Report the hazard to the supervisor who will in company with the safety representative, inspect the condition or circumstance and determine its validity.
- Obey the instruction to perform alternative work or cease work completely as directed by the supervisor.
- Return to the workstation or proceed once the hazard has been adequately dealt with or eliminated.

South Gem Sugar Company will maintain an industry wide system that details procedures for the following:

- Hazard Monitoring and Reporting
- Training and Education System for its Employees
- Industrial Accident Protocol
- Occupational Hygiene

This system will be extended to encompass the construction activity and modified where appropriate, for improved effectiveness during the operation of the new factory and expanded cultivation. The sections below outline the minimum standards that will be adhered to.

a) Hazard Monitoring and Reporting

Monitoring of hazards and work conditions will be the prime responsibility of the safety representative who will be elected from among the workers. He will be responsible for:

- Performing Safety Inspections on and off the operations site on a regular and programmed basis (at least once per month) for the detection of unsafe conditions or any potential hazards and for reporting of these hazards to management.
- Recording of all accidents (minor and loss time accidents) in a ledger as required by the Ministry of Labour (Table 79 shows the format to be used for recording industrial accidents).
- Remitting of reports of industrial accidents or fatalities to the Ministry of Labour when required.

Table 11: Potential Hazards

Phase	Potential Hazard	Protective and Preventative Safety Measures
Clearing of site: Felling trees Removal of topsoil and overlying vegetation Assembly of building Assembly of generating plant	Insect bites Snake bites Minor trauma to extremities Lacerations from use of sharp tools	Use of insect repellants Provision of snake bite kits Use of safety shoes and gloves Use of helmets, goggles and masks
Borrow pit operation and embankment fill placement Operation of heavy earth moving equipment and factory operations	Fugitive dust blown into eyes Inhalation of fugitive dusts High noise levels from working of heavy duty vehicles – trucks, tractors etc.	Use of safety shoes, and gloves Use of clear goggles Use of dust/mist respirators
Maintenance operations	High noise levels High noise levels	Use of ear plugs Use of helmet
	Contact dermatitis and skin irritation from exposure to grease High noise levels	Use of ear muffs Wearing of ear plugs Use of helmet, goggles and masks Use of barrier creams and detergents on hands Use of ear plugs Use of helmet, goggles and masks

b) Training and Education of Employees

In conformance with the objectives of the safety program the following training programs will be implemented:

- Basic first aid programmes (all employees).
- Advanced first aid programmes (ten employees).
- Accident investigation and reporting seminars (supervisory personnel and safety reps.)

The basic first aid program will be extended to all employees and will be geared to provide that in the event of an accident or injury, someone with first aid knowledge will always be

present to render initial assistance until further medical attention can be made available. Qualified personnel will run seminars to impart the necessary theoretical as well as practical skills required. These courses will be scheduled depending on the employee strength and attrition.

The advanced first aid program will constitute an upgrading course from the basic first aid program in which selected employees including supervisors and the Safety Representative will be exposed to advanced first aid knowledge and techniques which will enable them to participate in the recognition and the initial management of serious injuries and illnesses e.g. fractures, spinal injuries, malaria, typhoid fever etc.

c) Industrial Accident Protocol

Serious injuries will be referred to a medical practitioner and medical institution. In the event of an industrial accident the following protocol will be followed:

- A basic first aider will be summoned if not already present at the scene of accident.
- The basic first aider will render first aid care.
- The basic first aider will summon an advanced first aider who will administer further care if necessary and evaluate the necessity for removal to the first aid centre.
- The advanced first aider will summon the vehicle specifically identified for this purpose and supervise the removal of the injured to the first aid station.
- The employee's immediate supervisor will be informed. He will:

1. Make contact with the identified medical practitioner and institution and inform them of the time of arrival of the injured employee.
2. Complete the accident form and forward same along with the injured to the medical institution for completion by medical practitioner
3. Inform the Safety representative who will record the accident in the industrial accident register.

A vehicle should be available at all times to respond to accidents. That vehicle should be four wheel drive and have the following equipment:

- oxygen cylinder resuscitation equipment.
- a bed and accommodation for a first aid attendant to sit alongside the injured.
- A flashing light attached to warn other road users.
- communication equipment.

c) Occupational Hygiene

The main environmental occupational hazards to which employees will be exposed during the construction phase are:

- Dust.
- Noise.
- Heat
- Fumes

Dust Exposure

Particulate matter dispersed into the atmosphere will be fugitive wind blown dust from the roads, construction operations and during land preparation. Sampling and analyses of surficial soils reveal that more than twenty percent (20%) of the fine crystalline silica particles are more than 2 microns in size. ILO and WHO guidelines state that the danger from silica particles occur for diameters less than 5 microns and especially those with a diameter between 0.5 and 3 microns since those particles when inhaled can reach the alveoli and lead to lung impregnated disease. Development of respiratory disease due to inhalation of respirable dust has been shown to be in direct proportion to the total load of dust inhaled over a time period. This in turn is a function of:

- The dust particle size
- The concentration of particles in the atmosphere.
- The duration of exposure

The concentration of dust particles in the air is not expected to be consistently above acceptable international standards since it is basically wind blown dust. The development of respiratory disease due to inhalation of dust is very low and will probably need exposure time far in excess of twenty five years to develop. Workers will also be exposed to wind blown/fugitive dust being blown into the eyes and causing eye irritation and conjunctivitis. These employees will be provided with clear goggles and eye wash lotion will at all times be available for washing the affected eyes.

Noise

The following measures will be implemented to address worker health and safety related to noise associated with the operation:

- Control of noise levels at source via installation of silencers on exhaust system of equipment and plant.
- Provision of hearing protection to employees exposed to high noise levels
- Earplugs for employees who operate heavy-duty machines.
- Warning signs in areas of high noise levels instructing employees to wear ear protection.

Health and safety impacts will be mitigated by providing a medical doctor and ambulance for the duration of construction work. The estimated costs are KShs 3,000,000.00

9.0 CHAPTER NINE: ENVIRONMENTAL MANAGEMENT PLAN

Introduction

Environmental management is a crucial segment of Industrial Management, in view of the global concept of sustainable development. Apart from the social obligation, the industries are liable to suffer a series of drastic actions by statutory authorities, if the former ignore the above said aspect. At its worst, the running factories may be brought to a grinding halt by the pollution control authorities that possess the requisite powers. Therefore, the preparation of Environmental Management Plan (EMP) is a must to fulfill the bifocal aspect of the statutory compliance as well as that of social concern.

The Environmental Management programme envisions undertaking the following research areas/activities:

i. Evaluate the utilization of water in the milling factory and determine how its quality changes as it passes through the system with a view to reducing wastage and pollution
ii. Assess types of pollutants, their chemical composition and quantities
iii. Evaluate existing effluent treatment methods and determine their possible improvement
iv. Monitor the movement of fertilizer, herbicide and insecticides used in sugarcane production, and determine their temporal distribution and control
v. Trace the movement of agrochemicals in the soil and into water bodies by means of appropriate models
vi. Monitor the quantities and qualities of water in the major rivers and water bodies in the sugarcane growing and milling areas, and determine their sustainable use by the sugar industry
vii. Study the effect of the use of waste water for irrigation on sugarcane yields and on soil chemical and physical characteristics

The EMP involves the protection, conservation and sustainable use of the various elements of the environment. The EMP for the proposed project provides all the details of its activities, impacts, mitigation measures and expected costs during implementation and decommissioning phases of the project. With proper environmental management procedures in place and adhered to there should be minimal negative impact of concern emanating from it. Key areas that require mitigation measures include wastewater treatment, solid waste disposal, maintaining good air quality, occupational health and safety and risk management.

9.1 Policy

The management policy of this development will consistently in its operations ensure a clean and safe environment within the site and support of environmental management initiatives both within and outside the project through proactive and responsible activities. It will ensure compliance with the relevant Laws and Regulations governing the management of the environment for various aspects of its operations.

9.2 Objectives

i. Ensure environmental conservation and sustenance to ensure a balanced approach between the development and the ecosystem.
ii. Ensure and enhance safety within the development both within the construction and operational phases.
iii. Promoting environmental ethics within concerned parties and users to reduce risks of air, surface water and land pollution from leaks, spillages, and ensure correct measures to contain any hazards.

Land

i. Ensuring vegetative cover on unpaved surfaces to maintain the integrity of soil structure within the project area
ii. Proper waste management (both solid and liquid) to avoid polluting the soil and unsightly environment
iii. Plant many trees along the perimeter walls to absorb CO_2.

Biological diversity

i. Planting and maintaining of trees and grass along the perimeter and the facade of the premises.
ii. Creation and maintenance of a buffer between the project and other land users to mitigate micro- climate modification
iii. Ensuring adequate space maintained between the activities of the sugar mill and the rivers and streams

Air

i. Maintaining low dust levels during construction
ii. Erection of screens and buffer fences (noise barriers) to reduce the amount of dust and noise generated during construction reaching neighbouring utilities
iii. Use of ear- muffs by employees to reduce any exposure from noise
iv. Provision of workers at site during construction with safety equipment such as boots helmets and dust masks.
v. Retain and continue planting green-belts to create barriers between source and receiver- this strategy is a long term measure as trees take a long time to be effective in creating noise barriers. Flower bushes and shrubs can be planted around noise emitting utilities
vi. Monitoring of air emissions for opacity (maximum level of 10%) should be continuous; daily. Liquid effluents should be monitored for the listed parameters at least daily, or more often when there are significant process changes.
vii. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. The results should be reported to the responsible authorities and relevant parties, as required.

Ambient Noise

Noise abatement measures should achieve a maximum increase in background levels of 3 decibels (measured on the A scale) [dB(A)]. Measurements are to be taken at noise receptors located outside the project property boundary.

Water

Ensure conservation of water in the construction phase through wise and only necessary use as well as recycling where applicable and appropriate

Ensure water abstraction for use in the sugar mill does not exceed the required limits for sugar production

Hazards and soil maintenance

Hazards especially from moving vehicles and trucks around, in and out of the site could be handled in a number of ways.

i. Erecting hazards warning signs
ii. Using smaller trucks that make narrow turnings
iii. Constructing storm water drains to channel flood waters
iv. Keep the percentage of area of impervious surface as low as possible to reduce runoff during storm drains
v. Fire risks are also hazards that can be handled by installing fire-fighting equipment in strategic places in the building and carrying out fire drills
vi. A designated area should be identified as a central gathering place in case of fire to ensure all lives are safe.

Wastewater Management

i. Wastewater from domestic usage will be sent directly to the septic tank of size 3.0x2.0x2.0 followed by the soak pit of size 3.0 x 2.0 x 3.0m.
ii. Prevent and control spills of molasses

Health and Safety

Safety and Occupational Health will be dealt carefully. A disciplined approach is natural to this industry. Safety policy will be in place. The unit will be registered under Factory Act and are bound by OSHA 2007. Thus, First aid trained and Fire-fighting trained persons will be available in every shift. A Safety Officer will be appointed, as also the competent person retained. All legal provisions will be adhered to. Fire fighting systems will be kept as per norms of Insurance Company. DMP (Disaster Management Plan) and off-site emergency plans will be put in place.

Personal Protective Equipment (PPE) will be provided and use will be enforced. Issues of Health and Safety have been managed in Chapter 7 above.

The tables below indicate recommended environmental management measures to be undertaken by the SGSC sugar factory.

Table 12: Environmental Management Plan (EMP) for Construction Phase

Impacts during construction phase	Mitigation	Monitoring	Responsibility	Costs (KSH)
Soil				
Erosion	Installation of soil traps on lower edges Installation of traps for stored loose construction materials such as sand.	Installed soil traps Securing of construction materials	Project Manager	10,000
Construction equipment and waste	The vehicle maintenance area shall be located in such a manner to avoid sources by accidental spillage of oil. Unauthorized dumping of waste oil should be prohibited. Wastes shall be disposed off at an approved site. Provide oil receptors and tanks for collection of used oils and spillages should be quickly cleaned	Observations Records of waste oils Records of sales	Project Manager	10,000.00
Water				
Pollution	Provide sufficient sanitation facilities for workers Ensure effective drainage into the sewer system. Regular maintenance checks on drainage system Conduct regular tests at discharge points to meet the standards in the fourth schedule of waste regulations	Routine maintenance checks of drainage system and reports. Recommended water quality standards maintained	Facility Manager	20,000 30,000
Air				
Dust	Provision of dust masks to workers Use labour intensive methods Properly stack construction materials Screen construction area Stop work during strong winds	Dust masks provided More labour employed than machinery Orderly stock area	Project manager	10,000 and contracted negotiated cost for labour

Impacts during construction phase	**Mitigation**	**Monitoring**	**Responsibility**	**Costs (KSH)**
Emissions	Use of low sulphur diesel Use of mufflers on heavy equipment and vehicles Reduction in use of machinery to necessary requirement only It shall be ensured that both gasoline and diesel powered construction vehicles are properly maintained to minimize smoke in the exhaust emissions.	Low sulphur diesel used Mufflers installed Reduced machinery use	Vehicle contractor Site supervisor	50,000
Noise	Operation during daylight hours only Provision of ear muffs to site workers	Operation logs Ear muffs provision and numbers	Project manager Site supervisor	10,000
Biodiversity				
Bush clearing	Minimal excavation Keep bush clearing debris from the river Revegetation of bare areas Planting indigenous, exotic trees, flowers and grass	Excavated areas Revegetated areas Number of trees planted	Site Manager	10,000
Social Concerns				
Hazards	Erecting hazards warning signs Reduced speed of delivery trucks Provision of Personal Protective Equipment (PPE) First aid kits provided at easily accessible points Proper storage of hazardous materials such as painting materials, petrol and diesel, LPG, etc	Signage erected at road turnings and at the gate PPE provided and use enforced First aid kits available Proper storage facilities provided and monitored	Project manager Labour contractor	5,000 50,000 3,000 50,000 50,000
Security	Fencing off the project site and limiting movement and attraction of unwanted characters.	Fence and restricted entry Strict monitoring on movement of personnel and materials to and from site	Site Manager	70,000

Mushrooming of slums	Employ workers from the local community who have homes Ensure organized sourcing of supplies to avoid hawking		Project Manager	-

Table 13: Environmental Management Plan for Decommissioning

Expected Negative Impacts	**Mitigation Measures**	**Responsible**	**Cost**
Scrap materials and debris	Use of an integrated solid waste management system Waste generated will be characterized in compliance with standard waste management procedures Disposal locations will be selected by the licensed contractor	Site supervisor and Licensed Waste Disposal Contractor	60,000
Scrap materials and other debris	All buildings, machinery, equipment, structures and partitions that will not be used for other purposes should be removed and reused or sold to scrap material dealers	Project Manager and site supervisor	
Rehabilitation of Project Site			
- Vegetation disturbed - Soil erosion and drainage problem	Plant grass and trees on the perimeter areas left for the same Monitoring and inspection of the area for indications of erosion will be conducted and appropriate measures taken to rehabilitate any occurrences Fencing and signs restricting access posted to minimize disturbance to newly vegetated areas	Project Manager and site supervisor	6,000

Table 14: Environmental Management Plan for Operations

Project Activities	Potential Impact Description	Mitigation Measures	Responsibility	Objectively Verified Indicators	Cost
Air Discharge from flue duct/distillery	Air pollution	Wet scrubbers for flue duct and carbon dioxide scrubber for distillery	Production manager/Chief chemists	Daily check for optimal performance	3,000,000
Discharge of effluent in river	Increased BOD and nutrient levels	Waste water treatment at Effluent Treatment Plant Ensure constant monitoring of the quality of the treated water to ensure it meets water quality standards of NEMA	Chief Chemist/ Effluent Treatment Officer/WTP Manager	Daily BOD measurement treated water and three weeks incubation period before indirect discharge into river for influent Periodical water quality reports	3,500,000
Discharge of human wastes	Contamination of both surface and ground water; eutrophication, diseases, invasive species	Septic tanks and soak pits lined with waterproof cement Periodical emptying to prevent spillage or overflow	Clerk of works/General manager	Approved contractors report indicating septic tanks and soak pits construction Contracted NEMA Registered exhauster	250,000 As per negotiated contract
Discharge of waste oil	Oil slick; reduction of dissolved oxygen	Minimization of oil spillage, waste oil separator, burning of waste oil in boilers	Factory manager	Receipts of waste oil separator, reports of waste oil collected	100,000

Project Activities	Potential Impact Description	Mitigation Measures	Responsibility	Objectively Verified Indicators	Cost
Discharge of solid wastes; bagasse, sediments from various tanks/plants and distillery effluent, boiler ash	Mounds of solid waste; methane production leading to foul smell. Nuisance to the community	Use of bagasse as fuel in boilers for steam and power production; making mechanical paper, drying of sediments for use as fertilizers	Factory Manager	Input and output of various materials in production process.	Per supplier
Discharge of waste heat	Increased ambient temperatures and increased river water temperatures	Spray ponds	Factory manager	Daily report of volumes pumped	400,000
Stabilization of River Bank	Prevention of collapse of river banks	Reinforcing river bank with gabions and planting of reeds	Factory manager	Number of gabions put; areas planted	350,000
Health					
Building of health clinic	Improved health access and care	Reduction of HIV/Aids through awareness creation and ARVs, treatment of malaria, and provision of ante and post natal care among others	Managing Director	Actual health clinic built and records of services provided	1,000,000

Project Activities	Potential Impact Description	Mitigation Measures	Responsibility	Objectively Verified Indicators	Cost
Education promotion	Improved education standards and access	Support of local schools in cash and kind in terms of books and bursaries and various other activities	Managing Director	Yearly budgetary allocation	2,000,000
Improvement of Roads, provision of electricity and sinking of boreholes	Infrastructure improvement and creation of enabling environment for other business opportunities. Also improved health	Improving of access to facilities for neighboring communities	Managing Director/KSB	State of roads, roads improvement reports, number of households with electricity and telephones	100,000,000 (SDL)
Construction and Production Stages	Employment and wealth creation for surrounding community	Employment of labour from the local community	Managing Director	Personnel records	
Marketing and sale of sugar	Contribution to national economy	Exportation of finished products; being in line with government policy to create employment and wealth	Managing Director	Monthly quotas	

Project Activities	Potential Impact Description	Mitigation Measures	Responsibility	Objectively Verifiable Indicators	Costs
Accidents, Health and Safety Plan					
Pre-Construction and construction	Collapse of buildings, accidents from falling objects	Observing of construction standards, insurance cover for staff, protective clothing, building of scaffolds	Clerk of works/Managing Director	Receipts of sufficient protective clothing and insurance cover for staff	
Production stage	Fires	Water ring line around the factory, firefighting equipment, alarm system in factory and to Kisumu fire station, emergency routs for firefighting equipment and ambulances	Safety Officer/Factory and Managing Director	Number of firefighting equipment, regular maintenance of equipment, fire drills and training on fire fighting	300,000
	Falls and other accidents	Clean floors, non obstruction; observance of Factory Act; provision of PPE; insurance to all workers	Factory Manager/ S&H Officer/Production Managers	Observation; detergents purchased; reports of H&S Committee	50,000
Production Process	Burns/waste heat Capacity building and training Improved communication especially on H&S; risk communication	Insulation of boilers and hot water pipes Staff training programs for H&S especially in emergencies Ensuring a good and effective communication network between management and staff and also with neighboring	Clerk of works/H&S Officer H&S Officer and Managing Director Managing Director	Approved Contractor's report; number of related accidents. Number of employees trained per year No. of joint meetings with staff and staffs	

		community		trained on health and safety	
Security	Potential robberies, muggings, etc	Employ trained security personnel	Contracted Security contract records	Factory Manager	Negotiated contract

Project Activity	**Expected negative Impacts**	**Management Measures**	**Monitoring**	**Responsibility**	**Cost**
Water					
Water Consumption	Excess abstraction of water from water sources	Installation of water meters to monitor amount used Installation of water saving tap models Ensure water conservation is accorded high priority in every section of the factory. Keep record of input water every day for quantity and periodically of quality	Installed water meters Water saving tap models installed .	Project manager	50,000
Storm water drains	Surface flow	Plant grasses and trees in the non-paved area to reduce direct evaporation and enhance steam recharge Provide clear walking paths and driveways and restrict movement on grassed areas Establish proper drainage system	Grassed and green perimeter Well maintained lawns and driveway Well planned drainage	Project manager	10,000 15,000
Soil					
Waste Management and Soil erosion	Loss of Vegetative cover	Plant trees, grasses and flowers on unpaved surfaces in the perimeter and frontage of the factory to maintain the integrity of soil structure	More trees planted and grass and flowers in the unbuilt area	Project Manager	5,000

Solid Waste disposal	Soil pollution and unsightly environment	Proper solid waste management Fence off composting area and provide concrete floor and bunds for composting sludge and press mud into fertilizer	Clean compound Perimeter fence and bunded areas	Project Manager	20,000
Access Road					
	Traffic Increase	Ensuring clear roads without vegetation to obstruct view ahead Install signs Improve on the class of road Regular maintenance and grading Ensure the road is regularly watered to reduce dust	Observation	District Roads Engineer	Tendered sum

Project Activity	Expected Negative Impacts	Mitigation Measures	Monitoring	Responsibility	Cost
Air Pollution					
	Odour	Distillation and CO_2 scrubber of world class technology installed to reduce odour to bare minimum	Smell	Project Manager	Provided with equipment
	Air Monitoring	Monitor the consented parameters at ambient stations. Monitor additionally CO_2, Monitor the work zone at various stations to satisfy the corporate requirements for health and environment. Maintain a record of running of DG (diesel generating) sets Monitor the stacks or vents fitted to sections of raw material, manufacture, thermal and DG power plants			
Hazards and Social Concerns					
	Fire Safety	Smoke detectors installed Install fire extinguishers at strategic points Engage services of a safety officer	Detectors Firefighting equipment installed Safety officer on board	Project Manager	100,000.00
	Security	Fencing off the project site and limiting movement and attraction of unwanted characters. Ensure the sugar mill surrounding is fully lit during the night	Fence and restricted entry Strict monitoring on movement of personnel and materials to and from site	Site Manager	70,000

Project Activity	Expected negative Impacts	Mitigation Measures	Monitoring	Responsibility	Cost
	Workers Safety	Ensure provision of all PPE in stock Enforce use of PPE Adhere to Factory Act rules Adhere to OSHA 2007 Activate WIBA provisions Ensure workers are trained in ESH	Observation Records of distributed equipment Accident records	Project Manager	200,000
	Social integration	Help in promoting the activities related to environmental awareness in nearby villages. Help in promoting local people for livelihood commensurate with their will, skill and abilities.	Annual plans and budgets	Company Community Worker	Annual budget
	Work zone environment	Monitor the work zone temperature levels. Monitor the work zone humidity. Examine the health of workers and keep record. Keep Record where nutritional assistance is given to workers case wise. Monitor the ambient noise level and work zone noise level to conform the stipulated norms	Check hourly temperatures and humidity Records of downtime due to illness Records	Project Manager	

CHAPTER TEN: CONCLUSION

10.0 Conclusion

The GOK is committed to the restoration of economic performance that will lead to sustainable long-term growth consistent with national development objectives. Two of these objectives are to reduce the current poverty levels and to achieve a 'Newly Industrialized Country' (NIC) status by the year 2020 by promoting industrialization through Private Sector investments like the South Gem Sugar Factory initiative as well as via an export-led strategy. The macroeconomic framework recognizes the challenges currently facing the country, that is: how to revamp growth, raise productivity; encourage private sector investment, alleviate unemployment and drastically reduce poverty.

Good quality and adequate sugar supply, of course has obvious advantages to the consumers and sugar cane farmers. Some of these being increased cheap and good quality sugar in the market and competitive and timely payments to farmers amongst others. SGCL intends to establish a brand new sugar mill that will ensure minimal negative air emissions, dust emissions, noise emissions and raw effluent.

This environmental impact assessment project report indicates that with the establishment of best practices in the management of the environment, it is possible to have zero discharge of effluent into the environment and that proper measures put in place will greatly mitigate negative environmental impacts. Waste water will be treated and passed through an artificial wetland to ensure the discharge to River Yala is up to the quality standards required. Current sector interventions herein include the involvement of Environmental Audits for quality management and control.

The desire of the proponent is to ensure the local community are assisted in the production of sugar cane which will ensure the factory is well served with cane and at the same time, provide the local community with increased incomes and better standards of living. The company also intends to carry out various corporate social responsibility activities in the areas of education and health and the rehabilitation and maintenance of roads and bridges.

11.0 Recommendations

The project is therefore, environmentally feasible, economically viable and socially acceptable. It is a highly desirable project in an area whose cash crop failed and the community was left with no appreciable cash crop or income generating industry that would encourage the use of the vast fertile lands and the industrial use of the River Yala upstream of the Yala Swamp. It is recommended that this project be granted an Environmental Impact Assessment License and allowed to be established and operated.

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10 Export Processing Zones – Kenya Sugar Industry 2005
11 The Environmental (Impact Assessment And Audit) Regulations, 2003
12 Occupational Health and Safety Act 2007 – GoK
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30 Waste Management Facilities (IFC guideline, 1998);

ANNEXURE

Annex 1: Basic Information for the South Gem Sugar Factory

(I)

Name of the Project : **South Gem Sugar Company Ltd**
Location/site alternatives under consideration : **None**
Size of the Project : **1000 TCD Sugar Processing Factory**
Expected cost of the project : **USD million 9.4**

(II) Activity

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

SR. NO.	Information/Checklist confirmation	*Yes/No*	Details thereof (with approximate quantities/rates, wherever possible) with source of information data
1.1	Permanent or temporary change in land use, land cover or topography including increase in intensity of land use (with respect to local land use plan)	No	For this activity land already exists which has been hitherto used for sugar processing factory and sugar cane farming so no significant change in land use envisaged.
1.2	Clearance of existing land, vegetation And buildings?	No	Land is already existing, therefore clearance of existing land, vegetation & building is already done
1.3	Creation of new land uses?	No.	Land already existing therefore no any creation of new land uses.
1.4	Pre-construction investigations e.g. bore houses, soil testing?	No	Land already existing so no pre-construction investigation.
1 .5	Construction works?	Yes	Administration block, main factory with cane yard, cane milling, production, packaging, warehouse, laboratory, engineering workshop, boiler section generator section, bagasse shed, etc. Procurement store, weighbridge area, effluent treatment plant, water treatment plant, staff quarters, and perimeter walls
1.6	Demolition works?	No	There are no demolition works.
1.7	Temporary sites used for construction works or housing of construction workers?	No	Only one shift per day during normal working hours. No need for temporary housing
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations	No	Plant activity is above ground like buildings, all operational activity of plant. Cutting filling nearby balances. No Basement
1.9	Underground works including mining or tunneling?	No	
1.10	Reclamation works?	No	
1.11	Dredging?	No	

1.12	Off shore structures?	No -	
1.13	Production and manufacturing processes?	Yes	Production proposed a) Sugar b) Bagasse c) Molasses d) Filter mud and fly ash
1.14	Facilities for storage of goods or materials	Yes	Steel tanks, Covered godowns
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?	Yes	**Solid waste** Disposal-On own garden, sale, reuse, recycle **Liquid waste** Treatment- in Effluent Treatment Plant and Resuse in the Mill
1.16	Facilities for long term housing of operational workers?	Yes	Staff Housing
1.17	New road, rail or sea traffic during construction or operation?	No.	Existing Roads shall be used
1.18	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports, etc	No	Existing roads
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	No	Existing transport routes or infrastructure is satisfactory. Main raw material is available in-house therefore traffic is not affected because of this .So no changes in traffic movement or any closure or diversion of existing routes
1.20	New or diverted transmission lines or pipelines?	No	
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	No	
1.22	Stream crossings?	No	
1.23	Abstraction or transfers of water form ground or surface waters?	Yes	Only to limited extent for processing and domestic use
1.24	Changes in water bodies or the land surface affecting drainage or run-off?	No	Only protection of river-sides through gabions
1.25	Transport of personnel or materials for construction, operation or decommissioning?	Yes	For civil constructions there will be the transport of materials. Other materials being imported shall be transported from the port.
1.26	Long-term dismantling or decommissioning or restoration works?	No	
1.27	Ongoing activity during	No	

	decommissioning which could have an impact on the environment?		
1.28	Influx of people to an area in either temporarily or permanently?	No	Limited influx of people.
1.29	Introduction of alien species?	No	
1.30	Loss of native species or genetic diversity?	No	
1.31	Any other actions?	No	

2. Use of Natural resources for construction or operation of the Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply):

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
2.1	Land especially undeveloped or agricultural land (ha)	No	
2.2	Water (expected source & competing users) unit: LD		Water source – River Yala Water Requirement – 30m^3 lts per day
2.3	Minerals (MT)	No	
2.4	Construction material – stone, aggregates, and soil (expected source - MT).	Yes	Limited construction work. More of fabrication Nature. Local sources for bricks, sand, murram etc
2.5	Forests and timber (source - MT)	No	
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)	Yes	Electricity available from KPC During Season: Own generation from Sugar Mill During Off Season: 1.5 MW Energy—200KWH/day (during idle period) Fuel: Bagasse (own source)
2.7	Any other natural resources (use appropriate standard units)	No	

3. Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health.

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
3.1	Use of substances or materials, which are hazardous to human health or the environment (flora, fauna, and water supplies)	No	Nothing above threshold level

3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	No	
3.3	Affect the welfare of people e.g. by changing living conditions?	No	In fact will be improved
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,	No	
3.5	Any other causes	No	

4. Production of solid wastes during construction or operation or decommissioning (MT/month)

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
4.1	Spoil, overburden or mine wastes	No	
4.2	Municipal waste (domestic and or commercial wastes)	Yes	Canteen, Colony, Office and packing trash are generated from the activity.
4.3	Hazardous wastes (as per Hazardous Waste Management Rules)	Yes	Spent lubrication oil, discarded drums. They are to be disposed are per NEMA regulations.
4.4	Other industrial process wastes Nominal Yeast sludge.		Separated, dewatered and used in composting
4.5	Surplus product	No	
4.6	Sewage sludge or other sludge from effluent treatment	No	Limited - used in composting and spreading on nucleus farms and farmers' fields as fertilizer. Sewage sludge disposed off by NEMA licensed waste handlers
4.7	Construction or demolition wastes	No	
4.8	Redundant machinery or equipment	No	
4.9	Contaminated soils or other material	No	
4.10	Agricultural wastes	No	
4.11	Other solid wastes	No	

5. Release of pollutants or any hazardous, toxic or noxious substances to air (Kg/hr)

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources	No	.

5.2	Emissions from production processes	Yes	
5.3	Emissions from materials handling including storage or transport	Yes	Very little from chemicals being dosed in the plant viz lime
5.4	Emissions from construction activities including plant and equipment	Limited	Due to limited transport only while under construction
5.5	Dust or odors from handling of materials including construction materials, sewage and waste	No	Closed Operation. Effluent treatment plant. Sewage in closed septic tank.
5.6	Emissions from incineration of waste	No	No incineration of waste, therefore no emissions
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)	No	Construction debris will be sorted and sold or removed from site by NEMA registered waste managers
5.8	Emissions from any other sources --	No	

6. Generation of Noise and Vibration, and Emissions of Light and Heat:

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
6.1	From operation of equipment e.g. engines, ventilation plant, crushers	No	
6.2	From industrial or similar processes	Yes	Low and limited due to working motors only. Air compressor in closed isolated place. Steam in distillation process
6.3	From construction or demolition	No	No demolition involved. Civil and structural work will be done. Construction will be of short duration.
6.4	From blasting or piling	No	
6.5	From construction or operational traffic		Limited quantity of Raw Material and Products.
6.6	From lighting or cooling systems	No	
6.7	From any other sources --		

7. Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal waters or the sea:

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
7.1	From handling, storage, use or	No	

	spillage of hazardous materials		
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)	No	Sewage low quantity, effluent treated in ETP and standard quality water discharged into River Yala.
7.3	By deposition of pollutants emitted to air into the and or into water	No	
7.4	From any other sources	No	
7.5	Is there a risk of long term build up of pollutants in the environment from these sources?	No	

8. Risk of accidents during construction or operation of the Project, which could affect human health or the environment

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous substances	No	No use of explosives. Fire fighting precautions will be well mitigated and insured.
8.2	From any other causes	No .	
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloudburst etc)?	No	

9. Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

SR. NO.	**Information/Checklist confirmation**	***Yes/No***	**Details thereof (with approximate quantities/rates, wherever possible) with source of information data**
9.1	Lead to development of supporting, facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g.: • Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.) • Housing development • Extractive industries	No	Only Nominal or tea shop, tire repair shop etc. Most of these facilities will be established by KL as the main holding company. Housing for staff will be provided by the company. Roads already existing and will be improved upon be either government or the company. Other infrastructure already developed in Wagai and further afield.

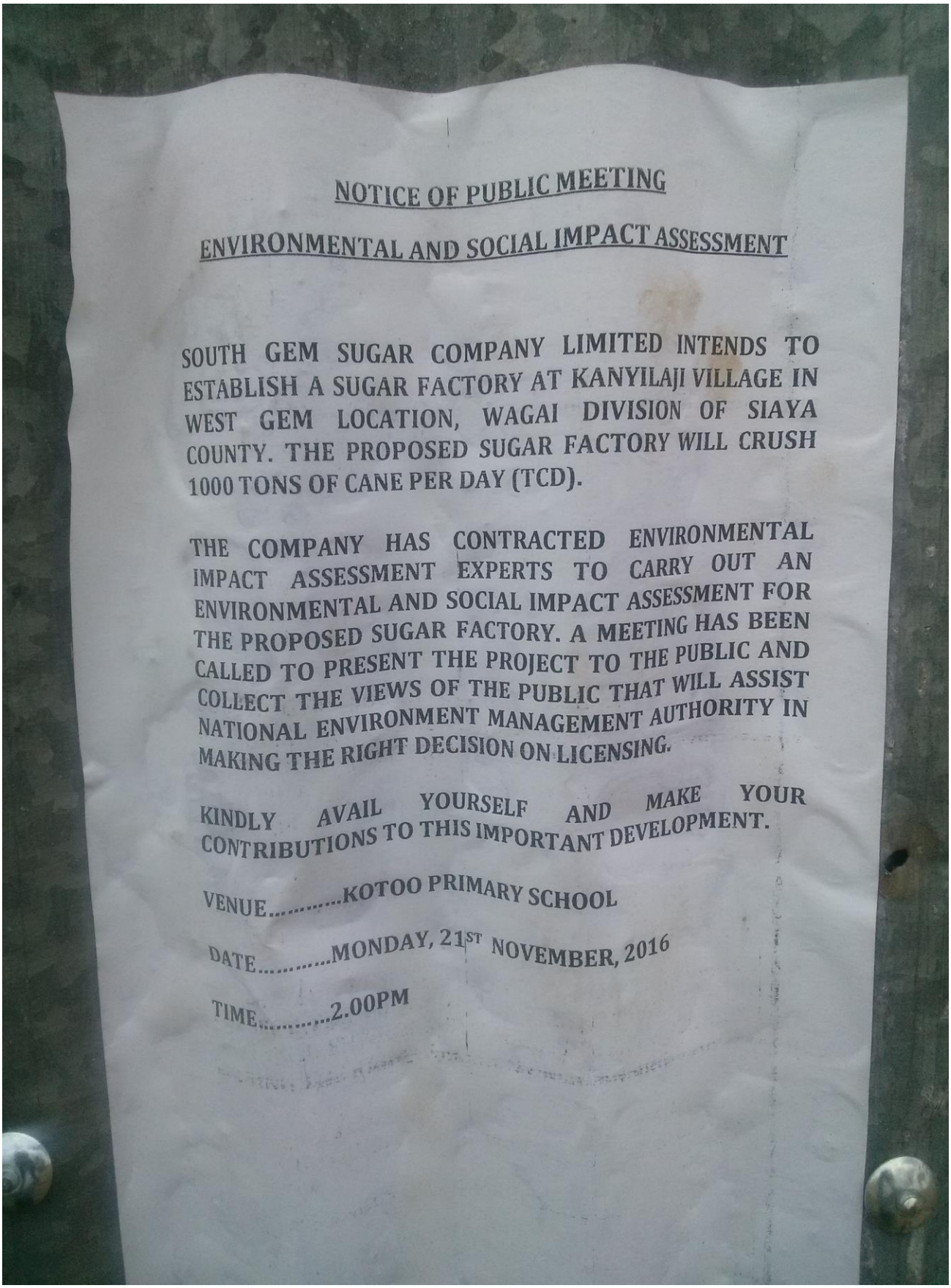
	• Supply industries • Other		
9.2	Lead to after-use of the site, which could have an impact on the environment	No	
9.3	Set a precedent for later developments	No	No downstream or upward integration.
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects	No	The sugar factory may in future invest in a distillery that will utilize by products of the sugar mill and will share facilities such as power generated from the sugar factory, the lagoons, water supply and circulation, spray ponds, etc. The molasses will be sourced from the sugar factory. It may also consider investing in a cement grinding industry to utilize the fly ash from the factory. The subsidiary industries will also enhance environmental management and increase employment.

(III) Environmental Sensitivity

SR. NO.	**Area**	**Name/Identity**	**Aerial distance (within 15 km.) Proposed project location boundary**
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	Yes	Yala Swamp above 20km downstream
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests	Yes	Yala Swamp above 20km downstream
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	Yes	Yala Swamp above 20km downstream

4	Inland, coastal, marine or underground waters	Lake Victoria	
5	State, National boundaries	No	
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	No	
7	Defense installations	No	
8	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities*)*	Yes	Schools
9	Densely populated or built-up area	No	
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	Yes	In addition, all precautions to be taken.
11	Areas already subjected to pollution or environmental damage, (those where existing legal environmental standards are exceeded)	No	
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions*)*	No.	

Annex 2: Invitation for a public meeting



NOTICE OF PUBLIC MEETING

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

SOUTH GEM SUGAR COMPANY LIMITED INTENDS TO ESTABLISH A SUGAR FACTORY AT KANYILAJI VILLAGE IN WEST GEM LOCATION, WAGAI DIVISION OF SIAYA COUNTY. THE PROPOSED SUGAR FACTORY WILL CRUSH 1000 TONS OF CANE PER DAY (TCD).

THE COMPANY HAS CONTRACTED ENVIRONMENTAL IMPACT ASSESSMENT EXPERTS TO CARRY OUT AN ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED SUGAR FACTORY. A MEETING HAS BEEN CALLED TO PRESENT THE PROJECT TO THE PUBLIC AND COLLECT THE VIEWS OF THE PUBLIC THAT WILL ASSIST NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY IN MAKING THE RIGHT DECISION ON LICENSING.

KINDLY AVAIL YOURSELF AND MAKE YOUR CONTRIBUTIONS TO THIS IMPORTANT DEVELOPMENT.

VENUE.....KOTOO PRIMARY SCHOOL

DATE.....MONDAY, 21ST NOVEMBER, 2016

TIME.....2.00PM