NAVA BHARAT

Kawambwa Sugar Limited

PROPOSED SUGAR PLANTATION AND FACTORY

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

ECO-WISE SOLUTIONS

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LIST OF ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immuno Deficiency Virus
Cap	Chapter
CSO	Central Statistical Office
CV	Curriculum Vitae
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMA	Environmental Management Act
FAO	Food and Agriculture Organisation
FD	Forest Department
GRZ	Government of the Republic of Zambia
HIV	Human Immune Virus
IAPs	Interested and Affected Parties
ISO	International Standard Organisation
KDC	Kawambwa District Council
km	Kilometer
KSL	Kawambwa Sugar Limited
l/s	Litres per Second
m	Meter
m^2	Square Meter
m^3	Cubic meter
mm	Millimetre
MOU	Memorandum of Understanding
MW	Mega Watt
NBVL	Nava Bharat Ventures Limited
NGO	Non Governmental Organisation
NHCC	National Heritage and Conservation Commission
NHCC	national Heritage Conservation Commission
R&D	Research and Development
ROW	Right of Way
SAFAL	Southern Africa Ferro Alloys Limited
SI	Statutory Instrument
SMP	Social Management Plan
STI	Sexually Transmitted Infection
TORs	Terms of Reference
WARMA	Water Resources Management Authority

WHO	World Health Organisation
ZDA	Zambia Development Agency
ZEMA	Zambia Environmental Management Agency

EXECUTIVE SUMMARY

Introduction

Background

Nava Bharat Ventures Limited (NBVL) proposes to establish an Integrated Sugar Project in Zambia through its local subsidiary Kawambwa Sugar Limited (KSL).

KSL, is implementing the integrated Sugar Project in Luena Farm Block, Kawambwa District, Luapula Province, Zambia. The Integrated sugar Project will be developed in an area of 10,000 ha in Four years after getting EIA clearance for the development of the project and envisages establishment of a Centre of Excellence (Research and Development, R&D Farm) in 500 ha, corporate farming (Nucleus Farm) of sugarcane in 8,000 ha (net), an Integrated Agro-based Processing Industry for the production of white crystal sugar, ethanol and alcohol, power and enriched organic manure to meet the domestic needs, as well as to export suitable agri-products. The project will also include the development of 2,000 ha outside the project area for an Out-Growers scheme.

Project Objectives

The main objective of the project is to establish an Integrated Sugar Project in Luena Farm Block, in an area of 10,000 ha for the production of white crystal sugar, ethanol, power and enriched organic manure to meet the domestic needs, as well as to export suitable agri-products.

Project Location

The earmarked site with the below stated coordinates and map falls under the jurisdiction of Chief Chama and is located about 6 km from Chibote village, Kawambwa District, Luapula Province, Zambia.

The coordinates of the beacons are indicated below:

702 A	E 774008.749	N 8933259.989
702 B	E 777969.800	N 8933779.972
702 C	E 780176.281	N 8921581.808
702 D	E 782175.602	N 8915488.800
702 E	E 779529.765	N 8914356.985
702 F	E 777730.354	N 8918868.548
702 G	E 775592.215	N 8918130.011
702 H	E 775578.422	N 8921382.065

702 J	E 776685.085	N 8921896.941
702 K	E 776208.670	N 8925445.172

Project Justification

Based on the information provided and the observations made during the site visit, the visiting team from NBV found that the proposed site area is quite suitable for sugarcane cultivation with respect to soil, weather, and availability of water for irrigation.

Total Project Cost Estimates

Based on the preliminary estimate, the investment for the Integrated Sugar Project is US$ 209.590 million.

Project life span

The project is expected to have a lifespan of over 50 years.

Objectives of the EIA study

The broad objective of undertaking this EIA is to identify significant potential impacts of the proposed project to the environment and social aspects and formulate recommendations to ensure the project takes into consideration appropriate measures to mitigate any adverse impacts to the environment in all phases of its implementation.

Baseline Environment

Physical Environment

The project area enjoys rainfall with an average of 1000-1500mm. Luena has a high irrigation potential; its covered by a wide expanse of wetlands and numerous streams.

The area has a tropical continental climate with a long rainfall period starting from October and ending around April. The farming season goes up to 190 days, which is one of the longest in Zambia. The dry season begins in May and ends in September. The season is cool with mean temperatures of 20 ºC to 23 ºC and maximum temperatures of 34 ºC.

The project site has an average altitude of 1300m.

Luapula River passes through Kawambwa over a stretch of 30km from Mununshi to Mbereshi. Other rivers are Mbereshi, Lufubu, Ng'ona and Mununshi. The other notable features are lagoons.

The Kalungwishi River flows west in northern Zambia into Lake Mweru. It is known for its waterfalls, including the Lumangwe Falls, Kabweluma Falls, Kundabwika Falls, and Mumbuluma Falls.

Biological Environment

The project area has two distinct ecological systems, the aquatic and terrestrial. The spilling of the Kalungwishi river as it flows results into the swamp channel that mostly characterize the Northern part of the project area. The site has distinct landscapes that include the ***miombo*** woodland that dominates much of the Project Site, the riparian vegetation and sections with water logged and grass cover (swamps).

Dry land areas which are covered with Miombo woodland, dominated by ***Brachystegia***, Julbernardia and Isoberlinia trees, transition zone between dry land and wetland covered with Chipya woodland that consists of tall grass with scattered trees of the ***Pterocarpus angolensis***, ***Erythrophleum africanum***, ***Burkea africana*** and ***Combretum*** and ***Terminalia*** species, and the wetland vegetation swamp/riverine forest (locally known as ***mushitu***) dominated by species such as ***Syzygium cordatum***, ***S.owariense***, ***Ficus brachypoda*** and ***Xylopia aethiopica***.

The proposed site for the KSL Sugar production displayed low human activity with regard to the extreme negative pathways of human and natural resources relationship which are seeing in the context of exploitation.

The proposed project area despite with void vegetation cover due to existing agriculture practice of cutting and shifting was found to be free from excessive clearing for other land use activities, hence having moderate potential for a natural system.

Social economic environment

The traditional organization of the Chishinga people has Senior Chief Mushota at the apex of the structure. The project site falls in the Chiefdoms of Senior Chief Mushota and Chief Chama, and borders the chiefdoms of Chiefs Munkanta and Mwenda (both of which fall under Senior Chief Mushota).

Village settlements follow linear patterns and are located along access roads. A village is comprised of a number of households. The people in the project area belong to a number of religious organizations, and churches are scattered throughout the area.

The villages are in form of family clusters and headed by a village headman/woman who subsequently reports to the chief.

Much of the land in Luena is under customary tenure that is administered by Chiefs.

The project area is largely based on an agro-economy. Crops grown include maize, groundnuts, sweet potatoes, and pumpkinsThe chitemene system, a form of shifting cultivation is widely practiced. Livestock rearing is also practiced and animals kept include cattle, goats, and chickens. Fruits trees are common and are grown close to homesteads. These include mangoes, pawpaw, banana, avocado, guavas and oranges.

The project site and its surroundings contain five primary schools (3 in Mushota and 2 on the Estate site) and one basic school located at Mushota that offers education up to grade nine.

The two health centers in the project area are located at Mushota and Kanengo. Each of them services a population of about 6,500.

Regulatory and Institutional Framework

The following are the institutions and pieces of legislation relevant to the project:

Regulatory Framework

- The Environmental Management Act, 2011
- The Environmental Impact Assessment Regulations, SI 28 of 1997
- The Environment Management Act (Licensing) Regulations (SI 112 of 2013)
- The Urban and Regional Planning Act, 2015
- The Lands Act
- The Lands Survey Act, 1960
- The Employment Act, 2015
- The Local Government Act, 1991
- The Workers Compensation Act, No. 10 of 1999
- The Occupational Health and Safety Act
- The Public Health Act, 1930
- The Forests Act, 1999
- The National Heritage Conservation Commission (NHCC) Act, 1986

Institutional Framework

Institutions relevant to the development of the water project include the following:

- The Ministry of Agriculture
- Forest Department
- Kawambwa District Council
- The Zambia Environmental Management Agency

Project Description

NBVL has acquired 10,000ha to set up the Integrated Sugar Project, as a core venture of the Luena Farm block. The sugar project will have a Centre of Excellence sitting on 500ha and will be used for Research and Development, a 8000ha Nucleus Farm for corporate farming of sugarcane, 2,000ha outside the project area through Out-Growers, an Integrated Agro-based Processing Industry for the production of white crystal sugar, ethanol and alcohol, power and enriched organic manure from the distillery to meet the domestic needs, as well as to export suitable agri-products.

This project is expected to produce 99,750 tons per annum of sugar (plant capacity: 5000 tcd). Apart from supplying sugar the project will contribute to fill the demand-supply gap of energy in Zambia by generating power from bagasse to the tune of 30 MW and the excess of which will be channeled into the National Electricity grid along with about 9 million liters of power alcohol/ethanol for energy and industrial requirements and about 25,000 tons of enriched organic manure to improve soil fertility.

Considering 50 per cent mechanization, the sugar project is expected to generate permanent employment for 500 people and seasonal employment for around 3,000 people directly and indirect employment opportunities for more than 15,000 people.

Project Alternatives

The No Option Alternative

The non- implementation of the proposed project will avoid all the negative potential environmental and social impacts but will deprive the residents of Kawambwa District the much needed employment and business opportunities. This option is therefore not feasible in view of the fact that the support the government is offering to the agriculture sector as an engine for economic growth will be in vain.

Site alternatives

Other places within Zambia with wetlands were considered. However, Kawambwa was suitable for the project because of favourable climate, good soils and the availability of water from Kalungwishi and Muppoposhi Rivers.

Waste disposal alternatives

The bagasse will be used as fuel to generate steam. Part of this power will be used at the plant while the remaining will be evacuated into the national grid. The estimated power that will be generated is 30MW. The molasses from purification will be used in the production of industrial alcohol.

Environmental Impacts and Mitigation Measures

The potential impacts are discussed according to how they relate to the proposed project components and its associated infrastructure.

Enhancement of positive impacts

Implementation of this project will involve the use of both skilled and unskilled labour from the planting phase up to operation phase.

The operation of this project will contribute to enhancing the nation's economy through the paying of taxes in form of duty, rates and pay as you earn remittances to the central and local governments as the case may be.

A number of services suppliers will be contracted to supply services and products such as saplings, consulting, and general planning for the successful management of the project.

Management of negative impacts

Overuse of Water

To avoid overuse of water, the effectiveness of irrigation strategies will be assessed by an analysis of Water Use Efficiency (WUE) which is the ratio of crop yield to water consumed by the crop.

Soil erosion and loss of soil nutrient

A wide range of measures to maintain or improve soil quality include trash mulching in cane cultivation, terracing, contour and strip planting of cane on slopes, maintenance of 'live barriers' (hedgerows, riparian zones), and modified (reduced or minimum) tillage.

The use of green cane harvesting rather than pre-harvest cane burning and 'trash-blanketing' (where the cane leaves are cut from the plant and left on the soil as a mulch while the stalks are taken away for processing) provides a range of environmental benefits.

To further prevent soil erosion on slopes, cane strip planting will be practiced. Strip planting will be used on all slopes greater than two per cent.

Increased fertilizer use

KSL will adopt a more site- specific assessment of fertiliser requirements, cultivation of leguminous green manure crops during fallow periods or in rotation, and the use of organic manure (combinations of nitrogen- fixing micro-organisms and organic amendments. The use of organic manure in place of chemical fertilisers, has potential to reduce inorganic fertiliser requirements by 20-25 percent and reduce the risk of nitrate leaching.

Overuse of agrochemicals

To achieve a reduction in the amount of agrochemicals used, KSL will adopt biological control and Integrated Pest Management (IPM) where there is a greater emphasis on non-chemical control methods, particularly for insect pests.

Reducing fly ash production

Bagasse will be dried prior to its use as boiler fuel, which increases the efficiency of burning and reduces emissions. Basic dust control measures will be incorporated in the production process.

Reduced gas and odour production

Using hydrogen peroxide in place of sulphur dioxide in the sugar mill has will reduce air pollution and result in a higher quality white sugar product while requiring no new equipment.

Reducing effluent discharge

Effluent discharge from the sugar mill will be reduced by recycling treated effluents as make-up water for cooling towers and spray ponds.

Protection of riparian vegetation

Riparian vegetation will be protected and left intact. The planting and maintenance of indigenous vegetation in riparian habitats can reduce sediment loads and agrochemical concentrations in waters running off from cane fields.

Use of byproducts through better management practices

Alcohol will be produced as a by-product of the sugar production process, through the fermentation of molasses.

Steam and electricity will be produced from the burning of bagasse; this process has the potential to increase the sustainability of sugar production.

Impact on public health

To prevent the transmission of diseases such as HIV/AIDS, and other STIs the following measures will be undertaken:

Prevention will be the key intervention measure and therefore sensitization campaigns on HIV/AIDS will be carried out on a regular basis among the workforce and extended to the community. Distribution of condoms to sexually active persons will be carried out.

Impact on landscape and aesthetics

To prevent significant impact on aesthetics especially after the cutting of trees is done, reforestation through the planting of suitable plant species will be done. The suitable type of species to be planted will be indegenous but will be identified after consultation with FD.

Environmental Management Plan

In order to effectively manage the environmental impacts and the proposed mitigation measures identified above, KSL has developed an Environmental Management Plan (EMP).

Conclusion and Recommendations

Even though a number of environmental impacts have been identified, management of KSL commits itself to adhere to the proposed mitigation measures in this EIS.

Management is committed to comply with the relevant pieces of legislation identified in this EIS. The environmental management and monitoring plans provided in this document will be used by KSL for the systematic management of significant environmental aspects.

There is need to include a system for treating backflow of water from the fields which will be expected to be rich in phosphates and nitrates so as to prevent eutrophication in nearby rivers.

Non Technical Summary

English

Nava Bharat Ventures Limited (NBVL) proposes to establish a Sugar Project through its local subsidiary Kawambwa Sugar Limited (KSL) in Luena Farm Block, Kawambwa District, Luapula Province, Zambia. The Integrated Sugar Project will be developed in an area of 10,000 ha in Four years after getting environment clearance. The project will have Research and Development Farm) in 500ha, an 8000ha area for sugarcane, and an area of 2,000 ha outside the project area for the development of Out-Growers and to set up an agro-based Processing Industry for the production of white crystal sugar, ethanol and alcohol, power and enriched organic manure to meet the domestic needs, as well as to export suitable agri-products.

This project is expected to produce 99,750 tons per annum of sugar (plant capacity: 5000 tcd). Apart from supplying sugar the project will generate power from bagasse to the tune of 30 MW and the excess of which will be channeled into the National Electricity grid along with about 9 million liters of power alcohol/ethanol for energy and industrial requirements and about 25000 tons of enriched organic manure to improve soil fertility.

Considering 50 per cent mechanization, the sugar project is expected to generate permanent employment for 500 people and seasonal employment for around 3,000 people directly and indirect employment opportunities for more than 15,000 people.

Bemba

Ba Nava Bharat Ventures Limited (NBVL), ukupitila mu kampanyi ka Kawambwa Sugar Limited, bakwete amapange ayakuleta ubuyantanshi ku Luena, mu Kawambwa, ku citungu ca Luapula. Ba Kawambwa Sugar balipeelwa impaanga ku buteko ukufika kuli 10,000 hectares iyakuti bengalimamo ifisali. Ukulima ifisali ku Luena kukasenda imyaka itatu. Muli iyi yine incende, mukaba 500 hectares umo ba Kawambwa Sugar bakalacita ifyakucencenta 8,000 hectares eko bakalalima ifisali, elyo 2000 hectares ikapeelwa ku bekalamushi ukutila nabo bene bakalelima ifisali ifyo bakalashitisha kuli ba Kawambwa Sugar. Ifisali nga fyasombolwa bakalapangamo insukale no ubwalwa, elyo ku fisoso ifikalashalako pa

kupanga insukale bakalapangako umufundo elyo nga baoca ifi fine fisoso bakalapangako amalaiti aya maka ukufika kuli 30MW.

Abantu impendwa ukufika ku myanda isano bakapeelwa incito kuli aka kene kampanyi elyo munshita yakusombola iyi impendwa ikafika ku makana yatatu. Abakela mushi nabo abakalalima ifisali bakengisha bambi ukufika ku mpendwa ya bantu amakana ikumi limo na basano.

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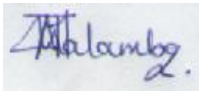
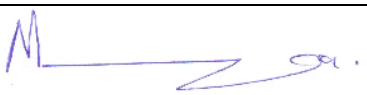
Managing Director

Project Team

Name	Responsibility	Signature
Danny Mwango	Team Leader - Project management and coordination, air quality assessment, characterisation of impacts, environmental management plan	
Mutinta Malambo	Landuse and Soils – Project Description, water quality assessment, soils characteristics, decommissioning and closure plan; monitoring plan	
Haggai Mutale Mulenga	Ecologist – study of flora and fauna characteristics of the area	
Lisa Mkanda	Socio-economic expert – study of land use, socio-economic and cultural issues affecting the project; development of social management plan	

1 INTRODUCTION

1.1 Background

Nava Bharat Ventures Limited (NBVL) proposes to establish an Integrated Sugar Project through its stepdown local subsidiary Kawambwa Sugar Limited (KSL).

KSL, is implementing the integrated Sugar Project in Luena Farm Block, Kawambwa District, Luapula Province, Zambia. The Project will be developed in an area of 10,000 ha in Four years after getting the EIA clearance for the development of the project and envisages establishment of a Centre of Excellence (Research and Development, R&D Farm) in 500 ha, corporate farming (Nucleus Farm) of sugarcane in 8,000 ha (net). KSL proposes to set up an Integrated Agro-based Processing Industry for the production of white crystal sugar, ethanol and alcohol, power and enriched organic manure to meet the domestic needs, as well as to export suitable agri-products. The integrated sugar project will also involve an out-grower scheme involving approximately 2,000 ha outside the project area.

NBVL has nearly Four decades of experience in agri-business in India. The company has been looking for global opportunities to expand its Agri-business by leveraging its strengths. In this process, NBVL having presence already in Zambia in Mining and Power sector at Maamba, through its stepdown subsidiary Maamba Colliries Limited, has chosen Zambia as the most suitable location for establishing an Integrated Sugar Project through its local stepdown subsidiary Kawambwa Sugar Limited (KSL) registered on 26th January 2016.

1.2 Project Objectives

The main objective of the project is to establish an Integrated Sugar Project in Luena Farm Block, in an area of 10,000 ha for the production of white crystal sugar, ethanol and alcohol, power and enriched organic manure to meet the domestic needs, as well as to export suitable agri-products.

1.3 Project Location

The earmarked site with the below stated coordinates and map falls under the jurisdiction of Chief Chama and is located about 6 km from Chibote village, Kawambwa District, Luapula Province, Zambia.

The survey process conducted by the Ministry of Lands fixed 10 Beacons (A to H & J, K) on the proposed site. The coordinates of the beacons and map are indicated below:

702 A	E 774008.749	N 8933259.989
702 B	E 777969.800	N 8933779.972
702 C	E 780176.281	N 8921581.808
702 D	E 782175.602	N 8915488.800
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702 H	E 775578.422	N 8921382.065
702 J	E 776685.085	N 8921896.941
702 K	E 776208.670	N 8925445.172

The layout map of the farm with various locations of the sections of the project is attached as **Appendix 1**.

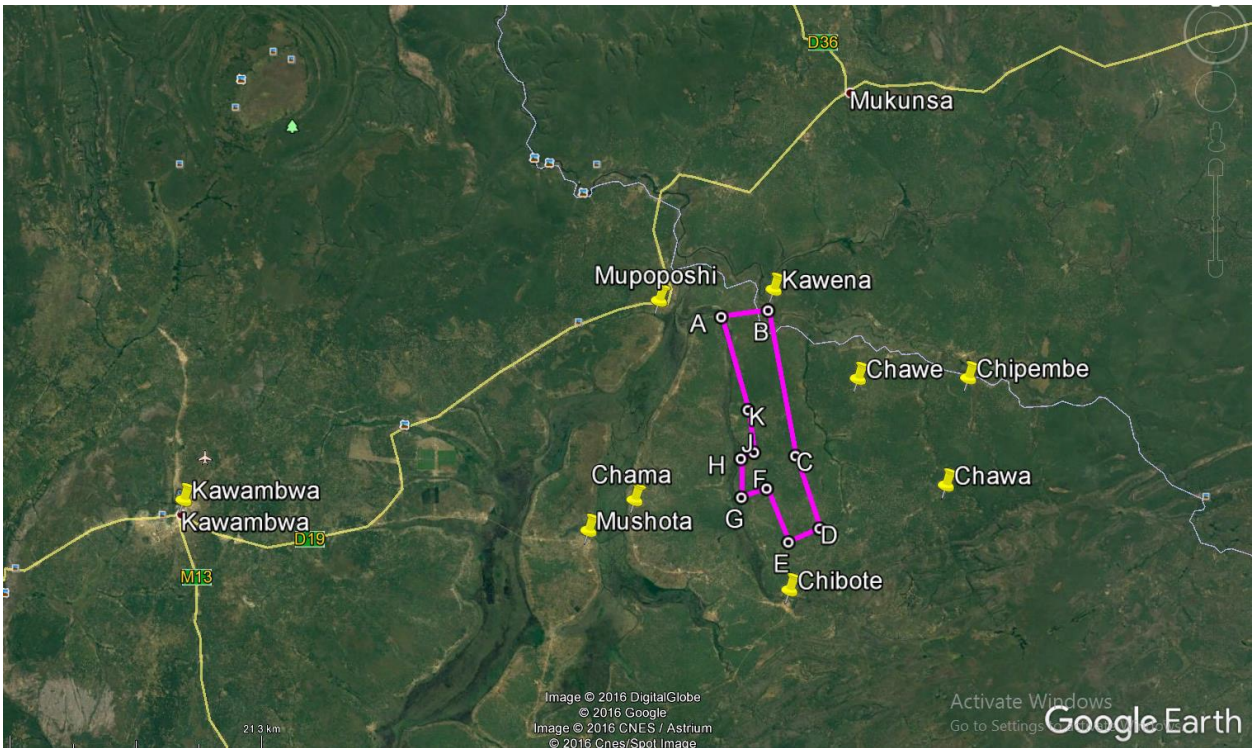


Figure 1-1: Location of the project site in Kawambwa

1.4 Summary Description of the Project

It is envisaged that the integrated sugar project will have a Centre of Excellence and will be used for Research and Development, a Nucleus Farm for farming of sugarcane, an integrated agro-based Processing Industry for the production of white crystal sugar, ENA, ethanol, power and enriched organic manure from the distillery to meet the domestic needs, as well as to export suitable agri-products. The project will also involve 2,000ha outside the project area for the development of an Out-Grower scheme.

The 10,000 ha is divided into three zones (**Appendix 1**) with each zone divided into six blocks. Each zone is further divided into blocks and blocks further divided into plots, with each plot having a size of 20ha. Zone 1 has 124 plots covering a total area of 2480ha. Zone 2 has 130 plots covering an area of 2600ha. Zone three has 86 plots on an area of 1720 Ha.

This project is expected to produce 99,750 tons per annum of sugar (plant capacity: 5000 tcd). Apart from supplying sugar the project will contribute to fill the demand-supply gap of energy in Zambia by generating power from bagasse to the tune of 30 MW and the excess of which will be channeled into the National Electricity grid along with about 9 million liters of power alcohol/ethanol for energy and industrial requirements and about 25,000 tons of enriched organic manure to improve soil fertility.

Considering 50 per cent mechanization, the sugar project is expected to generate permanent employment for 500 people and seasonal employment for around 3,000 people directly and indirect employment opportunities for more than 15,000 people. Employment and/or farm revenue from the out-growers land is expected to create more livelihoods around the factory area.

The land usage of the project is indicated in **Table 1-1** below:

Table 1-1. Land usage (area in Ha)

Project Component	Area in Ha
Plantation	7300
Plantation (future extension)	890
R&D Farm/RS & Building	587
Complex, office and residence	51
Canal and channels	27
Canal and channel bank	31
Roads (central + zonal/block division	122
Road pavement	20
MS pipe (foundation area)	5
Drainage	0.05
Swamp	645
Miscellaneous (pump house/hose etc	94
Total	**10,000**

1.5 About the site

There is a small river (Mupoposhi River), perennial in nature, passing across the border of the plot near the Coordinate A. The coordinate B is just touching the Kalungwishi River boarder and it is this corner touching the North. This is Perennial River with plenty of water even in this being of the rainy season. This will be the main water source which is almost 20 km from the entrance i.e. the Southern Boarder of the plot.

The expected water source (Misangwa River) on the Eastern Boarder is small.

There is some water source (Mupoposhi River) on the middle of the Western Border near G.

The area is with medium dense vegetation, some of them cut during shift cultivation. Except for a Lagoon on the eastern border, covering around 20 to 30 ha, the remaining area is plain and cultivable.

The area is earmarked by the Ministry of Agriculture so that there are no habitants and cultivation by the nearby villagers. However, there are landmarks of cultivation in small patches here and there in the proposed site as part of shift cultivation some years ago.

The area is plain, with gentile slope to all the sides. Soils are sandy loam with varying depths from 0.5 m to 5 m as seen in nearby profile, with a laterite (Gravel) substratum at the bottom. Good lateral drainage than vertical. Vegetation is medium with shrubs and trees. Tree growth is restricted due to influence of periodical forest fires. Soil pH is acidic.

1.6 Project Justification

The Luena Farm block development initiative, being spearheaded by GRZ through the Ministry of Agriculture, involves an area of 100 000 hectares and is planned to comprise a core venture, large, medium and small-scale farms operating under an out grower arrangement on similar lines like Nakambala Sugar Estates in Mazabuka. The proposed integrated sugar project is planned to be the core venture of the Luena Farm block.

Based on the information provided and the observations made during the site visit, the visiting team from NBV found that the proposed site area is quite suitable for sugarcane cultivation with respect to soil, weather, and availability of water for irrigation.

1.7 Project implementation date

KSL will begin to construct and develop nurseries as soon as the project is given a go ahead by ZEMA.

1.8 Track Record and Previous Experience of Enterprise Elsewhere

NBVL has nearly Four decades of experience in Agri-business in India. In Zambia, NBVL is already involved in the mining and power sector at Maamba, generating 300MW of electricity, through its stepdown subsidiary Maamba Collieries Limited.

NBVL is a diversified organization with interests in power generation, ferro alloys, mining and agri-business. The Company is in business for nearly four decades and operates in different locations spanning across India, and Africa.

The Company's Sugar Plant, in Andhra Pradesh, India, is one of the most energy efficient sugar plants, operating with an electrical energy consumption of 23 kWh per tonne of cane crushed and 31% steam consumption on cane. The plant has a capacity

of 4000tcd sugar, a distillery plant with a capacity of 20KLPD, an ethanol plant with an installed capacity of 30KLPD

The plant has achieved zero discharge of effluents by installation of a reverse osmosis plant and spent wash evaporation plant and 100% utilization of the product received from the evaporation plant for composting filter cake and producing organic manure.

Maamba Collieries Limited (MCL), a stepdown subsidiary of NBVL, is the largest coal mining company in Zambia. MCL has established a thermal power plant of 300 MW capacity(Phase-1) at Maamba and commenced its commercial operations in July 2017.

Nava Bharat Energy India Limited (NBEIL), a step-down subsidiary of NBV, is operating a 150 MW thermal power plant in India.

1.9 Company Shareholders and Directors

The consolidated details of the directors/shareholders is indicated in the table below.

Table 1-2: Company Directors/shareholders

Item No.	Name	Director/ Shareholder	Nationality	# shares
1	Gorthi Rama Krishna Prasad	Director	Indian	0.0
2	Ashwin Devineni	Shareholder	Singaporean	1
3	NAVA Agro Pte Limited	Shareholder		9,999

1.10 Contact Details

The company contact details are indicated in the table below:

Table 1-3: Contact Details

Postal Address	Contact Person
P.O. Box 31197 Alick Nkhata Road **Lusaka**	The Project Head Mobile: +260 960580344 e-mail: murtygodthi@nbv.in

1.11 Total Project Cost Estimates

Based on the preliminary estimate, the investment for the Integrated Sugar Project is US$ 209.590 million spread over four years for the establishment and commencement of production.

Table 1-4. Schedule of activities

Activity	Period			
	Year 1	Year 2	Year 3	Year 4
Planning				
Planting of nursery				
Planting of cane in fields and construction activities				
Harvesting and commencement of production				

1.12 The Need for Environmental Impact Assessment

Implementing a project of this nature can have a number of impacts on the socio-economic and bio-physical environment around the project site.

In order to ensure that the positive impacts are enhanced and the negative impacts are prevented or minimised, an Environmental Impact Assessment (EIA) has undertaken to determine the environmental and socio-economic implications of the integrated sugar project in the existing environment in line with the provisions of the Environmental Management Act (EMA) of 2011.

EIA is a versatile instrument designed to determine the environmental consequences of a developmental proposal and to ensure that these are integrated in the planning and implementation process. An EIA is meant to resolve potential conflicts between project activities and environmental attributes by mitigating against negative consequences and optimizing on positive elements.

1.13 Objectives of the EIA study

Compliance with the EMA 2011, which establishes a requirement for EIA study for projects of this nature, forms the basis of this study.

The broad objective of undertaking this EIA is to identify significant potential impacts of the proposed project to the environment and social aspects and formulate recommendations to ensure the project takes into consideration appropriate measures to mitigate any adverse impacts to the environment in all phases of its implementation.

The key objectives of this study include the following:

i) To identify and evaluate the significant environmental impacts of the proposed project.
ii) To determine the compatibility of the proposed project facilities with surrounding land uses.
iii) To assess and evaluate the environmental impacts and benefits associated with the proposed project.
iv) To evaluate and select the best project alternative from the various options identified.
v) To incorporate environmental management plans and monitoring mechanisms during project implementation and operational phases.

1.14 EIA Study Approach and Methodology

Implementing a project of this nature can have a number of impacts on the socio-economic and bio-physical environment around the project site.

In order to ensure that the positive impacts are enhanced and the negative impacts are prevented or minimised, an EIA has been undertaken to determine the environmental and socio-economic implications of developing the integrated sugar project in the existing environment in line with the provisions of the Environmental Management Act (EMA) of 2011.

The EIA development process involved a variety of methods. Desk review of documents was done to obtain background information on the proposed Project.

Ad hoc methods such as brainstorming, consultative meetings and discussions were also held with project proponents in order to gain a deeper understanding of the project, analyse possible alternatives, impacts and mitigation measures.

Other methods used during the EIA process included site visits, checklists and matrices, photography, community consultation through interviews with local communities.

Impact identification was aimed at determining the nature and magnitude of impacts. This exercise was achieved through professional judgment, site visits and discussions

with local communities and KSL personnel. Impact identification and assessment was followed by the generation of measures to mitigate the significant negative effects of the project and development of an environmental management and monitoring plan.

1.15 EIA Report Structure

This report is broadly structured as follows:

- Introduction covering background information, project justification and rationale;
- Relevant legislative and institutional framework;
- A description of the nature and purpose of the proposed development;
- An analysis of project alternatives;
- Potential environmental and social impacts;
- Proposed mitigation measures for identified impacts;
- Environmental management and monitoring plan; and
- Conclusion.

2 POLICY, LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

2.1 Policy Framework

2.1.1 The Vision 2030

The Vision 2030 is Zambia's first ever written long-term plan in which the Zambian people's vision is to become ***"A Prosperous Middle Income Nation by 2030".*** By 2030, Zambians, aspire to live in a strong and dynamic middle-income industrial nation that provides opportunities for improving the well being of all, embodying values of socioeconomic justice.

Relevance: The Vision recognizes that Zambia is endowed with abundant arable land and water resources. Out of the country's landmass of approximately 752,000 square kilometers, 56 percent is arable land (42 million hectares). In addition, about 35 percent of the fresh water resources in the SADC region are in Zambia, which if effectively utilized, could make agriculture a main stay of the economy.

With regard to value addition, agro-processing industries account for about 84 percent of manufacturing output, and are more than five times larger than the next largest group, textiles and leather products (both of which rely on agricultural raw materials).

It is with the above statistics in mind that the Agriculture Sector Vision is: ***An efficient, competitive, sustainable and export-led agriculture sector that assures food security and increased income by 2030.***

To achieve this goal, the agriculture sector has the following targets:

a) Increase agricultural productivity and land under cultivation by 2030;
b) Increase exports of agricultural and agro-processed products by 2030;
c) Preserve the agricultural resource base by 2030;
d) Increase land under cultivation to 900,000 hectares by 2030;
e) Increasing land under irrigation to 400,000 hectares by 2030;
f) Increase agricultural machinery, tractors per 100 hectares to 2 by 2030;
g) Increase livestock population to 6,000,000 by 2030;
h) Increase fish population to 300,000mt by 2030.

Compliance: The project will contribute to the realisation of the Vision 2030 through the establishment of an integrated farm which will support agricultural development as well as creation of employment opportunities.

2.1.2 The Second National Agricultural Policy, 2016

The Second National Agriculture Policy (SNAP) was developed to guide the development of the agriculture sector by providing a conducive environment that will stimulate sustainable agricultural development. The Policy provides a framework that promotes sustainable agricultural diversification, agricultural commercialization, private sector participation and inclusive agricultural growth.

The SNAP has provided for sustainable agriculture in Objective 8 which states: ***"To promote the sustainable management and use of natural resources."***

Relevance: In order to achieve sustainable agriculture, the objective stated in 2.3.1 is planned to be achieved using the following measures:

a) Promote sustainable land management technologies (including conservation agriculture, appropriate stock densities);
b) Promote afforestation, community wood lots and agro- forestry;
c) Promote use of renewable energy resources (solar, biogas and wind);
d) Promote energy efficient technologies in agricultural production and processing;
e) Strengthen co-management of inland and trans–boundary fisheries resources;
f) Decentralize capture fisheries management to communities;
g) Promote sustainable utilization of rangeland (grassland ecosystem) and pastures for livestock production;
h) Promote integrated agriculture especially among smallholder farmers;
i) Develop and promote water harvesting, storage and utilisation infrastructure;

Compliance: KSL intends to put in measures, during the operation of the project, that will contribute to the promotion of sustainable agriculture through sound tilling of the land, the sustainable utilisation of resources such as water and energy. The method of

irrigation chosen will ensure that water is properly utilized; the method of sugar harvesting is green and no burning of sugar will be practiced. Energy will be produced from the burning of bagasse.

2.1.3 The National Policy on Environment

The National Policy on Environment is designed to create a comprehensive framework for effective natural resource utilization and environmental conservation. The Policy is also sensitive to the demands of sustainable development.

Relevance: Under the Environmental Impact Assessment, Audits and Monitoring section, the policy has the following guiding principles that are related to the project:

a) EIAs will be required as deemed necessary to ensure that public and private sector development options are environmentally sound and sustainable and that any environmental consequences are recognized early and taken into account in project design, and implementation;

b) Obligatory IEE screening will precede EIAs to determine whether full EIAs are required for the specific site in question;

c) EIAs will consider not only biophysical impact but will also address environmental impact in terms of existing social, economic, political and cultural conditions;

d) Environmental Mitigation Plans for social and environmental impacts will be required for all activities where the EIA has determined a negative environmental threshold;

e) Environmental Audits, including inspections, record-keeping and monitoring will be required for activities as determined by the mitigation plans or otherwise;

f) Environmental Impact Assessments and Statements shall be made public and public comments on them invited and taken into consideration; and

Compliance: To ensure that environmental considerations are taken into account an EIA is being prepared before the project begins. The EIA report containing environmental management and monitoring plan has been prepared for submission to ZEMA for review and consideration.

2.2 Legislative Framework

The following are some of the pieces of legislation related and relevant to the project being developed by KSL:

The principal legislation governing environmental management in Zambia is the Environmental Management Act (EMA) of 2011. The Act provides for the sustainable management of natural resources and protection of the environment, and the prevention and control of pollution.

Relevance: Of particular relevance is section 29 of the Act which states that ***"A person shall not undertake any project that may have an effect on the environment without the written approval of the Agency, and except in accordance with any conditions imposed in that approval"***.

Further, In relation to the proposed project, some of the functions of ZEMA are to review EIA reports, and undertake environmental auditing and monitoring. The act also provides for public participation in decision-making and access to environmental information.

Compliance: This EIA report is being prepared for submission to ZEMA for review and decision making. The construction of the project will not commence until a decision is granted by ZEMA.

2.2.1 The Environmental Impact Assessment Regulations, SI 28 of 1997

The Environmental Impact Assessment (EIA) Regulations, Statutory Instrument 28 of 1997, Part III, under the Environmental Management Act of 2011 demands that before a developer commences implementing a project, an EIS be prepared and submitted to the relevant regulatory authority for review and approval.

Relevance: Regulation 7(2) specifically requires that a developer prepares and submits an environmental Impact Statement (EIS) for:

(a) Any project set out in the Second Schedule, whether or not the developer is part of a previously approved project;
(b) Any alterations or extensions of any existing project which is set out in the Second Schedule; or
(c) Any project which is not specified in the Second Schedule, but for which the Council determines a project brief should be prepared.

Compliance: The extent of the development site and the projected impacts demand that a full EIA be carried out. According to the Second Schedule, the projects categorised as:

Land clearance for large scale agriculture or Irrigation schemes covering an area of 50 Ha or more.

require that an environmental impact assessment be prepared.

2.2.2 The Environment Management Act (Licensing) Regulations (SI 112 of 2013)

There are several parts in this statutory instrument giving regulatory powers to ZEMA to control the discharge of water pollutants, air emission pollutants, pesticides and other toxic substances, waste (both municipal and hazardous) and ozone depleting substances. The parts of relevance to the project at hand are II and III.

Part II

Relevance: This part of the SI gives powers to ZEMA to regulate discharge of water pollutants and emission of air pollutants into the atmosphere in order to safeguard the general health, safety or welfare of persons, animal life, and plant life.

Compliance: KSL will ensure that clearing activities are done sustainably so as not to lead to the emission of dust. To ensure that dust emission is reduced, only sites earmarked for agriculture and construction will be cleared. At the construction sites, cleared areas prone to wind blown erosion, will be periodically watered.

Part III

Relevance: This part of the SI is meant to regulate the reclamation, reuse, recovery, recycling, transportation, export, collection and disposal of waste from industrial, commercial, domestic, or community activities. ZEMA regulates these activities through licensing of handlers of waste and operators of disposal sites; the licenses are accompanied by conditions.

Compliance: Much of the anticipated waste from the project is bagasse and molasses. Bagasse will be used to generated power while molasses will be used to make other products such as ethanol.

A limited amount of domestic waste will also be produced from camps during the construction period. This waste will be collected and stored in dedicated receptacles before being taken offsite for disposal at an approved disposal site

Further, in compliance with regulation 11, open air burning of waste will not be allowed anywhere within the premises unless with the express permission of ZEMA.

2.2.3 The Forests Act, No. 4 of 2015

The Forest Act, which repealed the Forests Act of 1999, provides for the establishment and declaration of National Forests, Local Forests, joint forest management areas, botanical reserves, private forests and community forests; provide for the participation of local communities, local authorities, traditional institutions, non-governmental organisations and other stakeholders in sustainable forest management; provide for the conservation and use of forests and trees for the sustainable management of forests ecosystems and biological diversity; and establish the Forest Development Fund.

The Act also provides for the implementation of the United Nations Framework Convention on Climate Change, Convention on International Trade in Endangered Species of Wild Flora and Fauna, the Convention on Wetlands of International Importance, especially as Water Fowl Habitat, the Convention on Biological Diversity, the Convention to Combat Desertification in those Countries experiencing Serious Drought and/or Desertification, particularly in Africa and any other relevant international agreement to which Zambia is a party.

The Act is the main legal instrument for the establishment, control, utilization and management of forests. The act provides for the establishment of the Forestry Department whose main function is to do all such things as are necessary for the rationalisation of the exploitation of forest resources and the promotion of sustainable forest management.

Section 8 of the Act provides for the principles for forestry development and management. Some of these principles include the following:

a) the principle that forests and trees shall be managed as an asset for succeeding generations;
b) the development, management, utilisation and conservation of forests and trees to achieve a sound ecological balance;
c) the need to achieve optimum utilisation and ecologically sustainable development and management of forest ecosystems, biological diversity and habitats; and
d) the need to conserve forests and trees as living resources for both present and future generations and to achieve economic growth, human resource development and employment creation.

Relevance: The area is with medium dense vegetation, some of them cut during shift cultivation. Except for a Lagoon on the eastern border, covering around 20 to 30 ha, the remaining area is plain and cultivable.

Compliance: KSL will not allow unnecessary cutting down of trees for upholding sustainable environmental practices and in compliance with the provisions of this legislation.

If rare flora specified in the Act is identified within the area, this will be conserved and protected.

2.2.4 The Water Resources Management Act, No. 21 of 2011

The Act was developed to establish the Water Resources Management Authority and define its functions and powers and to also:

- provide for the management, development, conservation, protection and preservation of the water resource and its ecosystems; provide for the equitable, reasonable and sustainable utilisation of the water resource;
- ensure the right to draw or take water for domestic and non-commercial purposes, and that the poor and vulnerable members of the society have an adequate and sustainable source of water free from any charges;
- create an enabling environment for adaptation to climate change;
- provide for the constitution, functions and composition of catchment councils, sub-catchment councils and water users associations;
- provide for international and regional cooperation in, and equitable and sustainable utilisation of, shared water resources;
- provide for the domestication and implementation of the basic principles and rules of international law relating to the environment and shared water resources as specified in the treaties, conventions and agreements to which Zambia is a State Party; and
- repeal and replace the Water Act, 1949.

As specified in section 57, in relation to the management of shared water resources, the Water Resources Management Authority (WARMA) is given powers to

a. establish national mechanisms for dispute resolution regarding shared water resources;
b. promote and ensure stakeholder participation, as part of Government's decision support system, in the management of shared water resources; and
c. facilitate the building of appropriate capacity for negotiations of shared water resources agreements as well as participation in institutions established to deal with shared water resources.

Relevance: KSL will need to abstract water from Mupoposhi and Kalungwishi for domestic use and irrigation. Abstraction of water from these sources is a commercial activity which will prompt KSL to obtain a permit for irrigation purposes. This is a requirement under section 71.

Compliance: In line with section 60, KSL shall ensure that the abstraction of water does not impact on the use of the water by other users of the water in the rivers. Further to

this, KSL shall comply with any condition, limitation, restriction or prohibition that WARMA may impose for the sustainable utilisation of the water in the rivers.

Wastage of water along the water canal and pipelines or at the plant will not be allowed in line with section 66 which prohibits causing water to run to waste from any water works or abstracting water in excess of that granted under a permit.

Furthermore, KSL shall continuously monitor amounts of water abstracted and keep records of the amount water used on a daily basis.

2.2.5 The Chiefs Act, No. 13 of 1994

This Act was developed to make provision for the recognition, appointment and functions of Chiefs and Deputy Chiefs; for the exclusion of former Chiefs and Deputy Chiefs from specified areas in the interests of public order.

Section 10 and 11 of the Act outlines the functions of chiefs and sub chiefs as under African customary law in so far as the discharge of such functions is not contrary to the Constitution or any written law and is not repugnant to natural justice or morality. Section 11 adds that every Chief is required to preserve the public peace in his area and to take reasonable measures to quell any riot, affray or similar disorder which may occur in that area.

Relevance: The Chiefs and traditional councils have influence over the project area and people. In the Luena area, Senior Chief Mushota rules a larger area than the district council, as his rule covers both Mwense and Kawambwa districts.

The traditional organization of the Chishinga people has Senior Chief Mushota at the apex of the structure. He rules the area through a number of Chiefs that have spatially defined Chiefdoms in both the Kawambwa and Mwense districts. The project site falls in the Chiefdoms of Senior Chief Mushota and Chief Chama, and borders the chiefdoms of Chiefs Munkanta and Mwenda (both of which fall under Senior Chief Mushota).

Compliance: Consultations with stakeholders have involved consulting with the chiefs identified above even before the project begins. During the operational phase, KSL will

need to consult with traditional chiefs for the recruitment process and any social investments planned for the area.

2.2.6 Biosafety Act, 2007

The Biosafety Act was developed:

- to regulate the research, development, application, import, export, transit, contained use, release or placing on the market of any genetically modified organism whether intended for use as a pharmaceutical, food, feed or processing, or a product of a genetically modified organism;
- ensure that any activity involving the use of any genetically modified organism or a product of a genetically modified organism prevents any socio-economic impact or harm to human and animal health, or any damage to the environment, non-genetically modified crop and biological diversity;
- set and implement standards for the assessment, evaluation and management of any potential risk involving the use of any genetically modified organism or product of a genetically modified organism;
- establish the National Biosafety Authority and prescribe its powers and functions; provide for the establishment of the Scientific Advisory Committee;
- provide for public participation, information and consultation in the field of biosafety;
- provide for a mechanism for liability and redress for any harm or damage caused to human and animal health, non-genetically modified crop, socio-economic conditions, biological diversity or the environment by any genetically modified organism or a product of a genetically modified organism; and
- provide for the formation and registration of institutional biosafety committees.

Relevance: KSL have proposed to have a research and development unit where research for maximum yields of sugar will be done.

Compliance: Sections 10 and 13 of the act will be taken into account. Section 10 prohibits research on, developing, producing, importing, exporting, transiting, carrying out any contained use, or placing on the market any genetically modified organism or any product of a genetically modified organism or deal in any manner with any

genetically modified organism or a product of a genetically modified organism without the prior approval of the Authority.

If any need arises to research into the production of a GMO, application will be made to the authority responsible for biosafety.

2.2.7 Noxious Weeds Act, 1969

The Noxious Weeds Act was developed Act to provide for the eradication of noxious weeds.

Section 11 of the Act prohibits importation, distribution, conveyance or sale of any noxious weed. The act has identified ***Lantana camara***, ***Salvinia auriculata*** and ***Eichhornia crassipes*** (water hyacinth) as noxious weeds which should be reported.

Relevance: The backflow of water used for irrigation (rich in phosphates and nitrates) can lead to the proliferation of noxious weeds in the receiving environment. The above weeds can also be inadvertently introduced in the area.

Compliance: Any notice of the any weed will immediately be reported.

2.2.8 Plants, Pests and Diseases Act, No. 176 of 1965

This act was developed to provide for the eradication and prevention of the spread of plant pests and diseases in Zambia, for the prevention of the introduction into Zambia of plant pests and diseases

Relevance: Inadvertently, unwanted pests and diseases can be introduced into the estate. Sugar growing has a number of diseases which will require that they are prevented before occurrence or once noticed controlled.

Compliance: Different pesticides will be used to prevent and control any emergency or proliferation of pests and diseases at the estate.

2.2.9 Food and Drugs Act, Cap 303 of 1972

The Food and Drugs Act was prepared to protect the public against health hazards and fraud in the sale and use of food, drugs, cosmetics and medical devices.

The Act prohibits selling of any food that is unfit for human consumption because it is poisonous or has harmful substances, is filthy, rotten, decomposed or diseased or has foreign matter, or is adulterated.

The Act also requires that food is sold, prepared, packaged or stored for sale according to the required standards and that this is done under sanitary conditions.

Relevance: The major product of the agro processing facility, sugar, is food which will need to be produced under acceptable standards of hygiene to ensure that the health of consumers.

Compliance: KSL will ensure that quality control is incorporated into the sugar and ethanol production process from receipt of the raw materials up to the time the processed products will be ready for sale.

2.2.10 The Lands Act (Cap 184)

The Lands Act is the statute governing land administration in Zambia which vests all land in the country in the President and alienation of land by the President.

The Act provides for the alienation, transfer, disposition and change of land. The Act also provides for compulsory acquisition of land by the President whenever he is of the opinion that it is desirable or expedient to do so in the interest of the Republic.

The Act gives Zambians an opportunity to participate in the country's economy.

Relevance: The Land was previously held by traditional chiefs before being given to the government as an area for the nucleus farm of the Luena Farm Block. The land has subsequently been converted to lease holding.

Compliance: Acquisition of the traditionally owned parcel of land for the project will take into account the provisions of the Lands Act. Consultations and adequate information

has been made available both to the government and traditional leadership before acquiring title.

2.2.11 The Land Survey Act, 1994

The Land Survey Act enacted in 1960 was aimed at providing guidelines to be followed when activities relating to land surveying were carried out. The Act among other things provides for the production of survey diagrams, plans, survey beacons and other survey marks.

Relevance: Before the planting and construction works can begin, the developer will survey the entire stretch to determine where the farm and other ancillary facilities will be located.

Compliance: Lay-out survey will be conducted to stake out orientation points and markers that will guide the construction exercise without encroaching in other peoples' land. These markers will be staked out according to a suitable coordinate system selected for the project. Cut lines/demarcations will be created for the identification of the edge of the farm.

In ensuring the above is implemented a registered surveyor will be required to carry out this exercise.

2.2.12 The Urban and Regional Planning Act, 2015

This piece of legislation was developed to:

- Provide for the development, planning and administration principles, standards and requirements for urban and regional planning processes and systems;
- Provide for a framework for administering and managing urban and regional planning;
- establish procedures for integrated urban and regional planning in a devolved system of governance so as to ensure multi-sector cooperation, coordination and involvement of different levels of ministries, provincial administration, local authorities, traditional leaders and other stakeholders in urban and regional planning; and

- ensure sustainable urban and rural development by promoting environmental, social and economic sustainability in development initiatives and controls at all levels of urban and regional planning.

The Act provides for the appointment of regional planning authorities, provincial planning authorities and local planning authorities whose main responsibilities are the preparation, approval of layout plans and revocation of development plans. The regional planning authorities will be appointed on an ad hoc basis.

Relevance: The project is within the Luapula Provincial planning authority and also Kawambwa District Council.

Compliance: The layout plans of the project and any modifications will need to be approved by the relevant provincial and local authorities before planting or construction can commence in accordance with the planning guidelines and framework set by the authorities. KSL will also recognize the jurisdiction of the provincial planning authority and their specifications will be complied with.

2.2.13 The Employment Act, No. 15 of 2015

This Act provides legislation relating to the employment of persons; to make provision for the engagement of persons on contracts of service and to provide for the form of and enforcement of contracts of service; to make provision for the appointment of officers of the Labour Department and for the conferring of powers on such officers and upon medical officers; to make provision for the protection of wages of employees; and to provide for the control of employment agencies.

According to this law, it is illegal for any employer to engage an employee on casual basis for any job that is of a permanent nature. The Act also bans unjustified termination of employment by employers.

Relevance: Considering 50% mechanization, the sugar project is expected to generate permanent employment for 500 people and seasonal employment for around 3,000 people directly and employment to more than 15,000 people indirectly.

Compliance: KSL will ensure that individuals employed at the project are of legal employment age, and are provided with conditions of service that meet or exceed the minimum conditions of service. Employees will not be subjected to exploitation and abuse of their rights through casualization.

2.2.14 The Local Government Act, 1991

The Act provides for the establishment of Councils in districts, the functions of local authorities and the local government system of which some of the functions relate to pollution control and protection of the environment in general.

Sections 69 and 70 of the Act give powers to Councils to impose levies on property, business or commodity as well as fees, respectively. The Councils are also given powers in section 76 to impose by laws for the good rule and government of their jurisdiction and, more particularly-

- for controlling any of the things which, and any of the persons whom, it is empowered by or under this Act to control;
- for providing for the issue or supply of licences permits, certificates and other instruments and documents.

Section 84(1) also gives powers to the minister of Local Government to, ***"by statutory instrument, make regulations for any purpose for which, and to the same extent to which a council is empowered by or under this Act to make by-laws or standing orders"***.

Relevance: The proposed project is within the jurisdiction of Kawambwa District Council and therefore all approvals required to be sourced from the local authority such as planning permission will be sought.

Compliance: KSL will comply with the specifications and any relevant by laws set up by the the local authorities.

2.2.15 The Workers Compensation Act, No. 10 of 1999

This Act makes provision for the establishment and administration of a Fund for the compensation of Workers disabled by accidents to, or diseases contracted by, such Workers in the course of their employment, and for the payment of compensation to

dependents of Workers who die as a result of such accidents or diseases; for the payment of contributions to such Fund by employers; for the grant of pensions and allowances to certain dependents of Workers who, being in receipt of pensions for such disablement, die from causes not connected with such accidents or diseases.

Relevance: The project will involve the use of machinery and tools that may cause injury to workers during their use or operation.

Compliance: KSL will make contributions to the Fund on behalf of the workers. In the event of any companies being contracted, these shall also be expected to show certificate of contributions made to the Fund.

2.2.16 The Occupational Health and Safety Act

This Act is promulgated to establish the Occupational Health and Safety Institute and provide for its functions; provides for the establishment of health and safety committees at workplaces and for the health, safety and welfare of persons at work; provide for the duties of manufacturers, importers and suppliers of articles, devices, items and substances for use at work; provide for the protection of persons, other than persons at work, against risks to health or safety arising from, or in connection with, the activities of persons at work.

Section 11 of Part III requires that an employer of ten or more persons at any workplace establishes a health and safety committee.

According to section 13 the functions of the health and safety committee are:

a) promote cooperation between the employer and the employees in achieving and maintaining healthy and safe working conditions;
b) share information about occupational health, safety and welfare with employees;
c) investigate and resolve any matter that may be a risk to the health and safety of employees at a workplace;
d) review the measures taken on the health and safety of employees at a workplace; and

e) formulate, review and disseminate to the employees the standards, rules and procedures relating to health and safety to be carried out at the workplace.

Section 16 of Part IV provides the duties of employers at workplaces in respect of health and safety at workplaces. These duties include:

(a) ensure, so far as is reasonably practicable, the health, safety and welfare of the employees of the employer at a workplace; and

(b) place and maintain an employee in an occupational environment adapted to the employee's physical, physiological and psychological ability.

Relevance: The operation of the project might raise the risks of occupational health hazards as a result of the use and operation of machinery and tools and the handling of fertilizers and chemicals. The generation of dust from clearing activities is another occupational health risk that will be generated by the project.

Compliance: Section 16 of Part IV provides the duties of employers at workplaces in respect of health and safety at workplaces. These duties include:

a) ensure, so far as is reasonably practicable, the health, safety and welfare of the employees of the employer at a workplace; and

b) place and maintain an employee in an occupational environment adapted to the employee's physical, physiological and psychological ability.

KSL will ensure that all the workers are provided with adequate and appropriate personal protective equipment. KSL will also provide information, instruction, training and supervision to ensure the health and safety of the employees at their workplace.

The employee is also expected to immediately inform the employer, the committee or health and safety representative if there are reasonable grounds to believe that any item, device, article, plant or substance, condition or aspect of the workplace is, or may be, dangerous to the employees' occupational health or safety at or near the workplace.

2.2.17 The Public Health Act, No. 22 of 1995

This Act provides for the prevention and suppression of diseases and the general regulation of all matters connected with public health in Zambia. Amongst other things, the Act prohibits anyone from causing a nuisance, where nuisances are given to include:

- The pollution of potable water;
- Any collection of water or any cesspit, latrine or urinal found to contain mosquito larvae;
- Any collection of water, sewage or waste which permits or facilitates the breeding of parasites, insects or other agents which may lead to the infection of people or domestic animals;
- The accumulation or deposit of waste which is offensive or injurious or dangerous to health;
- The discharge or noxious matter or waste water into a water course not approved for the reception of such discharge;
- Premises without sufficient lighting or ventilation;
- Dangerous buildings and overcrowded premises;
- Factories giving rise to smells and effluents which are offensive or dangerous to health.

Relevance: Temporary residential places will be erected during the construction period while permanent structures will be constructed and used by expatriates. Along with these structures will be public convenience places for the workers. Water of adequate quantity and quality will be required for domestic consumption.

Compliance: Management will ensure that the project site and more importantly the construction camps exhibit high levels of hygiene in order not to subject workers to public health nuisances. The project site will, at all times, be kept in clean and sanitary conditions.

2.2.18 The Factories Act, 1999

The Act regulates the conditions of employment in factories and other places of work as regards the safety, health and welfare of persons employed therein. The Act also provides for the examination and inspection of certain plant and machinery in order to ensure safety. The Factories Inspectorate under the Ministry of Labour and Social Security is the mandated authority under the Act.

Relevance: Even though other places of the project such as the farm are not deemed as a factory, they are a place of work as defined under this act where safety, health and general welfare of employees will be required to be upheld.

Compliance: To ensure that the occupational health and safety of employees is upheld during the construction and operational periods, all employees will be trained in health and safety protocols. All employees will be equipped with adequate and appropriate personal protective equipment and the devices, tools and equipment that will be used by the employees will be regularly inspected, maintained and repaired if found to be defective.

2.2.19 The National Heritage Conservation Commission (NHCC) Act, 1986

The NHCC Act provides for the conservation of ancient, cultural and natural heritage, relics and other objects of aesthetic, historical, pre-historical, archaeological or scientific interest.

Preliminary surveys indicate that the project site does not have any artefact of historical or archaeological value. However, in the event that any artefact is found at the project site, National Heritage and Conservation Commission (NHCC) will be notified.

In this case section 37(1) of the Act shall apply which states: ***"Any person who desires to excavate any ancient heritage or collect relics shall apply to the Commission for a permit to excavate or collect."***

2.3 Institutional Framework

Institutions relevant to the development of the integrated sugar project include the following:

2.3.1 Kawambwa District Council

Kawambwa District Council (KDC) is recognised under the Urban and Regional Planning Act as a planning authority whose main responsibilities are the preparation, approval and revocation of development plans.

KSL recognises that the company operates in the jurisdiction of the local authority and will observe the by-laws and regulations set up by KDC. The project plans will be submitted to the local authority prior to commencement of construction and planting exercise.

2.3.2 The Zambia Environmental Management Agency

The Environmental Management Act establishes the Zambia Environmental Management Agency (ZEMA). ZEMA is a statutory body within the Ministry of Lands, Environmental Protection and Natural Resources and the following are the main functions of ZEMA:

- Integrated environmental management and the protection and conservation of the environment and sustainable management and use of natural resources;
- The prevention and control of environmental pollution and environmental degradation;
- Provide for public participation in environmental decision making and access to environmental information
- Undertaking environmental auditing and monitoring; and
- Facilitating the implementation of international environmental agreements and conventions to which Zambia is a party.

In line with the EMA requirements, the TORs and curriculum vitaes of the EIA team will be submitted to ZEMA for approval. Furthermore, the EIA report will be submitted to ZEMA, after which ZEMA will undertake verification exercise and consultations with IAPs prior to making a decision.

3 PROJECT DESCRIPTION

3.1 Background

Nava Bharat Ventures Limited (NBVL) is proposing to establish an Integrated Sugar Project through its local subsidiary Kawambwa Sugar Limited (KSL) in the Luena Farm Block of Kawambwa District, in Luapula Province.

The Luena Farm Block is a 100,000ha agricultural project developed by the Zambian Government. NBVL has acquired 10,000ha to set up the Integrated Sugar Project, as a core venture of the Luena Farm block. The sugar project will be developed in Four years.

3.2 The Project

The Project will be developed in an area of 10,000 ha in Four years after getting the EIA clearance for the development of the project and envisages establishment of a Centre of Excellence (Research and Development, R&D Farm) in 500 ha, corporate farming (Nucleus Farm) of sugarcane in 8,000 ha (net). KSL proposes to set up an Integrated Agro-based Processing Industry for the production of white crystal sugar, ethanol and alcohol, power and enriched organic manure to meet the domestic needs, as well as to export suitable agri-products.

This project is expected to produce 99,750 tons per annum of sugar (plant capacity: 5000 tcd). Apart from supplying sugar the project will contribute to fill the demand-supply gap of energy in Zambia by generating power from bagasse to the tune of 30 MW and the excess of which will be channeled into the National Electricity grid along with about 9 million liters of power alcohol/ethanol for energy and industrial requirements and about 25 000 tons of enriched organic manure to improve soil fertility.

Considering 50 per cent mechanization, the sugar project is expected to generate permanent employment for 500 people and seasonal employment for around 3,000 people directly and indirect employment opportunities for more than 15,000 people. Employment and/or farm revenue from the out-growers land is expected to create more livelihoods around the factory area.

3.3 Sugar processing

3.3.1 Planting and harvesting

The estate is divided into three zones, from south to north, and each zone ranging between 1700 and 3500 hectares. Each zone is further divided into six blocks of sugarcane fields. Each block is again sub divided into plots, and a plot will have a size of 20Ha with a spacing of 1.5m of planted sugarcane rows. Zone one has 124 plots covering an area of 2480ha; zone two has 130 plots on an area of 2600ha; and zone three has 86 plots in an area of 1720ha. Approximately 645Ha of the 10,000ha is a swamp.

Sugarcane requires an average temperature of 23.9 degrees Celsius and uniform rainfall of about 203 centimeters per year. A nursery will be prepared from where the stalks will be collected and planted in the fields. After preparing the soil, the procedure for growing the cane is as follows:

- Select healthy sugar cane plants; the N-19, N-25, N-41, N-46, N-51, N-53 of South Africa and R-570 and R-579 of Reunion will be planted. Apart from this, KSL will do research and development of some more varieties at the Centre of excellence R&D department.
- Split the sugarcane stems into foot long pieces
- Dig furrows in a sunny area
- Moisten the furrows to prepare them for the sugar cane
- Plant the sugarcane stems horizontally
- Fertilize the sugarcane with with nitrogen rich fertilizers
- Weed the plant bed regularly
- Monitor for pests and diseases

Different fertilizers and pesticides (for the control of pests and diseases) will be stored on site in the warehouse on a concrete surface in an area with enough ventilation to prevent the build up of aerosols. There will also be material safety data sheets at storage sites for the various chemicals. These chemicals will be in a bunded area equipped with enough cleaning materials in the event of spills or leaks.

One of the most common forms of pesticide application is the use of mechanical sprayers. Hydraulic sprayers consist of a tank, a pump, a lance (for single nozzles) or boom, and a nozzle (or multiple nozzles). Sprayers convert a pesticide formulation, often containing a mixture of water (or another liquid chemical carrier, such as fertilizer) and chemical, into droplets, which can be large rain-type drops or tiny almost-invisible particles. This conversion is accomplished by forcing the spray mixture through a spray nozzle under pressure. The size of droplets can be altered through the use of different nozzle sizes, or by altering the pressure under which it is forced, or a combination of both. Large droplets have the advantage of being less susceptible to spray drift, but require more water per unit of land covered. Due to static electricity, small droplets are able to maximize contact with a target organism, but very still wind conditions are required.

The sugarcane will take about seven months to mature. At this time, fields of sugarcane will be tested for sucrose, and the most mature fields will be harvested first. The standing cane, about 1.8 – 3m tall, will be cut down. There will be no burning of the fields before harvesting.

3.3.2 Preparation and processing

After the cane arrives at the mill yards, it will be mechanically unloaded, and excess soil and rocks removed. Based on the field conditions and practical requirement the cane will be cleaned by spreading the cane on agitating conveyors that pass through strong jets of water and combing drums (to remove larger amounts of rocks, trash, and leaves, etc.). At this point, the cane is clean and ready to be milled.

3.3.3 Juice extraction pressing

Swing-hammer type shredders shred the cane without extracting the juice. Revolving knives cutting the stalks into chips are supplementary to the crushers. The pressing process involves crushing the stalks between the heavy and grooved metal rollers to separate the fiber (bagasse) from the juice that contains the sugar.

As the cane is crushed, hot water (or a combination of hot water and recovered impure juice) is sprayed onto the crushed cane counter-currently as it leaves each mill for diluting. The extracted juice contains 95 percent or more of the sucrose present. The

mass is then diffused, a process that involves finely cutting or shredding the stalks. Next, the sugar is separated from the cut stalks by dissolving it in hot water or hot juice.

3.3.4 Purification of juice — clarification and evaporation

The juice from the mills, a dark green color, is acidic and turbid. The clarification process is designed to remove both soluble and insoluble impurities (such as sand, soil, and ground rock) that have not been removed by preliminary screening. The process employs lime and heat as the clarifying agents. Milk of lime (about one pound per ton of cane) neutralizes the natural acidity of the juice, forming insoluble lime salts. Heating the lime juice to boiling coagulates the albumin and some of the fats, waxes, and gums, and the precipitate formed entraps suspended solids as well as the minute particles.

The muds separate from the clear juice through sedimentation. The non-sugar impurities are removed by continuous filtration. The final clarified juice contains about 85 percent water and has the same composition as the raw extracted juice except for the removed impurities.

To concentrate this clarified juice, about two-thirds of the water is removed through vacuum evaporation. Generally, four vacuum-boiling cells or bodies are arranged in series so that each succeeding body has a higher vacuum (and therefore boils at a lower temperature). The vapors from one body can thus boil the juice in the next one—the steam introduced into the first cell does what is called multiple-effect evaporation. The vapor from the last cell goes to a condenser. The syrup leaves the last body continuously with about 65 percent solids and 35 percent water.

3.3.5 Crystallization

Crystallization takes place in a single-stage vacuum pan. The syrup is evaporated until saturated with sugar. As soon as the saturation point has been exceeded, small grains of sugar are added to the pan, or "strike." These small grains, called seed, serve as nuclei for the formation of sugar crystals. (Seed grain is formed by adding 1,600 grams of white sugar into the bowl of a slurry machine and mixing with 3.3 parts of a liquid mixture: 70 percent methylated spirit and 30 percent glycerine. The machine runs at 200 RPM for 15 hours). Additional syrup is added to the strike and evaporated so that the original crystals that were formed are allowed to grow in size. The growth of the crystals

continues until the pan is full. When sucrose concentration reaches the desired level, the dense mixture of syrup and sugar crystals, called massecuite, is discharged into large containers known as crystallizers. Crystallization continues in the crystallizers as the massecuite is slowly stirred and cooled.

Massecuite from the mixers is allowed to flow into centrifugals, where the thick syrup, or molasses, is separated from the raw sugar by centrifugal force.

3.3.6 Centrifugaling

The high-speed centrifugal action used to separate the massecuite into raw sugar crystals and molasses is done in revolving machines called centrifugals. A centrifugal machine has a cylindrical basket suspended on a spindle, with perforated sides lined with wire cloth, inside which are metal sheets containing 400 to 600 perforations per square inch. The basket revolves at speeds from 1,000 to 1,800 RPM. The raw sugar is retained in the centrifuge basket because the perforated lining retains the sugar crystals. The mother liquor, or molasses, passes through the lining (due to the centrifugal force exerted). The final molasses (blackstrap molasses) containing sucrose, reducing sugars, organic non-sugars, ash, and water, is sent to large storage tanks. Once the sugar is centrifuged, it is "cut down" and sent to a granulator for drying.

3.3.7 Drying and packaging

Damp sugar crystals are dried by being tumbled through heated air in a granulator. The dry sugar crystals are then sorted by size through vibrating screens and placed into storage bins. Sugar is then sent to be packed in different sizes for domestic consumption, in bulk packaging, or in liquid form for industrial use. The estimated production figures are 99,750 tons per year.

3.3.8 Byproducts

The two major byproducts are bagasse and molasses. The bagasse produced after extracting the juice from sugar cane will be used as fuel to generate steam. Part of this power will be used at the plant while the remaining will be evacuated into the national grid. The estimated power that will be generated is 30MW. The molasses from purification will be used as feed for livestock. It can also be used in the production of industrial alcohol, yeast, organic chemicals, and rum.

3.3.9 Quality Control

Mill sanitation is an important factor in quality control measures. A small amount of sour bagasse can infect the whole stream of warm juice flowing over it. The mills will thus have self-cleaning troughs with a slope designed in such a way that bagasse does not hold up but flows out with the juice stream. Strict measures will be taken for insect and pest controls.

Because cane spoils relatively quickly, measures have been put in place to automate the methods of transportation and get the cane to the mills as quickly as possible. Maintaining the high quality of the end-product means storing the refined sugars (which contain two percent to five percent moisture) in a cool and relatively moist atmosphere, so that they continue to retain their moisture and do not become hard.

3.4 Organic manure

The technology for the production of organic manure uses sugarcane by-products like bagasse, mud-press, slops and ash from the sugar factory and alcohol distillery. Bagasse is the pulp or dry refuse left after the juice has been extracted from sugarcane while slop is what remains of the mash after an alcoholic beverage has been distilled.

The advantages of composting are that not only does it return precious organic matter to the soil, but the process also helps to get rid of waste materials that are serious health hazards to the community around the factories. With more people conscious of what how their food is produced, bio-organic fertilizers are becoming popular as an eco-friendly alternative to restore nutrients to degraded soils.

3.4.1 Raw materials

In order to carry out the composting, three main ingredients are required: the activator, the sugarcane residues and the acidified solution. The activator contains cellulolytic fungi such as ***Trichoderma koningii***, ***T. resii***, ***T. viride***, ***T. harzianum*** and ***Phanerochaete chrysosporium***. These organisms are cultured in liquid media such as a rice bran decoction, coconut water and slops. Next, sugarcane residues such as cane trash, bagasse and mud-press, wastes and manure are added.

3.4.2 Composting

Manure and green leaves are added to the compost pile since these are rich sources of nitrogen that are needed to promote accelerated growth of the microorganisms. To hasten the composting process, an acidified solution (distillery slops and furnace ash) containing phosphates and ammonium sulfate is required. Recommended mixture is 2:1:1, that is two parts mudpress, one part bagasse and one part manure and green leaves. Addition of activator and 0.5% ammonium sulfate constitute the most essential ingredients for the compost pile. The amount of activator added is 1% of the total mixture or substrate.

In order to make the compost pile, the layers of bagasse, mudpress, green leaves, manure, mineral matter and activator using the recommended proportion are prepared. The layering is continued until the pile is three feet high, five feet wide and ten feet long, while ensuring that there are enough green leaves for the nitrogen needs of the microorganisms. The compost pile will be kept moist but not soggy as too much moisture can delay decomposition. A laminated plastic or canvas will be laid over the compost for five days. Temperature of the compost should rise to 65-70 degrees centigrade within 2-3 days, a sign that the fungi are doing their work. To speed up "baking" time, the pile will be turned over and sprinkled with the acidified solution every three days after the first five days. This is done to allow adequate aeration and mixing of the materials. For the composting to be successful, the acidity of the compost pile from will be maintained between 5.7 to 6.2 pH. When the temperature drops to 35 degrees centigrade, the compost is ready for harvest. The compost is dark-brown to black and should look like dark crumbly soil mixed with small pieces of organic material. It should have a sweet, earthy smell. Before drying the compost, the liquid enricher will be added and incubated for five days after which the compost will be air-dried for one day so it will be easy to handle. The dried compost will then be packed in sacks and stored in shaded areas. If there are large particles, a grinder will be used to have a uniform texture of bio-organic fertilizer.

3.4.3 Benefits from compost

a) Compost improves soil structure by creating passageways for air and water creating a better environment for plant growth.
b) It supplies necessary nutrients to the plants such as nitrogen, phosphorus, potassium, sulfur, and other nutrients.
c) Compost holds moisture and immobilizes pollutants.
d) Compost can hold large amounts of water - many times its own weight.
e) Humus- compost's main ingredient acts like glue, holding soil particles together, making soil resistant to erosion and improving moisture retention.
f) Compost supplies organic matter to the soil stimulating the growth of beneficial microorganisms that promote root development and make nutrients available to the plants.
g) Certain microorganisms found in compost suppress some soil-borne diseases and plant pathogens such as pythium, fusarium and other lawn diseases thus, aiding plant health.

3.5 Ethanol Production

Sugarcane ethanol is an alcohol-based fuel produced by the fermentation of sugarcane juice and molasses. Because it is a clean, affordable and low-carbon biofuel, sugarcane ethanol is emerging as a leading renewable fuel for the transportation sector.

3.5.1 Ethanol production process

Ethanol is produced through biochemical processes based on fermentation using cane juice or molasses as a feedstock (or a mixture of cane juice and molasses). After preparation of a mash with the appropriate concentration of sugars and solids, the sugars are transformed into alcohol using yeasts as the catalyst. Fermentation takes four to 12 hours. The chemical reaction liberates a significant amount of CO_2 and heat. The fermentation process can be conducted in batch or continuously, using open or closed fermentation tanks. Cooling is applied to maintain the resulting fermented wine mixture. Much of the CO_2 liberated can be captured and converted into marketable products, such as dry ice, liquid CO_2 for soft drinks, fire-fighting foams, filtration products, and various industrial uses.

After fermentation, the ethanol is distilled from other by-products, resulting in a level of purity of approximately 95%. This is often referred to as hydrous ethanol because it contains 5% water. This mixture of ethanol and water is azeotropic, so that the compounds cannot be separated by simple addition of heat, as is done in the distillation process. Hydrous ethanol can be commercially used, but cannot be blended with gasoline. An additional reactant, such as cyclohexane, is needed in order to dehydrate the ethanol, by forming a tertiary azeotropic mixture with water and alcohol. Anhydrous ethanol is nearly 100% pure and can therefore be blended with gasoline.

The projects will also contribute to the development of local communities through the provision of social amenities like water, electricity, roads and bridges, schools, health facilities, afforestation, eco-tourism and community-based income generating activities. Various activities will be taken up as part of social responsibility and thrust areas will be identified through mutual discussions as the project progresses.

A detailed survey will be conducted on the community needs. Based on the information collected and the outcome of the discussions with the local officials and Village leaders, an action plan will be drawn and implemented to meet the local requirements.

3.5.2 Benefits of ethanol

a) Clean air – ethanol adds oxygen to gasoline which helps reduce pollution and harmful emissions in tailpipe exhaust.
b) Reduced greenhouse gas emissions – compared to gasoline, sugarcane ethanol cuts carbon dioxide emissions by 90 per cent on average. That's better than any other liquid biofuel produced today at commercial scale.
c) Better performance – ethanol is a high-octane fuel that helps prevent engine knocking and generates more power in higher compression engines.
d) Lower petroleum usage – ethanol reduces global dependence on oil.

3.6 Electricity production from bagasse

When burned by a sugar mill, bagasse, the fibrous material leftover after juice is extracted from sugarcane, usually produces enough electricity to power all of the mill's operations. For every 10 metric tons of sugarcane crushed, a sugar factory produces nearly 3 metric tons of wet bagasse.

The bagasse will be used for generation of steam which in turn will be used as a fuel source and the surplus generation exported to the national power grid. Once the bagasse dries, it will be burned in boilers to make steam. The steam will be used to create electricity.

Bagasse when burned in quantity produces sufficient heat energy to supply all the needs of a typical sugar mill, with enough energy to spare. To this end, a secondary use for this waste product is in cogeneration, the use of a fuel source to provide both heat energy, used in the mill and the electricity which is typically sold on to the consumer through power grids.

The power produced through co-generation substitutes the conventional thermal alternative and reduces greenhouse gas emissions. The resulting CO_2 emissions from the burning of bagasse are equal to the amount of CO_2 that the sugarcane plant absorbed from the atmosphere during its growing phase, which makes the process of cogeneration greenhouse gas-neutral.

4 PROJECT ACTIVITIES

The activities for the integrated farm will evolve through the following phases:

4.1 Planning and Design Phase

It is during this stage that planning for the project will be carried out. This will entail designing the layout of the various facilities of the project, taking into account environmental, technical and financial implications. The consultations with the government for the access route into the project and connection of the site to the national grid for power will be done during this stage. It must be pointed out that the access route leading to the project site is the responsibility of government while KSL will prepare the road network within the core venture. It is also the reposnsibility of government to supply power to the estate. The following activities will also form part of the planning stage:

a) Seek and obtain the appropriate approvals from the relevant authorities; these authorities include Zambia Development Agency (ZDA), Water Resources Management Authority (WARMA), ZEMA, the affected traditional authority and the local authority.
b) The proponent will also mobilize human workforce at skilled and unskilled levels.
c) Appraisal of baseline condition to feed into the development of the EIA report.
d) EIA Study Report preparation and submission to ZEMA.

4.2 Construction Phase

The construction works will include the setting up of structures which include factory for sugar processing, ethanol and compost production, warehouses for raw materials and products, offices, residences, road network, water infrastructure such as canal and pipes.

Construction works will include selective land clearing, earthmoving, trenching for foundation strips, cutting access routes, construction of superstructures, finishing works and landscaping.

The architectural designs and site layout plans shall be implemented and the setting out will comply with the specifications set out under the supervision of qualified engineers. In accordance with the designs and the layout plans, the construction of the proposed

project and associated infrastructure will begin immediately ZEMA approves the EIA study report. The construction will include the following activities:

4.2.1 Transportation of machinery to the construction site.

The machinery will be used for ground breaking and transportation of materials from the sources to the site. The major machinery and equipment that will be used include mixers, welding machines and transmission machines.

4.2.2 Mobilising workforce

The proponent will also mobilize human workforce at skilled and unskilled levels. It is estimated that between 250-350 local persons will be directly employed locally while the construction team will also include approximately 50 internationally specialized workers who will be accommodated in a small construction workers' camp established on site. Social interaction activities will undoubtedly result between project workers (especially those who are Zambian employed) and local communities. The project will as much as possible hire labour from within local communities.

Although a canteen and catering facilities will be provided for project workers, local market transactions will take place between construction workers and local communities and it is envisaged that some informal restaurants will spring up in the vicinity of the project site providing food and beverages. Casual sexual relationships are likely to result from interactions between workers and the community.

The presence of construction workers will require the acquisition of fuel (wood or charcoal) and water for food preparation and domestic purposes as well as the provision of sanitation and health services.

4.2.3 Acquisition and transportation of building materials

The contractor will source for materials for construction from the various available suppliers. Supply of materials will be a continuous activity throughout the construction period since different materials will be needed at different phases of construction.

The materials that shall be used in the construction include among others, building stones, sand, ballast, cement, timber, reinforced concrete frame, steel, bars, G.I pipes, PVC pipes, paving blocks, concrete slabs, insulated electrical cables among others.

Cement will be obtained from Lafarge, Zambezi Portland or Dangote, sand and stones from ZEMA approved local quarries in Kawambwa, steel from Kafue Steel Plant, electrical cables from Zamefa in Luanshya while pipes, pavement blocks and timber from local suppliers in Lusaka.

4.2.4 Construction of roads

The external access roads to the project site is the responsibility of the government while the KSL will construct the internal roads.

Construction of the road formation for internal roads will involve earth moving and shaping of formation and shoulders, and stabilization of the base with the piling, spreading and compaction of gravel and aggregate.

4.2.5 Construction of structures – Residences, Offices, Complex - Factory, Warehouse,

The structures will be situated to the northern part of the farm as indicated in **Appendices 1** and **2**. There will be a building for research which will sit on a 587ha farm while the complex, office and residences will take up 51ha. The pump houses will be part of the facilities that will take up a land measuring 94ha. The layout and architectural drawings of the proposed structures as the type and number of houses is being worked out and will be submitted to ZEMA. Suffice to say that there will be two types of houses for officers and general workers on site.

In addition, it is not yet known whether fuel will be stored on site and once a decision is made, a separate application will be made to the relevant authorities.

The construction of the above mentioned facilities will go through the following phases:

4.2.5.1 Excavation and land filling works

Site clearing, setting out and excavations for the foundation of the building will proceed. Materials from the excavations of the ground and foundation work will be reused for earth works and landscaping. This activity will involve the use of heavy earthmoving machinery such as loaders, tippers and bulldozers.

4.2.5.2 Masonry, Concrete Work and Related Activities

The construction of the building walls, foundations, floors, pavements, drainage systems among other components of the project will involve a lot of masonry work and related activities. General masonry and related activities will include stone shaping, concrete mixing, plastering, slab construction, construction of foundations, and erection of building walls and curing of fresh concrete surfaces. These activities are known to be labour intensive and will be supplemented by machinery such as concrete mixers.

4.2.5.3 Structural Steel Works

The buildings will be reinforced with structural steel for stability. Structural steel works will involve steel cutting, welding and erection.

4.2.5.4 Roofing and Sheet Metal Works:

The proposed roof will have iron sheets and roofing activities will include cutting and fastening the roofing materials.

4.2.5.5 Transportation of the construction rubble from the site

Construction waste that cannot be used for either back filling or landscaping work at the site will be taken offsite to be deposited at another construction site or an approved dumpsite.

4.2.5.6 Electrical Work

Electrical work during construction of the premises will include installation of electrical gadgets and appliances including electrical cables, lighting apparatus, sockets, etc. In addition, there will be other activities involving the use of electricity such as welding and metal cutting.

4.2.5.7 Plumbing

Installation of pipe work for water supply and distribution will be carried out within the plant, offices and residences. In addition, pipe work will be done to connect sewage from the premises to the wastewater disposal lines, and for drainage of storm water. Plumbing activities will include metal and plastic cutting, the use of adhesives, metal grinding and wall drilling among others.

4.2.5.8 Fire protection

Self-contained fire detection and alarm system complete with manual call points, optical smoke detectors, heat detectors and electronic sounders will be set up. Hose reel fire protection system will be provided to cover the buildings. The system will comprise of a water storage tank, distribution of pipe work and fire hose reels and portable fire extinguishers will be provided at convenient spots.

4.2.5.9 Landscaping and tree planting

To improve the environmental and aesthetic value or visual quality of the site once construction ceases, the proponent will carry out landscaping and tree planting. This will include establishment of flower gardens and lush grass lawns and will involve replenishment of the top soil. It is noteworthy that the proponent will use plant species that are available locally preferably indigenous ones for landscaping.

4.2.6 Collection and disposal of domestic waste:

In view of the expected swelling up of population at the project site, there will be need to site and develop a ZEMA approved disposal sites where waste that can be recycled or reused can be disposed off.

4.2.7 Irrigation infrastructure (pump stations, irrigation and drainage channels)

Water will be required for construction, workers domestic use and dust suppression measures. Water will be abstracted from the water sources nearby such as Mupoposhi and Kalungwishi Rivers.

An open canal will be constructed in the middle of the farm from where channels feeding into the fields will be constructed. Water will be abstracted from both the Kalungwishi and Mupoposhi Rivers. Irrigation is planned to cover 7500 – 8000Ha of the estate.

Surface irrigation is proposed and a central canal running south to north in the middle of the estate for about 18 to 20km. the canal will be 6m wide. There will be three (3) pump houses, one for each of the three zones of the estate. A series of pumps will be installed to allow maintenance and reduce the risk of intermittent supply. Each pump house will have four (4) pumps with a head of 60m and capacity of 1800m^3/hr. the power usage of the pump is designed to be 450kW. The lengths of the pipes from the pump houses to the canal range between 700m to 1000m. The pipes will lead and discharge into the central canal located in the middle of the estate. There will be no reservoir constructed for the storage of the water and the excess water from the fields will discharged through the drainage back to the river. However, the irrigation adopted will have minimum wastage. A total of 65,520,000 m^3 of water per year will be required.

This option of abstracting water directly from the river will include the installation of a pump house near the river to house the pumps as well as a guard house for personnel that will provide security. The construction works will thus involve the development of a complete and functional pump station with control building and necessary electrical and civil works on a turnkey basis.

The following equipment will be installed at the pump station:

- Pumps for the pumping of water, instrument transformers, surge arrestors, and earthing system;
- Booster pumps for supplementing the pumps;
- Power to run the pumps;
- Standby generator for supplying power when electricity is down;
- Civil works associated with all of the above works including provision of an internal access road and internal pump station access roads for delivery of pumps and other equipment into the pump station;
- Substation control building and guard house;
- House for security personnel; and
- Cable trenches.

Sugarcane crop grows efficiently with average rainfall of 150-200 mm per month uniformly distributed over 6-8 months or 1200-1500 mm per annum. The amount of average annual rainfall at Kawambwa District is just 1250 mm, most of which is

distributed in 6-7 months, i.e., from October to April. The deficit in rainfall amount during dry month has to be compensated by supplementary irrigation. Thus, irrigation of the sugarcane crop during the dry months starting from the month of May to Oct is a must for higher yields of plant and ratoon crops. The irrigation water requirement at KSL estate is worked out in Table 4-1.

Table 4-1: Water requirement for KSL Estate

S.No	Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Remarks
1	Monthly average pan evaporation in mm	142	114	135	129	145	171	166	211	210	190	144	128	
2	Daily average pan evaporation in mm	4.5	4.1	4.4	4.3	4.7	5.7	5.4	6.8	7	6.1	4.8	4.1	
3	Pan factor	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
4	Reference crop evaporation in mm	3.4	3.1	3.3	3.2	3.5	4.3	4.0	5.1	5.3	4.6	3.6	3.1	
5	Peak Kc value	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	Crop age is taken as 4 to 10 months for estimation
6	Peak Crop water requirement in mm	4.3	3.8	4.1	4.0	4.4	5.3	5.0	6.4	6. 6	5.7	4.5	3.9	
7	Peak Irrigation water requirement in mm @ 60% application efficiency for flood irrigation	7.1	6.4	6.8	6.7	7.3	8.9	8.4	10.6	10.9	9.6	7.5	6.5	Due to various crop age groups available in a year 75% of peak IWR is taken for IW estimation. (10.9x0.75=8.2). So 80mm/ha is taken for IW estimation

Since KSL needs to irrigate the sugarcane for 5 to 6 months during the dry season as and when it is required, it is essential to have pump stations to supply irrigation water and irrigation channel system to distribute needed water to each field. Due to heavy rains during rainy season, and surplus water at the time of irrigation, a network of drainage channels is to be laid out. The layout and map of pump stations, irrigation and drainage network as per topography of the land is given in **Appendix 1**. The details of irrigation water required for each zone, pump specifications and power required are given in **Tables 4-2** and **4-3**. Schematic plan for complete pump stations is given in **Figure 4-1** and 4-2. Some illustrations of central canal, distribution points and surface irrigation are given in **Figures 4-3** to **4-6**.

The irrigation water is available up to September in Mupoposhi stream (locally called as Choma), present on western border (connecting coordinates G and H up to A point, without touching J and K points). In the event of water shortage in Mupoposhi, it can be lifted from Kalungwishi River, present at north-eastern side of the estate.

Table 4-2. Irrigation water (IW) required for each zone, pump specifications and power required

Particulars	Unit	Zone I	Zone II	Zone III
Water requirement /irrigation/hectare	mm	80	80	80
Area of one Hectare	Sq.Met	10000	10000	10000
Water requirement /irrigation/hectare	M^3	800	800	800
Total irrigation	Nos.	10	10	10
Water requirement/hectare/10 irrigation	M^3	8000	8000	8000
Total estate area	Hectare	2932	2982	2276
Total water requirement	M^3	23456000	23856000	18208000
No. of days water applied	days	180	180	180
Quantity of water required/Day	M^3	130311	132533	101156
Quantity of water required/Hour	M^3	5430	5522	4215
Pump capacity	M^3/hr	1800	1800	1800
No. of pumps required	Nos.	3	3	2
Pump power	kW/Pump	450	450	450
Total power	kW	1357.4	1380.6	1053.7
Total power	MW	1.4	1.4	1.1
Total no.of zone	Nos.	1	1	1
Power requirement/ Hectare	kW/hr	0.46	0.46	0.46

Irrigation window: 24 hours (Spare pumps can be used simultaneously to reduce irrigation window)
[@]Two pumps in each pump house (PH) would be kept as spare (Total pump in each PH: 3+2=5)
[#]Pump house in Zone-III also have 5 pumps as the left over area will be utilized for cultivation in second phase

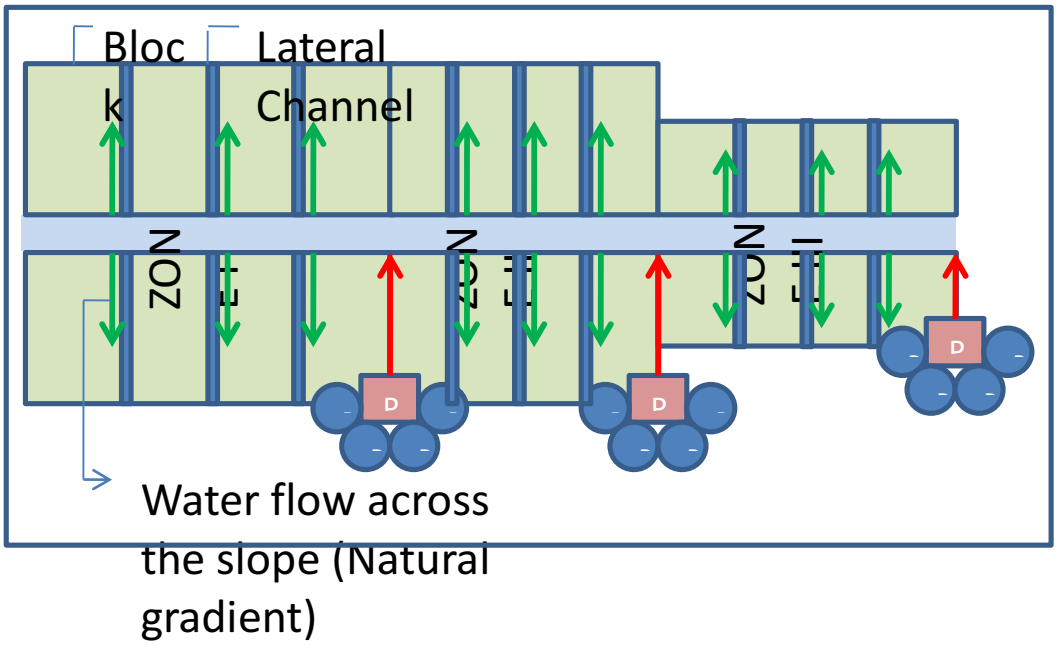


Figure 4-1. Schematic diagram for irrigation infrastructure

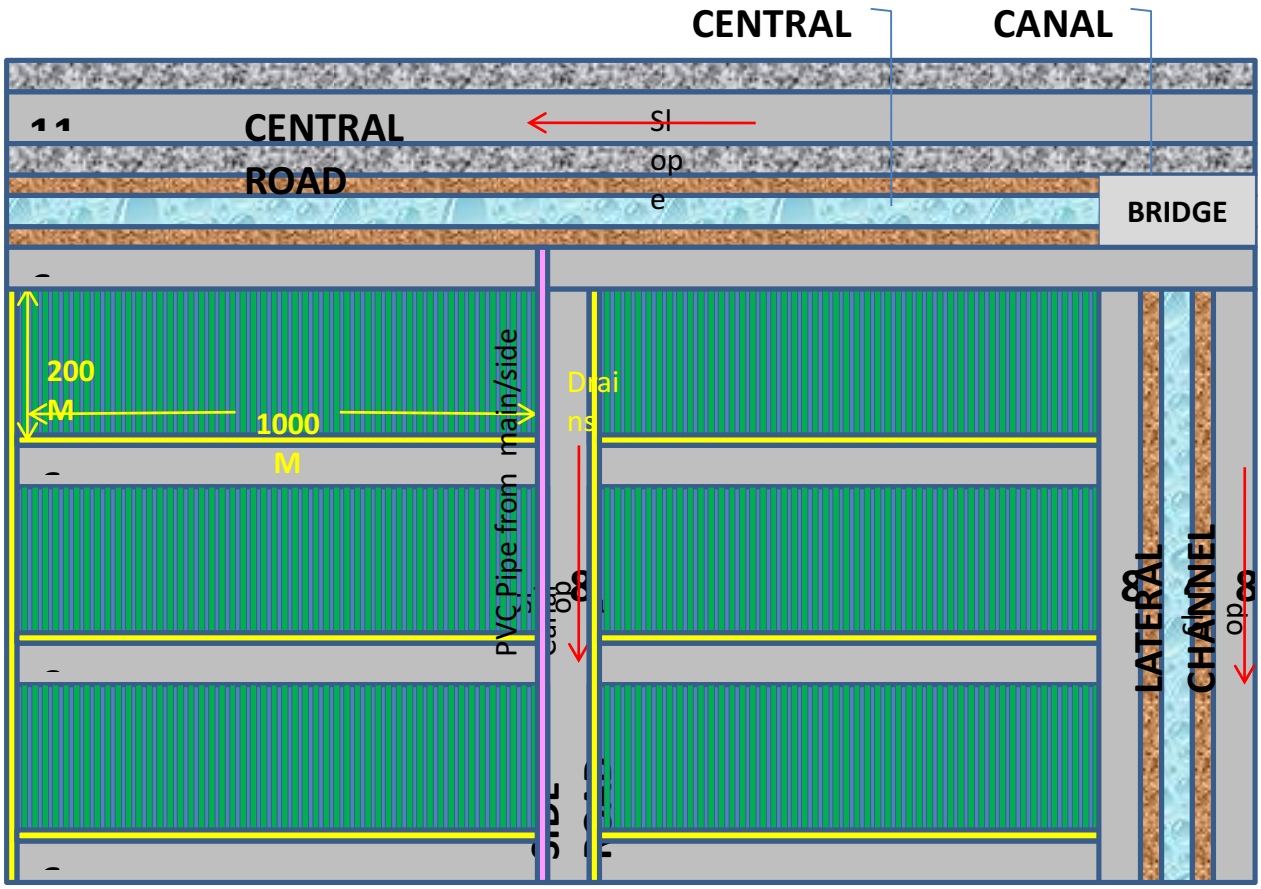


Figure 4-2. Schematic diagram for irrigation infrastructure in a block

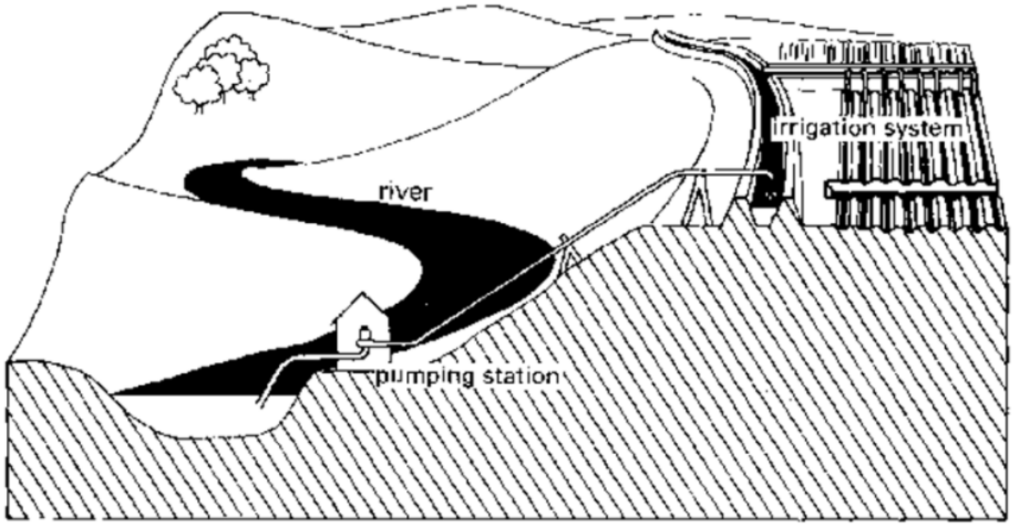
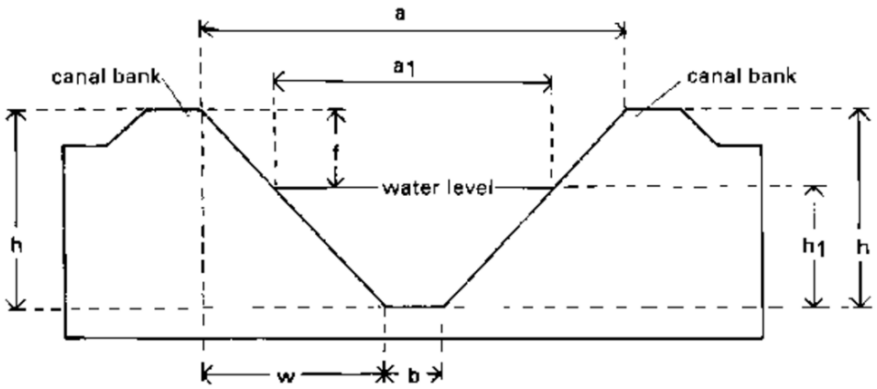


Figure 4-3. Schematic diagram of pumping station



a: Top width of canal
a1: Top width of water level
h: Height of the canal
h1: Height of water in canal
b: Bottom width of canal
h;w Side slope of canal
f: Free board (h–h1)

Figure 4-4. Cross section of trapezoidal canal

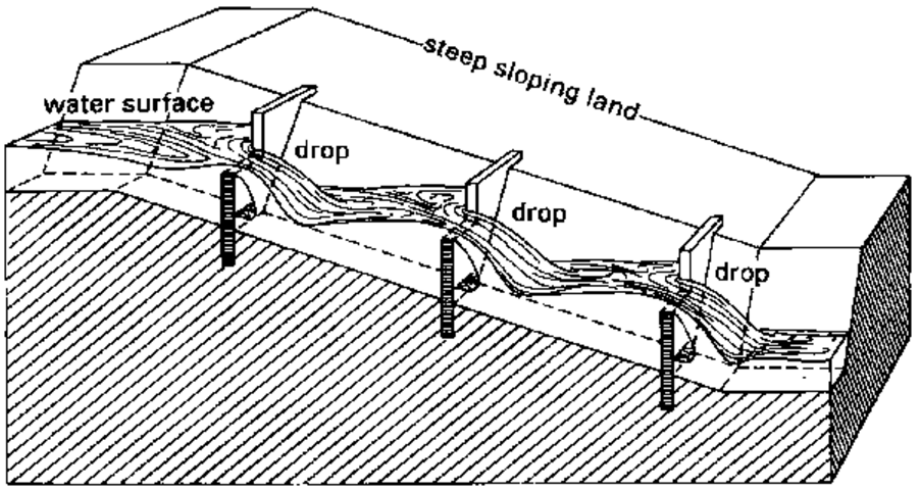


Figure 4-5 Longitudinal section of series of drop structures

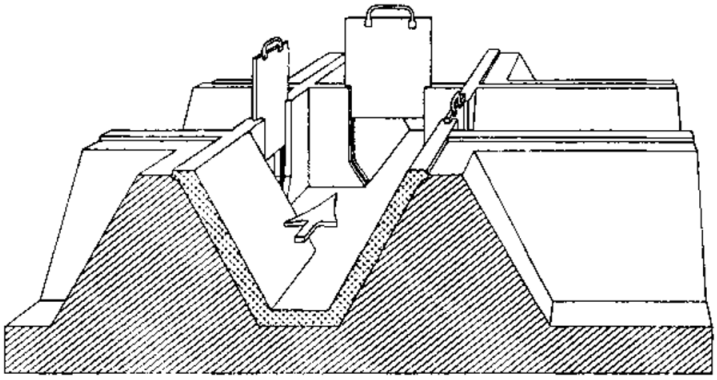


Figure 4-6. A division box with gates

Photo 4-1 Furrow irrigation in sugarcane plots through gated pipes

Table 4-3. Area occupied by Irrigation canal, channels and drainage in proposed KSL Plan and estimated length and diameter of different pipes

Particulars	Area in ha
Area of irrigation structures/roads (in Meters)	
Canal and Channels	27
Canal and channel Bank	31
Roads (Central+Zonal/block div.)	122
Road Pavement	20
Plot roads	228
MS Pipe (Foundation Area)	5
Drainage lines	0.052
Pipe lengths (in Meters)	
MS Pipe length (1000 mm dia)	11032 m
PVC Pipe length (200-250 mm dia)	38152 m
Gated pipe length (150mm dia)	60000 m

- To lift the water from river to central canal, MS/ GRP pipes (1000 mm diameter) would be used
- A Contoured Central Irrigation Canal (Approximate length-20 km; width-6m with 4 m bank on each side) would be constructed from middle of the south to north direction
- In each zone, 3 lateral channels (1 covering two blocks) will distribute water in blocks (in 2nd Zone, due to topography of land 1st channel will be used to irrigate 4 blocks, therefore, this zone has two lateral channels)
- From lateral channels, water would be supplied to plots through PE-Gated pipes
- From centre to east and west side, rain/excess water would be drained from plots through drainage canals as per gradient in to main drainage (river sides)

4.2.8 Construction by products

The main products from the construction stage include construction debris such as packaging materials, timber and steel off-cuts. The packaging waste includes cement bags, cardboards, plastic and paper bags. The dust that will be generated from excavation works and from the use of cement, stones and sand is another by product. Soil will also be generated from the excavation activities.

4.3 Operating Phase

The operating phase will be limited to:

- Water abstraction and pumping
- Sugar planting, harvesting and processing;
- Weeding, control of pests and diseases;
- Production of organic manure;
- Production of ethanol;
- Production of power from bagasse and the evacuation of this power into the national grid.

5 PROJECT ALTERNATIVES

5.1 The No Option Alternative

The non- implementation of the proposed project will avoid all the negative potential environmental and social impacts but will deprive the residents of Kawambwa District the much needed employment and business opportunities. This option is therefore not feasible in view of the fact that the support the government is offering to the agriculture sector as an engine for economic growth will be in vain.

5.2 Irrigation systems

The principal irrigation systems available are:

- surface (flood / furrow)
- overhead sprinklers (drag line / centre-pivot)
- drip / trickle techniques.

Drip and trickle techniques tend to be the most water-use efficient, but require significant financial investment, while surface techniques are the least efficient, but are low cost and do not require farm machinery. Taking convenience and cost into consideration, the proponents will thus choose between furrow and drip. The overhead method will be considered in due course. Based on the experience and results from the proposed trials in R&D farm during the first 3 years, a suitable irrigation method will be established in the nucleus estate for sugar cane irrigation.

5.3 Site alternatives

Other places within Zambia with wetlands, such as the Kafue and Bangweulu flats, were considered. However, Kawambwa was suitable for the project because of favourable climate, good soils, the availability of water from nearby water courses for irrigation, local acceptance of the project, as well as support from the government for establishing the project in this area.

5.4 Design alternatives

5.4.1 Co-producing sugar and ethanol

The decision for or against co-production is based on the relative economic value of sugar vs. ethanol, along with the size of the two product markets. Where ethanol is highly valued and a sufficiently high volume market appears likely, then an autonomous distillery would be favored. Where sugar is highly valued and the market for ethanol is somewhat uncertain, then co-production would be favored.

Co-producing sugar and ethanol is often accomplished by annexing the distillery with the sugar factory. Molasses or a mixture of cane juice and molasses is used as the primary feedstock. The value of molasses from a sugar factory is generally much greater as an ethanol feedstock on-site than the value of exporting the molasses to a separate distillery. Without annexing, there are chances of incurring transportation costs. In addition, the ethanol distillery often supplies fertilizer for the cane fields. Thus annexing offers synergistic advantages to both industries. In this analysis, given the remoteness of the site and the lack of transportation infrastructure, we have assumed that annexing with unified ownership of the sugar factory and ethanol distillery is the only feasible option. After ethanol distillery supplies fertilizers to the cane fields by fertilizing Vinasse (slop) through irrigation water

5.4.2 Bagasse utilization alternatives

The produced fibrous outer residue from the extraction of cane juice can be disposed of on land or sent to the boiler to provide steam and electricity for the factory. The fact that the sugarcane plant provides its own source of energy for sugar production in the form of bagasse has long been a special feature of the sugar industry and any factory designed and constructed today would be at least efficient enough to cover its own energy needs. With the availability of advanced cogeneration technologies, KSL will harness the on-site bagasse resource to go beyond meeting its own energy requirements and produce surplus electricity for sale to the national grid.

5.4.3 Electricity production

In the traditional approach, sugar factories use medium pressure (1.5-2.5 MPa) bagasse-fired boiler/steam turbine systems to cogenerate just enough steam and electricity to meet the on-site needs. More efficient steam turbines operating at higher

pressures can significantly increase electricity production at sugar factories. A typical Condensing Extraction Steam Turbine (CEST) operates at 4.0 to 6.0 MPa. These systems produce enough steam to supply a typical sugar factory and distillery and export 30 to 100 kWh of electricity per tonne of cane (kWh/tc) to other users or to the national grid. CEST systems represent the state-of-the-art for bagasse cogeneration in terms of mature technologies that are fully commercialized in the marketplace.

Gasification of biomass for use in a high- efficiency gas turbine is a more advanced approach to bagasse cogeneration. This approach is based on the marriage of two technologies: a biomass gasifier unit with a gas turbine. There are a number of possible configurations, of which two have been extensively analyzed and undergone experimentation. The first is the Biomass Integrated Gasifier-Combined Cycle (BIG-CC) and the second is the Biomass Integrated Gasifier/Steam Injected Gas Turbine (BIG/STIG). A BIG-CC system adds a separate steam turbine bottoming cycle to an industrial gas turbine. The BIG/STIG employs steam not needed for process uses and injects it in order to boost the power output of the gas turbine. The economic value arises in that these systems increase electricity production, which is a higher- value export product, once factory steam needs are met.

BIG-CC and BIG/STIG systems would produce over twice as much power per tonne of cane as CEST systems. However, unlike CEST systems, BIG-CC and BIG/STIG systems are not commercially mature at present. In addition, they are expected to have significantly higher capital costs. Nevertheless, Combined Cycle systems using natural gas are widely available. Because combined-cycle gas turbines represent one of the most energy-efficient power generation choices on the market, and one of the most promising emerging technologies for utilizing biomass energy resources, BIG-CC system will be used.

5.5 Waste disposal alternatives

The main waste streams that will be generated are bagasse and molasses. The bagasse produced after extracting the juice from sugar cane will be used as fuel to generate steam. Part of this power will be used at the plant while the remaining will be evacuated into the national grid. The estimated power that will be generated is 30MW. The molasses from purification will be used in the production of industrial alcohol.

5.6 Green harvesting of cane or Pre-harvest cane burning

The cane fields are burnt immediately before harvesting for easier cutting, post harvest cultivation and pest control. Although it has some benefits, as noted above, pre- harvest burning leads to:

- Elevated levels of particulate matter, carbon monoxide and ozone can be generated into the atmosphere at the time of pre-harvest burning.
- There is evidence that sustained pre-harvest burning of sugar cane 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 percent of the annual nitrogen removal in a cane crop.
- 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 five percent.

Because of the above reasons, KSL will thus employ green harvesting with the leaves being left in the field as a source of compost.

5.7 Irrigation alternatives

A comparative analysis of the three irrigation methods – furrow, sub-surface drip and centre pivot – was carried out by the engineers based on cost, depreciation, operating costs and yield potential. Even though centre pivot has higher water use efficiency if applied properly, the following table shows that when all the criteria indicated below are taken into account, furrow irrigation is cheaper. The water use efficiency for the furrow will be increased by the use of a gate system which will entail that water required for a particular block of sugarcane is supplied and the gate closed once the area is irrigated.

Table 5-1: Comparison of Furrow, Sub-surface Drip and Central Pivot irrigation systems

Principal factors	Criteria	Units	Furrow	Sub-surface drip	Center Pivot
Capital cost (Installed)	Infield	$/ha	1200	4500	3200
	Bulk water supply (to field edge) basic cost	$/ha	2400	2400	2400
	adjustment for difference in bulk water costs	factor	0.65	0.55	0.6
	Bulk water supply (to field edge)	$/ha	1680	1320	1440
	TOTAL BULK WATER COSTS	**$/ha**	**2880**	**5820**	**4640**
Depreciation	Infield	Years	10	7	12
		$/ha/annum	120	643	267
	Bulk water supply	years	15	20	20
		$/ha/annum	112	66	72
	TOTAL DEPRECIATION COSTS	**$/ha/sec mgr**	**232**	**709**	**339**
Operating Costs	Management - Ha per section Manager	$/ha/annum	400	300	650
	Cost of management using $54,000 cost/annum	**$/ha/annum**	**135**	**180**	**83**
	Repairs and maintenance	**$/ha/annum**	**30**	**130**	**70**
	Labour usage-peak labour estab-applic	md/20ha field	2	0.5	0.6
	Man-days/annum for 100 days irrigation	md/ha/annum	10	3	3
	Labour Cost @ $ 6/man-day (incl supervisor)	**$/ha/annum**	**60**	**15**	**17**
	Water use efficiency	**%**	**68%**	**94%**	**84%**
	Power usage - Total dynamic head	Head(m)	20	60	65
	Demand factor (Head x efficiency)	**Demand factor**	**29**	**64**	**77**
	Vulnerability (theft & vandalism etc)	**$/ha/annum**	**18**	**26**	**38**
Yield potential	Sensitivity to local staff deficiencies	**Factor (1-10)**	**5**	**4**	**8**
	Yield estimation - all other factors being equal	**Est TCH**	**93**	**93**	**91**
	Yield over break-even yield @ 70 TCH	TCH	23	23	21

5.8 Raw materials

The project proponent will incorporate resource efficiency in the construction of facilities and the production of the various products at the agro-processing plant.

Instead of digging pits for backfilling foundations, the materials extracted from constructing the canal will be used as backfill material.

Instead of using biomass from other sources for the production of organic manure, KSL will use by products like bagasse, mud-press, slops and ash from the sugar factory and alcohol distillery. Bagasse is the pulp or dry refuse left after the juice has been extracted from sugarcane while slop is what remains of the mash after an alcoholic beverage has been distilled.

Instead of disposing of the molasses, KSL will produce ethanol through biochemical processes based on fermentation using cane juice or molasses as a feedstock (or a mixture of cane juice and molasses).

The above strategies will ensure that waste is minimized, land pollution from disposal avoided and production costs lowered.

6 ENVIRONMENTAL BASELINE CONDITIONS

6.1 Physical Environment

6.1.1 Location and Access

The project site can be accessed via Mporokoso Road then turning into Luwingu Road after 17km from Kawambwa Boma. The access route goes past Senior Chief Mushota's palace (located some 19km from the Luwingu-Mporokoso turn-off) and turns northwards to the left from the Luwingu Road after 27.5km from the turn-off. The project site is located near Chibote Village, a further 21km onto a gravel road after turning off from the Luwingu Road.

6.1.2 Luena Farm Block

The Luena Farm Block, where the project is located, is a 100,000Ha parcel of land set aside by the the government in Kawambwa District for agricultural development. Luena is suitable for can growing as it enjoys rainfall with an average of 1000-1500mm. suitable crops for this area include sugarcane, fruits, wheat, tea, maize, rice, potatoes, onions, oil seed, cassava, beans, finger millet, tobacco and soya beans.

Luena has a high irrigation potential; its covered by a wide expanse of wetlands and numerous streams.

6.1.3 About the district

Kawambwa district is about 233km from Mansa. Kawambwa sits at the junction of gravel roads to Nchelenge, Mporokoso, Mushota and Mansa, and a tarred road to Mbereshi linking with the Zambia Way, the main tarred highway of the Luapula Province through Kazembe (Mwansabombwe) and Mansa.

6.1.4 Climate

Kawambwa District has a tropical continental climate with a long rainfall period starting from October and ending around April. The farming season goes up to 190 days, which is one of the longest in Zambia. The dry season begins in May and ends in September. The season is cool with mean temperatures of 20 ºC to 23 ºC and maximum

temperatures of 34 ºC. The evaporation rate is generally 160 mm but may go up to 200 mm in September. The average total rainfall is about 1406mm which is the second highest in the province. The heaviest rainfall is experienced between December and March of each year and the average total Monthly rainfall is 250mm (http://www.luapulaprovince.gov.zm/districts/kawambwa.html).

The climatic variables are shown in the graph and table below. They include temperature, sunshine (daylight hours), relative humidity and precipitation.

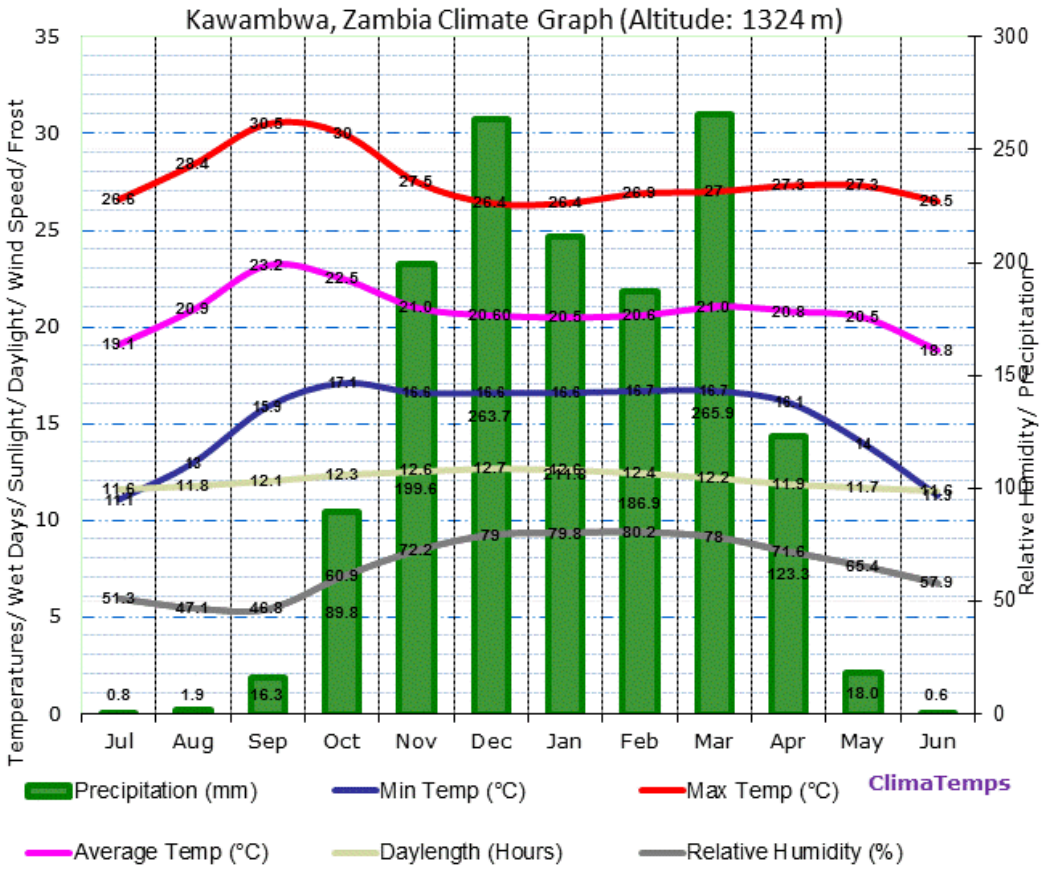


Figure 6-1. Kawambwa Climate Graph (source: www.climatemps.com)

Table 6-1. Kawambwa Climate Table

Climate Variable	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Average Temperature °C	19	21	23	23	21	21	21	21	21	21	21	19	21
Average Precipitation mm	1	2	16	90	200	264	212	187	266	123	18	1	1379
Average Daylight Hours/ Day	11h 36'	11h 48'	12h 04'	12h 20'	12h 34'	12h 40'	12h 37'	12h 25'	12h 10'	11h 53'	11h 40'	11h 33'	12h 00'

Source: www.climatemps.com

6.1.5 Topography

The project site is located on the edge of the northern Zambian plateau above the Luapula valley at an altitude of 1300m.

Kawambwa has two main topographical features, namely the Valley and the plateau. The valley is the area along the Luapula River ranging in altitude from 900 - 1000 m above sea level. The plateau is the area around the Muchinga escapement ranging from 1,200 m to 1,500 m above sea level.

6.1.6 Geology

The geology in the Luena area consists of Pre- Cambrian quartzite, sandstone, slates and schist that form the upper elements of the Basement Complex. Folded rocks occupy the escarpment zone in the southeast of the area. Rivers have formed wide alluvial swamps and dambos (seasonally waterlogged areas) with very low gradients, because they cannot cut into the rocks of the Basement Complex[1].

6.1.7 Soils

The River system in the project site forms wide alluvial swamps and dambos (seasonally waterlogged areas) having low gradients since they cannot cut into the rocks of the Basement Complex. Therefore, the soils in the proposed project area are deep and permeable with a uniform physical and chemical composition. The topsoil is loamy sand to sandy clay loam, while the subsoil is sandy loam to clay. The subsoil is friable, reddish-brown to reddish-yellow and is overlain by thin humus topsoil. The soils have a high proportion of silt and very fine sand with a laterite zone at a variable depth of 30 to 70 cm.

The soils are slightly acidic (pH 4.2 to 6.3) throughout the profile, with a low cation exchange capacity (CEC) (1.0 - 3.0 meq/100g). Influencing the low values of CEC is Sandy nature of soils which render them have low holding capacity for cations compared to clayey and silty soils which have negatively charged sites that enable them adsorb and hold on to cations. Further, the soils recorded low organic carbon (C: 0.89-1.23 %) which is an indication of low organic matter and poor micro-organisms activity in the

[1] Sugarcane Research in Zambia, 2001

decomposition of the debris. The chemical characteristics of the soils reflect the fact that they are derived from parent material that is poor in basic minerals which include Sodium (Na: 12.9- 37.4ppm), Phosphorous (P: 11-23ppm), Potassium (K: 22.9-149.4ppm). The soils recorded low values of Nitrogen (N: 0.06- 0.08%) which is critical for plant growth. Refer to **Appendix 7** for laboratory soil test results.

6.1.8 Hydrology

Luapula River is the biggest in the province. It passes through Kawambwa over a stretch of 30km from Mununshi to Mbereshi. Other rivers are Mbereshi, Lufubu, Ng'ona and Mununshi. The other notable features are lagoons.

The Kalungwishi River flows west in northern Zambia into Lake Mweru. It is known for its waterfalls, including the Lumangwe Falls, Kabweluma Falls, Kundabwika Falls, and Mumbuluma Falls. The Kalungwishi River forms the boundary between Luapula and Northern provinces of Zambia, and also the eastern boundary of Lusenga Plain National Park.

Lumangwe Falls on the Kalungwishi River is the largest waterfall wholly within Zambia, with a height of 30-40 m and a width of 160 m. The falls is 80 km from Mporokoso on the Kawambwa road. It has a similar depth of water falling over the edge to the Victoria Falls on the Zambezi River.

At the river's height at the end of the rainy season in April/May, spray from the waterfall may be carried 100 m into the air and the roaring sound in the gorge below seems to shake the ground.

In the project area, there is a small river (Mupoposhi River), perennial in nature, passing across the border of the plot near the Coordinate A. The coordinate B is just touching the Kalungwishi River boarder and it is this corner touching the North. This is Perennial River with plenty of water even in this being of the rainy season. This will be the main water source which is almost 20 km from the entrance i.e. the Southern Boarder of the plot.

The expected water source (Misangwa River) on the Eastern Boarder is small.

There is some water source (Mupoposhi River) on the middle of the Western Border near G.

The western boundary of the project site is approximately 30 kilometers east of Kawambwa and is drained by the Luena and Musambeshi Rivers in the west, Lufubu and Mupoposhi Rivers in the east and Pambashe River in the center. These rivers drain a total land area of about 2,830 square kilometers. About 27% of the area[2] is in the Mwense district. The dry land elevation ranges from 1,200 to 1,500 meters above sea level (a.s.l.) with slopes of 1.0 to 1.5%, while wetlands are flat at altitudes of 1,160 to 1,240 meters a.s.l.

Photo 6-1. Lufubu River

[2] Sugar Research in Zambia, 2001

Photo 6-2. Wetland between Chief Chama and Chief Mushota

6.1.9 Surface water quality

Water quality results for the Kalungwishi River indicate almost all the parameters, except for bacteriological results, meeting standards for drinking water. Sampling was done during the wet season when surface runoff was high carrying with it and depositing matter that could raise the amount of coliforms in the water. Refer to **Appendix 6** for laboratory results of water analysis.

6.1.10 Air Quality

The project area is largely rural and is devoid of industries discharging air polluting substances. The air quality is however, occasionally impacted on by bush fires which generate smoke to form a haze. Localised air pollution is also caused by dust emissions from unpaved road surfaces. This emission is however, intermittent and not significant in view of the light traffic in the area and the fact that the dust emission usually occurs during windy conditions. The burning of wood for heating and lighting is also another source of localised, particularly indoor, air pollution.

In like manner, the source of noise in the project area is limited to music played, wind gusts and infrequent light vehicles using the local roads. The area is usually serene at night.

At the project site, the following sound levels were recorded:

42.5dB Breeze

52.8dB Wind blowing

72.5dB Rainstorm

6.1.11 Land Use

Land use in Kawambwa district is associated with land tenure. While all land is Zambia is vested in the Republican President, most of the land in the district is customary and under the administration of Chiefs. The district is endowed with diversity of flora, fauna, and water resources which includes lagoons, rivers, and streams.

There are protected forests such as the Lusenga Plain National Park, and farm blocks each of which is administered by the responsible government department and chiefs. Many of the households own traditional land which is either given by the chief or passed on from forebearers. The parcels of land are predomantly used for small scale farming where maize, cassava, millet, sweet potatoes and sorghum are grown.

6.2 Biological Environment

6.2.1 Background

This report presents the findings of the ecological impact assessment for the proposed 10,000Ha Kawambwa Sugar Plantation in Kawambwa District in the Luena Plains. This was done in accordance with the environmental regulations that require such an undertaking to inform decision makers on the ecological footprint a particular development is likely to exert, thus providing input in the preparation of the Environmental Impact Assessment (EIA) which is the basis for impact mitigation strategies. The full report is attached as **Appendix 9**.

The assessment exercise included; review of relevant legislation and guidelines that relate to the proposed development, literature review to determine the existing conditions within and adjacent project area, undertake flora inventory for the affected area, to identify ecological habitats and species of potential importance and field surveys to collect data on the flora and fauna resources in order to ascertain the impact the plantation project would have on the existing environment.

Therefore, the objective of this assignment was to identify, assess and characterize the existing ecological condition in and around the study area, suggest mitigation measures for the potential impacts for inclusion into the EIA report, including EMP for establishment of the Sugar plantation in the proposed location.

The anticipated project impacts to habitats as well as the existing ecological system of the study area were assessed based on the ZEMA guidelines, the consultants' local knowledge and international standards / practice in conservation biology.

6.2.2 Background of the proposed crop (Sugarcane)

The proposed site for plantation occurs in a high rainfall area that is prone to low pH soils (acidic soils) which might present a challenge in attaining high yields. In acid soils conditions (pH less than 5.2), Al replaces Ca on cation exchange capacity. Aluminium toxicity may occur on mineral soils when Al occupies greater than 30% of the cation exchange capacity. In sandy soils having a very low cation exchange capacity, lower concentrations of Al in the soil solution may cause toxicity problems. High applications of K may induce Ca deficiency in acid soil containing low Ca levels. However, in both cases root growth, tillering, shoot elongation are experienced all of which result in the nutritional disorders thus causing poor cane yield and juice quality. Therefore, management of such soils is critical in attaining a sustained yield. In this case liming is required to neutralize the acidic conditions and the following proportions can be established;

- Sandy soils 450 - 675 kg/ha every 2 years
- Clay loams 1800 - 2250 kg/ha every 3 - 4 years
- Clay soils 2700 - 3600 kg/ha every 4 - 5 years.

The 10,000Ha proposed site for the Kawambwa Sugar Limited Plantation (KSL) occurs in the ecological zone between Longitudes 0775607mE /0782303mE and Longitudes 08914091mS/08933763mS bordered by Mupoposhi and Kalungwishi perennial River systems and one corner point of the site occurring about 40Kms South-East of Lusenga Plain National Park. Refer to the coordinates and the figure below for the surveyed area location.

***Table 6-2**: Beacon points for the proposed Kawambwa Sugar Limited (KSL) in Luena Plains*

Beacon-Name	GPS (coordinate)	
	Easting	**Northing**
A	E 774008.749	S 8933259.989
B	E 777969.800	S 8933779.972
C	E 780176.281	S 8921581.808
D	E 782175.602	S 8915488.800
E	E 779529.765	S 8914356.985
F	E 777730.354	S 8918868.548
G	E 775592.215	S 8918130.011
H	E 775578.422	S 8921382.065
J	E 776685.085	S 8921896.941
K	E 776208.670	S 8925445.172

Plotted on the Satellite Map together with the survey path taken, this is as represented in the figure 6-1 below.

6.2.3 Methodology

6.2.3.1 Literature Review

The Ecological study on the proposed Kawambwa Sugar Limited (KSL) plantation site and adjacent areas included review of the relevant local and international legislation and guidelines that concern the proposed project and ecological conditions of the study area to determine flora and fauna species diversity and ascertain the habitat value and sensitive and ecological significance of the site. The literature review included Government and private sector reports, herbarium floras and specimens, internet, vegetation and land use maps and geospatial data review as well as other relevant environmental reports related to sugarcane production.

6.2.3.2 Field Surveys

The field survey included flora studies and fauna searches and identification of habitat types/quality on the proposed KSL plantation site and immediate surrounding areas. The survey was designed to create a foundation for assessing and ascertaining the proposed project's impact on the exiting ecological components of the proposed site (both terrestrial and aquatic). Based on the results of the surveys, flora and fauna groups were characterized and listed followed by their diversity estimation.

6.2.4 Flora and Habitat survey

The flora survey conducted provided information on the following key aspects; types and diversity of flora species as well as location of their communities, characteristics, and habitat and conservation value. These are critical attributes in ascertaining ecosystem integrity and developing conservation measures for maintenance of environmental processes that encourage plant species diversity conservation, and landscape productivity while supporting the intended development and the welfare of the local people. The survey design focused on identifying protected/endangered species listed in the IUCN red list and likely to occur on the project site. This involved delineation of the study site based on topography, vegetation, and unique ecosystem components such as river systems and plain areas, then circular sampling plots of 50m diameter (giving 0.196Ha) assigned to the 4 transects established on the woodland area at 500m apart running from the South boarder of the project area (E-D) to the North (A-B) (Smith and Allen, 2004). Further, the riparian and aquatic vegetation were assessed through walks along the banks of the river and the plain/swampy section treated as plots.

6.2.5 Fauna assessment

The fauna survey approach adhered to the Melbourne Water Flora and fauna survey Guidelines (Melbourne-Water, 2011). Prior to the field visitation a thorough desktop review of available published, unpublished literature and information from relevant databases was conducted to provide a description of the existing fauna. The following techniques applied;

Traps set to determine the species occurring in the existing river systems in the project area

Scat and design which employed the use of secondary signs of animals that provides indirect records of the activity of a species at a site such as tracks, scratches, feeding marks, scats, nests or roosts, hair or feathers and bones or carcasses. These occurred opportunistically while undertaking flora and only provided information on the species presence and not abundance data.

- Incidental records during the survey walks of the study area subdivided
- Sand plots and tracks were established to indentify the type of species available on the study area
- Sound recognition for variety bird species

In addition, interactive interviews with the local people along the project area provided key information in identifying species with high likelihood of occurring on the proposed project area.

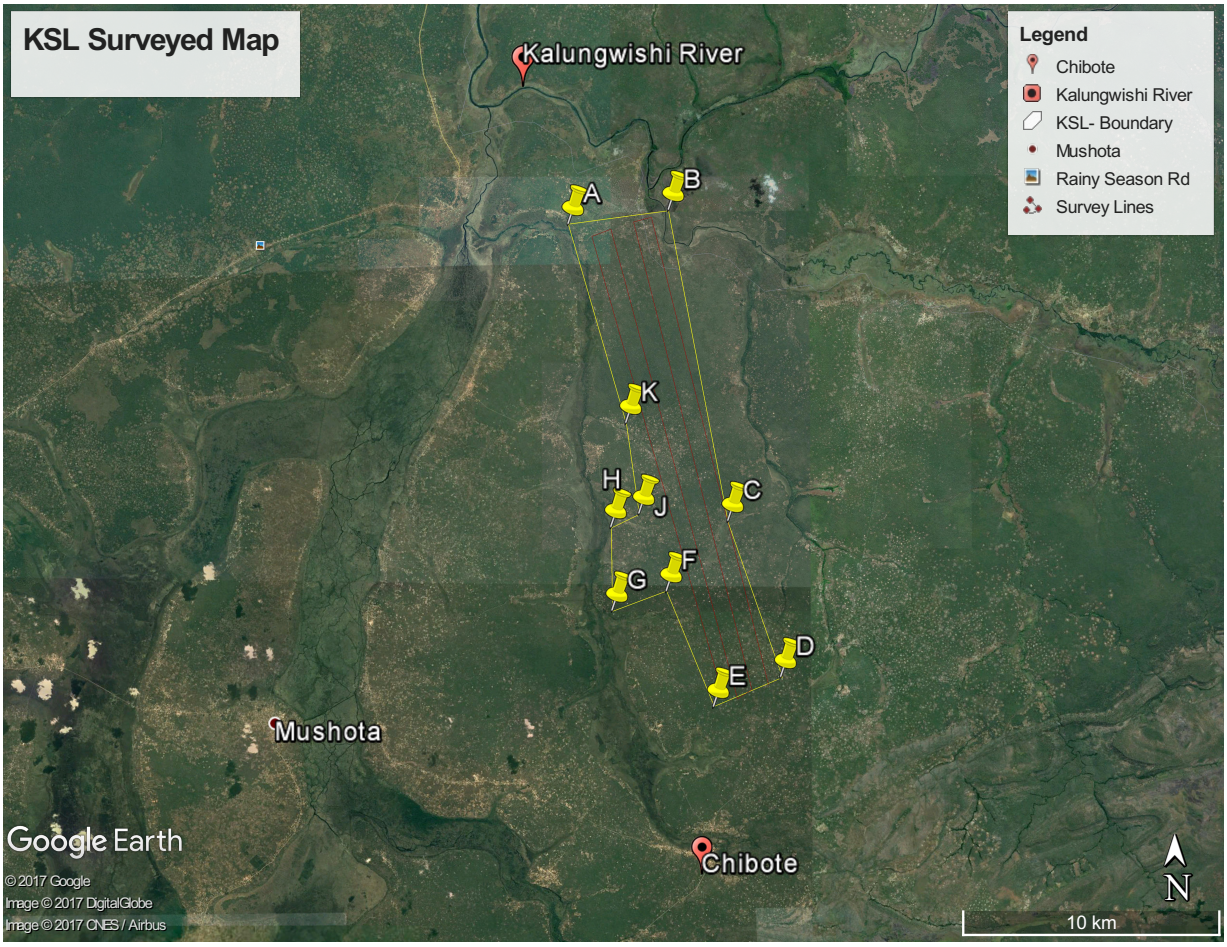


***Figure 6-2**: Map of the surveyed KSL Area*

6.2.6 Ecological Aspects in relation to the proposed KSL Area

6.2.6.1 Ecological Systems near the Project Area

The project area has two distinct ecological systems, the aquatic and terrestrial. Kalungwishi River is the main water body (other than Mupoposhi River) closer to the project area in the Northern boarders (A-B) and is regarded as the source of water that fills Lake Mweru (one of the great lakes for fishing industry) in North-West of the Project area about 90Km after providing water for Lumangwe Falls, Kabwelume Falls, and

Kundabwiku Falls (Wikipedia, 2015) all which have potential for enhancing tourism and were declared as National Heritage Sites. The spilling of the river as it flows results into the swamp channel that mostly characterize the Northern part of the project area. The site had distinct landscapes that included the ***miombo*** woodland that dominates much of the Project Site, the riparian vegetation and sections with water logged and grass cover (swamps).

The study area is situated about 40Km South of Lusenga Plain National Park (relatively medium sized-880 Km^2) which was declared in 1972. Located at an average attitude of 1,300m and receiving an average of 1,500mm rainfall per year, the Park and adjacent areas are characterized by wet Miombo and Mushitu. Wildlife associated to the area include buffalo, blue and yellow backed duicker, bushbuck and reedbuck, zebra, eland, sable and roan antelope, common duicker, baboon and a rich bird life characterized by species such as; ruwet's masked waxbill, black-faced waxbill, grey-crested helmet shrike, Lilian's lovebird, slender-tailed Cisticola. Several globally threatened water-associated birds are found here including wattled crane, slaty egret and corncrake. The area presents a variety of local and migratory avifauna species, and relatively diverse common reptiles, insects, mammals and amphibians.

6.2.6.2 Vegetation and Ecological attributes of the study area

As pointed out by Chidumayo in the Research report on "***Sugarcane Resources for Sustainable development: A Case Study in Luena",*** four main vegetation types or ecosystems were identified and verified during the field survey of the project area; Dry land areas which are covered with Miombo woodland, dominated by ***Brachystegia***, Julbernardia and Isoberlinia trees, transition zone between dry land and wetland covered with Chipya woodland that consists of tall grass with scattered trees of the ***Pterocarpus angolensis***, ***Erythrophleum africanum***, ***Burkea africana*** and ***Combretum*** and ***Terminalia*** species, and the wetland vegetation swamp/riverine forest (locally known as ***mushitu***) dominated by species such as ***Syzygium cordatum***, ***S.owariense***, ***Ficus brachypoda*** and ***Xylopia aethiopica*** (see photo below).

***Photo 6-3**: Mushitu of the Project area*

The proposed site for the KSL Sugar production displayed low human activity with regard to the extreme negative pathways of human and natural resources relationship which are seeing in the context of exploitation. Much of the area remains undisturbed despite the vegetation voids attributed to by the agriculture attributes of ***chitemene*** prevalent to the project area. Miombo type of vegetation was dominant (above 85%) on the site with patches of swampy areas and streams which are mostly preferred for avifauna activity, hence the similarity in the conditions found in the Lusenga Plain National Park. Aquatic life is present in the project area due to the existence of water bodies though not as diverse as that in developed Rivers and Lakes in the Region of proposed project implementation.

The identified terrestrial habitats within the Study Area include ***miombo*** woodland dominated by ***Brachystegia*** and common features such as anthills/termite mounds (see figure 2 below). Fanshawe (1971), describes ***Miombo*** as woodlands in central, southern and eastern Africa dominated by the genera ***Brachystegia***, ***Julbernardia*** and/or ***Isoberlinia*** species comprising an open canopy of semi deciduous trees usually 12 - 15 m tall, a discontinuous understory, a scattered shrub layer and saplings, and a patchy layer of grasses, forbs and suffrutices. However, the growth form, availability, diversity and richness is strongly influenced by the topographical aspects, climatic patterns and

edaphic factors. Most species are deciduous for a short period of time during the cool and dry season usually in July and August and flush by September. The distinct layers were encountered on the project site, during the reconnaissance and field surveys, especially in the Northern section where there has been low ***chitemene*** due to proximity to water bodies and high water table.

Photo 6-4. *Open* Brachystegia *woodland with termite mounds*

The tropical and semi tropical vegetation, generally Miombo (***Brachystegia)*** grows in three layers which include the emergent layer, the canopy layer and the under – storey layer. The emergent layer consists of larger tree of heights between 30-45 meters high with some rare tress going as high as 70 – 80 meters (Fanshawe, 1971). These include some ***Brachystegia*** and ***Marquesia macroura***, common to the study area, which provide habitat for fauna such as Eagles (closer to River systems), bats and butterflies. The canopy is vegetation areas that consist of medium height tree approximately 30 –40 metres and are mostly epiphytic plants. The under – storey of the project area included grass species of ***Loudetia simplex, Hyparrhenia hirtia, Panicum maximum, Eragrotis brizoides, Digitaria scalarum*** and ***milanjiana, Pennisetum purpureum, Heteropogon contortus*** and ***Imperta cylindrica***,. Other plants are wild flowers such as ***Mucuna coriacea, Cissus quadrangularis, Cucumis africanus*** and ***Vernonia*** species (see Annex 1 for the common species identified) (Phiri, 2005). Associated with the flora where edible and toxic mushrooms which only appear at the onset and throughout the rain season.

Common to the project area were a variety of flora species that were reported to have been used for construction and medicinal purposes over a period of time some of which include the ***Pterocarpus*** species (including the mukula), ***Pericorpsis*** angolensis (Umubanga), and ***Aloe*** species (see picture below).

Photo 6-5*Aloe species common on the project site*

Based on the sample plots established, Table 2 below shows the estimated project footprint on vegetation in terms of volume estimates to be affected by the development.

Table 6-3*: Sampled points location and estimated biomass*

Plot #	GPS (coordinate)		Vol.(m^3) (estimate)	Description
	Easting	Northing		
1	781057	8916498	2.412	
2	780811	8918186	3.112	
3	780593	8919525	1.431	
4	780601	8920509	0	Grass cover (Swampy) negligeble vegetation cover
5	779697	8922739	2.531	Miombo vegetation with 50% Canopy cover
6	779794	8924229	0	Open area previous agriculture field
7	778770	8926511	4.012	Thick Miombo 75% Canopy cover
8	777871	8931306	3.406	Advanced tree forms with undergrowth above 75 Canopy cover
9	777428	8932706	1.111	open area scattered trees about 300m to Kalungwishi River in the East
10	777065	8131595	2.674	
11	777530	8930441	2.451	Thick miombo
12	777991	8927192	3.112	Thick miombo

13	7778487	8924776	1.937	Open miombo near agriculture fields
14	778197	8919566	2.424	
15	780378	8916976	1.333	
16	779990	8917400	2.61	
17	779478	8917399	2.57	
18	779077	8920083	3.952	Near the end of the Swamp coming from the Eastern Boundary
19	778020	8923019	3.451	
20	777545	8927224	4.521	Thick miombo closer to the thick vegetation near the Western Boundary Swampy Area
21	777037	8927222	2.678	
22	775809	8930451	3.1	
23	777307	8924931	1.234	Near Beacon J
24	778243	8924763	2.157	Near Beacon I
25	779425	8920084	0	Swamp
26	774809	8930583	0.975	Boundary (A-J) Swampy

*Form factor used was 0.7

*Total volume (m^3) surveyed (@ 0.05% sampling intensity) = **59.194 m^3**

*Total volume estimated to be affected by project establishment= **115,936 m^3**

6.2.7 Fauna of the project area

The fauna categories of the proposed KSL projected included avifauna (diverse bird species), herpetofauna (reptiles and amphibians), insect (diverse groups and categories), and mammals (small-macro).

6.2.7.1 Avifauna (Bird species)

The study area exhibited potential for a diverse local bird species as well migratory ones due to the swampy condition of the area and diverse insects. Some of the local birds include; ***Pycnonotus barbatus*** (Pwele-Bemba), ***Acrocephalus baeticatus (titi -*** Bemba), Common Bulbul ***(Pycnonotus barbatus),*** African Yellow White Eye (***Zosterops senegalensis),*** Black Collared Barbet (***Lybius torquatus***), White Bellied Subird (***Cinnyris talatala)***, Amethyst Sunbird (***Chalcomitra amethystina***), Starling(***Cinnyricinclus leucogaster),*** Yellow Fronted Canary (Serinus mozambicus) Others included***,*** the Robin chats ***(Cossypha semirufa),*** Marico Flycatcher (***Bradornis mariquensis)***, Common Fiscal (***Lanius collaris***), Bronze Mannikin(***Lonchura cucullata***), Scarlet Chested Sunbird (***Chalcomitra senegalensis***), Green Backed Honey Guide (***Prodotiscus zambesiae***) and the African Yellow Bellied Green Bull

(***Chlorocichla flaviventris***). Other bird species included the helmeted guinea fowls, francolins, wild geeses and ducks, eagles (short-tailed, marshal and fish), vultures (which are more common in Lusenga National Park), stocks, egrets (considered to migratory) and kites. The site adjacent areas are more likely to be associated with some bird species known to be rare or endangered though not encountered at the time of the survey.

6.2.7.2 Fish species of the study area

Species of the area included; ***Oreochromis macrochir, Tilapia rendalli,serrachromis robustus, Momyrus longishith, Momyrus delicisias, Momyrus laceda, Others include, Discodus sp, Labeo ativeries , Clarias mozambicas, Clarias zambeziasis*** and ***Synodolis zambeziasis***.

6.2.8 Ecological significance of the proposed plantation site

The proposed project area despite with void vegetation cover due to existing agriculture practice of cutting and shifting was found to be free from excessive clearing for other land use activities, hence having moderate potential for a natural system. Based on the results and analysis of the ecological data collected the table below summarises the ecological significance of the proposed Kawambwa Sugar Limited plantation Site as predetermined by the key aspects which include; naturalness, size, diversity, rarity, fragmentation, abundance, age and potential value of the area.

Table 6-4: Ecological Significance Evaluation of proposed Kawambwa Sugar Limited

Criteria	Discussion
Naturalness	The proposed plantation area exhibits moderate ecological disturbance due to absence of diverse land use that convert forested area to none, since only small scale farming was observed. However, due to the shifting cultivation agriculture practice spurred by chitemene, potential areas were found to be degraded and not to be in their full capacity to have enhanced biodiversity. The vegetation type and condition cannot be distinguished significantly to that of Lusenga National Park which is 38Km North-West of the project area.
Size	The project site is moderate big (10, 000Ha) separated by two river systems Mupoposhi (on the southern end) and Kalungwishi (on the northern end). The area has distinct sections which include dry land and

Criteria	Discussion
	swampy areas which influence even the vegetation type.
Diversity	Diverse indigenous flora species with all habit forms (shrub, herbs, trees, and creepers). However, fauna diversity was very low despite relative vegetation cover and water availability. Wildlife is poor in the area due to the continued poaching that has occurred and the remnant animals are in the north of the project area. However, other fauna categories existed which included the avifauna, coleoptera, termiteria, and divers forms of invertebrates.
Rarity	No uncommon habitats, ecological units or communities were recorded. However, due to diversity of flora species certain endangered and threatened species are likely to occur on the project area yet not encountered during the survey due to the sampling biasness and/or seasonal variations as well as edaphic conditions to support their existence.
Fragmentation	The habitat is moderately fragmented due to previous clearing for agriculture fields and the swampy area limits the availability of flora and fauna species that are not tolerant to such conditions.
Potential value	Moderate potential value
Age	Regenerating- secondary flora species and grass cover
Abundance/ Richness of wildlife	Relatively Low-moderate abundance/richness of wildlife due to moderate diversity of the habitats and poaching as well as small scale agriculture farming

6.3 Social economic environment

6.3.1 Politico-Administrative Dynamics

6.3.1.1 Local Geography

The Luena Farm Block, where the project is located, is a 100,000Ha parcel of land set aside by the the government in Kawambwa District for agricultural development. Luena is suitable for can growing as it enjoys rainfall with an average of 1000-1500mm. suitable crops for this area include sugarcane, fruits, wheat, tea, maize, rice, potatoes, onions, oil seed, cassava, beans, finger millet, tobacco and soya beans.

Luena has a high irrigation potential; its covered by a wide expanse of wetlands and numerous streams.

6.3.1.2 About the district

Kawambwa district is about 233km from Mansa. Kawambwa sits at the junction of gravel roads to Nchelenge, Mporokoso, Mushota and Mansa, and a tarred road to Mbereshi linking with the Zambia Way, the main tarred highway of the Luapula Province through Kazembe (Mwansabombwe) and Mansa.

6.3.1.3 Settlement pattern and built environment

Kawambwa District is a rural area and the settlements are largely built along the main highway, close to the road. The largest concentration of settlement is close to or within the town of Kawambwa. This is not surprising in view of the economic activities and employment opportunities being offered by the proximity to the town.

The nearest built-up areas to the project area such as Chama and Chibote are typical villages. The residential areas in the villages are sparsely populated in sharp contrast to the urban settlements of Kawambwa town where the population is a bit more concentrated and housing development well planned. The villages are in form of family clusters and headed by a village headman/woman who subsequently reports to the chief.

6.3.1.4 Governance and Planning

The people are governed by a dual political and legal system — traditional and modern — as is common in rural Zambia. The former is based on customs and norms, while the latter is based on constitutional laws and regulations. This dual system of governance has important implications for the people's perspectives and expectations regarding their personal and the community's rights and obligations with respect to significant changes in land use and settlement patterns.

The modern system of government has an executive wing and a legislative wing. The executive wing is based at district centers, commonly known as bomas. The district executive secretary is in charge of the district. All departments of the government ministries are represented at the bomas. All constitutional laws and regulations,

including criminal law within the bomas and criminal laws in the chiefdoms, are implemented and enforced under this structure. The various wings of central government appoint officers at the district level. An elected Member of Parliament represents the legislative wing of the government. His/her influence covers a spatial area known as a constituency, which can cover areas of one or several chiefs but only one district.

The district council is the policymaking body on local matters within its spatial area and draws its membership from government officers, traditional rulers and ordinary citizens. Heads of government departments and the area Member of Parliament are automatically district council members, as are the chiefs. Chiefs are elected to local government and are also representatives of the political parties.

The Senior Chief is at the apex of the traditional political hierarchy and rules a spatially defined area called a Chiefdom. The senior chiefdom of the Luena area spans over both the Kawambwa and Mwense districts. Although the positions of Senior Chief, Chief, Group Village Headman/woman and Village Headman/woman are hereditary, a traditional council composed of some members in the existing traditional leadership class officially appoints them. The traditional rulers have jurisdiction over civil cases in their areas. The Chiefs and traditional councils have influence over the same area and people. In the Luena area, Senior Chief Mushota rules a larger area than the district council, as his rule covers both the Mwense and Kawambwa districts.

The traditional organization of the Chishinga people has Senior Chief Mushota at the apex of the structure. He rules the area through a number of Chiefs that have spatially defined Chiefdoms in both the Kawambwa and Mwense districts. The project site falls in the Chiefdoms of Senior Chief Mushota and Chief Chama, and borders the chiefdoms of Chiefs Munkanta and Mwenda (both of which fall under Senior Chief Mushota).

Chiefdoms are composed of a number of villages that are governed by Headmen/women. The main functions of a Headmen/women are representing the Chief at the village level, maintaining harmony in the village (resolving disputes among the village inhabitants, etc.), allocating land to village newcomers, and performing traditional ceremonies. The Headman/woman has the power to summon and punish, through fines, any erring member of his/her village. The Headman/woman also has the power to expel

anyone who is deemed a threat to the peace and harmony of the village. However, an aggrieved person has the right to appeal the ruling of the Village Headman/woman to the Chief.

Village settlements follow linear patterns and are located along access roads. In densely populated areas, such as Mushota, adjacent villages coalesce, with no visible boundaries between them. A village is comprised of a number of households. Members of each household recognize one person as household head. Generally, kinship determines membership to a household. The household is therefore the basic unit of social organization in the project area. The Chishinga people also have a clan system that is used, among other things, to determine marriages. Almost all of the adults in the project area are married. Within-clan marriages are usually discouraged. The Chishinga are matrilineal matrilocal. They generally do not object to inter-tribal marriages, but the man is required to live in the wife's village. The people in the project area belong to a number of religious organizations, and churches are scattered throughout the area.

6.3.2 Community Profile and Demographics

With a population of 130,680, desegregated as 49% and 51% for males and females, as per 2010 census (CSO, 2010), the district is divided into two constituencies namely Kawambwa central and Pambashe constituency. The population share of the province stands at 13.6 while the population density is 14.0. During the intercensal period, the population grew by 2.5 per cent. The district recorded 25,950 households in 2010.

The local people, the Chishinga tribe, celebrate Malaila traditional ceremony in October at senior Chief Mushota's palace. The Malaila Traditional Ceremony "Death of an Evil Lion" of Senior Chief Mushota. is held annually in the month of October by the Chishinga people of Kawambwa District.

A number of religious groupings of different faiths belonging to Christianity are common in the area. The Catholic Church has a strong presence in the area particularly in Chibote where the Catholics have historical church buildings. Other Christian based faiths include Seventh Day Adventists, Jehovah's Witnesses, Christian Mission in Many Lands and United Church of Zambia.

6.3.3 Economics, Labor and Livelihoods

6.3.3.1 Land ownership and use

Land use in Kawambwa district is associated with land tenure. While all land is Zambia is vested in the Republican President, most of the land in the district is customary and under the administration of Chiefs. The district is endowed with diversity of flora, fauna, and water resources which includes lagoons, rivers, and streams.

There are protected forests such as the Lusenga Plain National Park, and farm blocks each of which is administered by the responsible government department and chiefs. Many of the households own traditional land which is either given by the chief or passed on from forebearers. The parcels of land are predomantly used for small scale farming where maize, cassava, millet, sweet potatoes and sorghum are grown.

Much of the land in Luena is under customary tenure that is administered by Chiefs. In the questionnaire survey for the project area, the majority of respondents (57%) perceive the Chief as the owner of the land, while the rest consider the land that they inhabit as either theirs or belonging to their families. Among those who perceive that they own their land, about 74% (Chidumayo et al) stated that they acquired it through inheritance or as a gift. However, two-thirds of them believe that they are free to dispose of the land as they wish.

Forest reserves in the area were established by the Government to be used on a sustainable basis by local communities under the management of the Forest Department. In the past, the major land use in the Luena area was shifting cultivation — locally known as ***chitemene*** — that is practiced on upland dry land (away from wetlands). This cultivation system is based on lopping tree branches and piling and burning them at the center of the cleared plot to make an ash garden in which crops (such as, millet and cassava) are grown (Trapnell, 1953; Chidumayo, 1987; Stromgaard, 1984; Araki, 1992; Oyama, 1996). The ash garden is cultivated for three to four years and subsequently abandoned.

Due to the depletion of upland forest cover, few households currently practice traditional chitemene cultivation. Only a few chitemene gardens were observed in the area during

the reconnaissance survey in November 1998. The majority of households grow cassava in intensively cultivated plots near villages. The major land cover changes in the Luena area have largely been caused by land clearing for subsistence cultivation.

6.3.3.2 Local economy

Kawambwa District is largely based on an agro-economy. Crops grown include maize, groundnuts, sweet potatoes, and pumpkins. Much of the crops are grown on a subsistence level for home consumption with a little for sale. The chitemene system, a form of shifting cultivation is widely practiced.

Photo 6-6. Maize is grown by many in the project area

Photo 6-7. Field of banana in Chief Chama's area

Livestock rearing is also practiced and animals kept include cattle, goats, and chickens.

Fruits trees are common and are grown close to homesteads. These include mangoes, pawpaw, banana, avocado, guavas and oranges.

Industrial activities in the district have not yet developed much even though previously the main industrial activity was when the Kawambwa Tea Estate was thriving. Efforts are being made by the government to revive the Tea Estate. The Estate has since been sold to ZAFFICO.

A few of the people are employed by local businesses such as those in the hospitality industry (mainly lodges and guest houses), shops, farming developments and a good number of them is in the civil service as teachers and health workers.

6.3.3.3 Livelihood

As referred to above, the economy of Kawambwa district in general and the project area in particular is agriculture based and many residents derive their livelihood from agriculture. Roadside trading in “tuntembas” – small shops – is widely practiced and commodities grown include agro inputs and produce, as well as groceries.

Photo 6-8. Roadside trading in tuntembas is common

Other sources of livelihood are job opportunities offered by government agencies and institutions such as schools and health care facilities; other residents find employment opportunities within non governmental organisations (NGOs).

Zambia's largest tea plantation, Kawambwa Tea Estate, which is situated 27 km from Kawambwa on the Mporokoso road, has formed the backbone of the district economy. The Tea Estate is owned by ZAFFICO.

6.3.3.4 Housing

The project area has an array of houses constructed using a variety of materials. The majority of the houses are constructed using mud brick and grass thatched. A few of the houses are constructed using burnt bricks with iron sheets for roofing.


Photo 6-9. Type of housing in the project area

6.3.3.5 Energy sources

The major source of energy for the locals is firewood. This is used for lighting and heating purposes. Solar and battery powered bulbs are also used for lighting.

6.3.4 Social Services

6.3.4.1 Health

There are a number of health centres which provide health care to the locals in the project area. The health centres provide primary health care services and complicated cases are referred to the district hospital at Kawambwa and later on Mansa General Hospital for further specialised treatment.

The two health centers in the project area are located at Mushota and Kanengo. Each of them services a population of about 6,500. The Mushota health center has three beds

and an ambulance that also serves Kanengo health center. Serious cases at the health centers are referred to Kawambwa hospital, where there is a doctor. The health centers are staffed by clinicians/nurses.

In addition to the two health centers, there are a number of community health posts that have been established to dispense medicine for simple ailments. Community health workers supplied with pre-packed medical kits staff these health posts. However, medical supplies to the health centers and posts are erratic. For example, the Kanengo health center had no drugs at the time of the survey in November 1998. This has tended to reduce the number of people seeking treatment and has reduced the value of the facilities to the community.

Malaria is the most common disease treated at the health centers. Other diseases include respiratory infections, diarrhea, pneumonia and injuries. The most serious diseases among children are malnutrition, diarrhea and measles. High levels of malnutrition, coupled with disease, have caused the province to have the highest levels of undersized children in the country. Other services offered by the health centers include child immunization, public health inspection and natal care.

6.3.4.2 Education

The district has a total number of 91 learning institutions. Eight (8) Secondary schools, (two (2) Grant Aided), one (1) skills Training Center, one (1) Special School, fifty-six (56) Primary Schools, twenty-three (23) Community Schools and two (2) Private Schools. In terms of pupil enrolment the District has a total population of 32,092 pupils from grade 1-12 of which 16,729 are boys while 15,363 are girls (http://www.luapulaprovince.gov.zm/districts/kawambwa.html, accessed on 20 February, 2017).

The project site and its surroundings contain five primary schools (3 in Mushota and 2 on the Estate site) and one basic school located at Mushota that offers education up to grade nine. All of these are publicly-run institutions, except Kabombo primary school on the Estate site, which was built on a self- help basis by the local community. All of the primary schools are generally under-enrolled. 45% of the households surveyed in 1998 had at least one school-aged child (> 6 years) who was not attending school. Lack of

money was the main reason reported by parents/guardians for not sending children to school. The nearest secondary school is at Kawambwa boma, which is the headquarters of the district.

The literacy level in 1990 for people over four years old was 51%. Of these, 81% and 19% respectively had primary and secondary school educations. Attaining an education has been a vehicle for upward social mobility, allowing people from poor socio-economic backgrounds to move up in income class. Comparisons of the highest education levels attained by respondents in the 1998 survey revealed significantly more educated males than females.

The parliamentary report[3] of the committee on education, science and technology for the fourth session of the National Assembly appointed on 24 September, 2009, found adult literacy in Kawambwa standing at 31.7 per cent.

6.3.4.3 Telecommunication

The project area has wide Zamtel, Airtel and MTN cellular coverage with a cellular mast located at Chibote and near Chief Chama's palace.

6.3.4.4 Water and sanitation

Water for domestic consumption is obtained from various sources which include streams, shallow wells and boreholes. During the rainy season, flooding prevents the locals from accessing points of water found near the streams. Recently, World Vision sunk boreholes in the project area to alleviate water shortages and distances to sources of water encountered by the locals. Consultations with the people revealed that the people prefer to fetch water from the streams rather than from boreholes as the water from the latter is deemed to have a salty taste.

For sanitation purposes, pit latrines are used within the project area. The locals have been practicing "No Defecation Zone" an undertaking that instills a sense of

[3] Second Report of the Committee on Education, Science, and Technology for the Fourth Session of the National Assembly Appointed on 24 September 2009.

responsibility in the locals by way of using toilets instead of the bush. Bathrooms constructed outside using grass and pole are used for bathing. Municipal solid waste disposal is via the use of pits dug within homesteads while the rest is burnt. Night soil disposal is usually done through drop-down toilets.

Photo 6-10. Drop down toilet (left) and pole and grass 'bathroom'

6.3.4.5 Archaeological and Cultural Sites

There is no known site at and within the Project area that has archaeological or cultural value. In the event that this is found later, management will ensure that this discovery is reported to the National Heritage Conservation Commission (NHCC) for conservation.

The existing sites of historical and archaeological value are the Lumangwe, Ntumbachushi, Kabwelume and Chilongo Falls. The project will not have any impact on these sites.

6.3.4.6 Recreation and Tourism

Kawambwa district boasts of a number of spectacular tourist attractions the notable ones being the Ntumbachushi falls, Lumangwe falls, Chilongo water falls, and the Malaila culture ceremony of the Chishinga people.

Lumangwe Falls

The falls is situated on Kalungwishi River, 82km from Kawambwa and Mporokoso district in Northern province. Lumangwe falls is the second largest falls in Zambia after the mighty Victoria Falls. It is 35m high and 100 wide.

Ntumbachushi Falls

Ntumbachushi Falls is situated on the Ng'ona River just 1.3km off the main road to Kawambwa district. Ntumbachushi consist of a series of breath taking crystal clear water pools and rapids, culminating into a spectacular 30km high water fall.

Kabwelume Falls

Kabwelume falls is situated on the Kalungwishi River about 5km from Lumangwe falls. Kabwelume consists of a group of three powerful cascades each pouring into the next.

Chilongo Falls

Chilongo falls is situated in the north east of Kawambwa off Kawambwa Luwingu road via Mushota. The falls is on Lufubu River in chief Chama's area, about 85km from Kawambwa boma.

6.4 Information gaps

The ecological survey was carried out towards the end of the rainy season. Some areas were waterlogged and virtually impassable and thus could not be accessed. In addition some species that are more prevalent in drier parts of the year could not be identified during the survey. In an ideal case, the EIA should be done over a prolonged period of time, preferably over the three season common to the project area. There are no boreholes within the project area to determine the groundwater quality and quantity. The existing boreholes that are in the area are outside the project and were done by NGOs. It was difficult to obtain yields obtained during the sinking of the boreholes.

Information gaps will be filled in as the project starts and the EIA updated.

7 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

This section discusses the preliminary potential impacts identified from stakeholder consultations as well as expert analysis. The impacts have been identified and classified according to the classification criteria described below. The criteria used to characterize the environmental and social impacts are explained in **Table 7-1**. Preliminary impacts are indicated in **Table 7-2**.

Table 7-1: Criteria and Terms used to describe Potential Environmental Impacts

Item no	Impact criterion	Description	Criterion classification	
			Term	Description
1	Positive or Negative Impact?	Will the impact have a positive or negative effect on the environment?	Positive	A positive impact.
			Negative	A negative impact.
2	Likelihood of Impact occurring?	What is the likelihood/ certainty associated with a potential impact?	Unlikely	Unlikely to occur.
			Possible	May possibly occur.
			Probable	Likely to occur.
			Certain	Certain to occur.
3	Timing of impact?	At what point in time will the impact occur?	Pre-project	Site construction phase.
			Start of project	Will occur immediately operations begin.
			Near-future	Will occur within the lifetime of the Project
			Mid-future	Will occur after the Project has closed.
			Distant-future	Will occur in the distant-future.
4	Duration of impact?	What is the likely duration or time over which the impact will occur?	Indeterminate	Unable to be predicted with certainty
			Short-term	Will cease once activity stops
			Medium-term	Will continue for the lifetime of the project.
			Long-term	Will continue beyond project closure
			Permanent	Will remain permanently.
5	Extent of impact?	What is the geographical extent of the impact?	Project Area	Will affect the immediate project area.
			Regional	Will affect areas outside the project area.
			Provincial	Will affect the Province.
			National	Will affect the whole of Zambia.
			International	Will affect other countries.
6	Significance of impact?	What is the severity of the impact, either positive or negative?	Very High	Very high impact.
			High	High impact.
			Moderate	Moderate impact.
			Low	Little impact.
7	Further studies?	Are further studies required to assess the significance of the impact?	1	Requires detailed assessment & specialist studies.
			2	Requires detailed assessment.
			3	Requires further assessment.
			4	Unlikely to require further assessment.
			5	Further assessment not required.

Table 7-2: Environmental and social impact characterization

ID No.	Impact	Positive or Negative	Intensity	Spatial Extent	Duration	Project Phase	Frequency	Likelihood	Sensitivity	Further Studies
1.	Contribute to national development by payment of taxes to government	Positive	High	National	Long term	Construction - Operation	Continuous	Certain	High	5
2.	Contribute to national development by offering employment opportunities	Positive	High	National	Long term	Construction – closure	Continuous	Certain	High	5
3.	Contribute to national development by offering business opportunities to suppliers and contractors	Positive	High	National	Long term	Construction – closure	Continuous	Certain	High	5
4.	Filling the demand-supply energy gap	Positive	High	National	Long term	Operation	Continuous	Certain	High	5
5.	Soil enrichment from the use of enriched organic manure	Positive	High	Local	Long term	Operation – closure	Continuous	Certain	High	5
6.	Local social services development such as health, education, road network, etc	Positive	High	Regional	Long term	Construction – closure	Continuous	Likely	High	5
7.	Soil degradation impacting on soil quality and quantity	Negative	Low	Local	Medium term	Construction – Closure	Occasional	Likely	High	3
8.	Soil erosion	Negative	Low	Regional	Medium term	Construction – Closure	Occasional	Likely	High	4
9.	Reduction of future crop yield due to erosion	Negative	Low	Local	Medium term	Operation – Closure	Occasional	Likely	High	3
10	Soil loss at harvest	Negative	Low	Local	Medium term	Operation	Intermittent	Unlikely	Low	5
11	Impact on soil biological, chemical and physical variables	Negative	Low	Local	Medium term	Construction – Closure	Occasional	Likely	High	3
12	Soil compaction leading to loss of soil structure	Negative	High	Local	Medium term	Construction – Closure	Occasional	Likely	High	3
13	Soil surface sealing leading to reduced water infiltration and increased surface run-off	Negative	Low	Local	Medium term	Construction – Closure	Occasional	Likely	High	3
14	Soil acidification as a result of use of inorganic nitrogenous fertilizers	Negative	Low	Local	Medium term	Construction – Closure	Occasional	Likely	High	3
15	Habitat loss from land clearance	Negative	High	Local	Medium term	Construction – Closure	Occasional	Certain	High	3
16	Crop yield reduction due to soil salinization	Negative	Low	Local	Medium term	Construction – Closure	Occasional	Likely	High	2
17	Environmental and social impacts due to overuse of water	Negative	Low	Local	Medium term	Construction – Closure	Occasional	Likely	High	3
18	Inefficient irrigation system leading to enhancement of waterborne	Negative	Low	Local	Medium term	Construction – Closure	Occasional	Likely	High	3

ID No.	Impact	Positive or Negative	Intensity	Spatial Extent	Duration	Project Phase	Frequency	Likelihood	Sensitivity	Further Studies
	parasitic infections									
19	Intensive use of chemicals and inorganic fertilizers	Negative	High	Local	Medium term	Construction – Closure	Occasional	Likely	High	3
20	Water pollution from the discharge of mill effluents	Negative	Low	Local	Short term	Construction - closure	Intermittent	Likely	Low	3
21	Impact of air emissions on air quality from bagasse burning	Negative	Low	Local	Short term	Operation	Occasional	Likely	Low	4
22	Impact on soil and water resources through disposal of waste	Negative	Low	Local	Short term	Construction – closure	Intermittent	Likely	Low	5
23	Impact of emission of dust particles from cleared surfaces on local surroundings	Negative	Low	Local	Short term	Construction – closure	Occasional	Likely	Low	3
24	Impact of ecological disturbance	Negative	High	Regional	Long term	Construction – Closure	Continuous	Likely	High	1
25	Impact on land use	Negative	High	Regional	Long term	Construction – Closure	Continuous	Likely	High	1
26	Erosion of top soil on disturbed areas	Negative	Low	Local	Short term	Construction - operation	Occasional	Likely	Low	3
27	Impact of leaks and spills of hydrocarbons (fuel and oils) on land and water resources	Negative	Low	Local	Short term	Construction	Occasional	Unlikely	Low	2
28	Impact of construction activities on landscape and aesthetics	Negative	High	Local	Long term	Construction – closure	Continuous	Certain	High	2
29	Impact on water resources due to abstraction of water	Negative	High	Regional	Long term	Construction – closure	Continuous	Likely	Low	1
30	Impact on air from noise generated by construction equipment and vehicles	Negative	Low	Local	Short term	Construction – closure	Intermittent	Occasional	Low	3
31	Increase in traffic in the area	Negative	High	Local	Long term	Construction – closure	Continuous	Occasional	Low	4
32	Potential of fire risks in the processing plant	Negative	Low	Local	Short term	Operation	Occasional	Likely	Low	2

7.1 Positive Impacts

7.1.1 Employment creation

Considering 50% mechanization, the sugar project is expected to generate permanent employment for 500 people and seasonal employment for around 3,000 people directly and employment to more than 15,000 people indirectly. Employment and/or farm revenue from the out-growers land will improve the livelihoods of the people around the project site.

The development of the sugar project will generate employment and businesses for small-scale farmers. This will broaden the tax base and generate revenue for the Government.

7.1.2 Filling the demand-supply energy gap

Apart from supplying sugar the project will contribute to fill the demand-supply gap of energy in Zambia by generating power from bagasse to the tune of 30 MW which will be evacuated into the national grid. In addition, about 9 million liters of power alcohol/ethanol for energy and industrial requirements will be generated.

7.1.3 Soil enrichment

The clearing activities to leave way for the planting of the cane, the use of heavy machinery and the intensive use of fertilizers and chemicals may leave the soil deficient of nutrients. Instead of furrowing to improve soil retention and the constant use of fertilizers the project includes the production of about 25,000 tons of enriched organic manure to improve soil health.

7.1.4 Contribution to the development of the national economy

The infusion of an investment valued at US$209.590 million for the Integrated Sugar Project spread over four years will contribute to enhancing the not only the national but also the district economy. Further contributions towards the treasury through taxes and pay-as-you remittances will contribute to the development of the nation’s economy.

7.1.5 Social services development

The projects will also contribute to the development of local communities through the provision of social amenities like shops, post office, banking services, water, electricity, roads and bridges, schools, health facilities, afforestation, eco-tourism and community-based income generating activities.

7.1.6 Contribution of KSL sugar project to GDP

Increase in export earnings from the integrated sugar project will contribute to Gross Domestic Product and improve the economy.

Improvement in agricultural production through the out-grower scheme in the Luena farm block and subsequent earnings will enable rural communities engaged to access agricultural inputs and create opportunities to bring in more needed cash through the purchase of agricultural produce on the one hand and lead to more opportunities for rural communities to sell their produce. The KSL project will ultimately, lead to more reinvestment into agricultural development in Kawambwa and surrounding areas. Rural poverty leads to urban migration, which causes the spread of poverty amongst rural migrants who cannot find employment in urban areas.

The lack of access to socio economic amenities and markets has a negative impact on poverty levels as it contributes to stagnation of agriculture and does not stimulate production and economic development.

7.2 Negative impacts

7.2.1 Field level impacts

Since soil is a living, dynamic resource, made up of different sized mineral particles (sand, silt and clay), organic matter and a diverse community of living organisms, cultivation of sugar crops can contribute to soil degradation impacting on soil quantity (by increased rates of erosion and soil removal at harvest) and soil quality.

7.2.2 Soil erosion

The clearing of vegetation for the planting of sugar has potential to increase the erosive potential of soil. Soil erosion can be a significant issue especially since erosion rates in

tropical agro- ecosystems are usually greater than the rate of soil formation. The physical loss of soil by erosion is influenced by a range of factors including rainfall and irrigation, wind, temperature, soil type, cultivation disturbance and topography.

7.2.3 Economic and environmental aspects of soil erosion

The loss of soil by erosion is a major problem that can affect future yields and ultimately limit the sustainability of sugar cultivation by redistributing or removing soil organic matter and nutrient- rich material. Soil erosion also represents a substantial environmental threat from the washing of sediments, which are often polluted, into nearby waterbodies.

7.2.4 Water-generated soil erosion

If irrigation application is inefficient or rainfall is high, water loss is generally experienced coupled with the loss of valuable soil from the farm. This usually occurs on cleared bare land.

7.2.5 Soil loss at harvest

Soil losses may occur during harvesting.

7.2.6 Impacts on soil health

Soil health includes a wide range of biological, chemical and physical variables, but can be broadly defined as the sustained capability of a soil to accept, store and recycle nutrients and water, maintain economic yields and maintain environmental quality. Combined impacts on soil health can lead to a loss of soil fertility, a particular risk under cane, which is generally grown as a continuous monoculture.

7.2.7 Soil compaction

A particularly significant impact of cultivation on soil physical characteristics is compaction resulting from a loss of soil structure. Heavy infield transport machinery is most commonly associated with soil compaction problems. Loam-rich soils are more vulnerable to compaction than clays or sands, and compaction risk increases with soil moisture content.

Soil compaction increases bulk density and soil strength, restricting the rooting ability of the crop, and decreases porosity and water infiltration rate, which can negatively affect the soil mesofauna. Soil compaction may particularly affect invertebrates in the upper strata of the soil, and it is in this zone where numbers of certain invertebrates is greatest. Increased rates of surface water runoff due to reduced infiltration can also alter peak flow leading to flooding events.

7.2.8 Impacts on soil health due to tillage

Conventional tillage i.e. deep ploughing, can drastically change soil structure and is probably one of the most disturbing agricultural practices for soil fauna. In addition, tillage in cane cultivation systems can promote organic matter breakdown leading to declines in soil structure and health.

7.2.9 Surface sealing

Surface sealing and crust formation can occur on heavily compacted cane growing soils, resulting in a relatively impermeable layer at the soil surface. Sodic soils are particularly vulnerable to sealing, and the loss of organic matter, often associated with cultivation, can also render soils more susceptible to sealing. Sealing reduces water infiltration and increases runoff, enhancing the risk of erosion and pollution of water bodies, as well as reducing the water available to the crop and inhibiting seedling emergence.

7.2.10 Soil salinisation

Salinisation of soils is a problem that can affect cane growing as result of over-irrigation, inadequate drainage and cultivation in a flood plain. Salinity of soils can lead to cane yield declines.

7.2.11 Soil acidification

Increased soil acidity affects plant health and crop yield. Acidification is largely due to the use of inorganic nitrogenous fertilizers such as urea and ammonium sulphate. Under high rainfall conditions nitrate leaching occurs, which also promotes acidification.

7.2.12 Habitat destruction for cane cultivation

Substantial areas of biodiversity-rich habitat such as riparian vegetation will be cleared for cane cultivation. Land clearance not only results in the direct loss of species and habitats, but underlies a range of wider impacts on land-use change, ecosystem function, including changes to hydrology and increased soil erosion. A total area amounting to 8,224Ha of the 10,000 will be cleared and used for cane cultivation. Other parcels of land as indicated in **Appendices 1** and **2** will be used roads, drainage and infrastructure development. Only 645Ha of the swamp will not be cultivated.

7.2.13 Overuse of water

7.2.13.1 Agricultural water use

Considerable amount of water will be obtained from the Kalungwishi and Mupososhi Rivers for sugar cane irrigation. The findings by WWF[4] indicate that agriculture is by far the biggest user of water worldwide. Seventy percent of global freshwater withdrawals are for irrigation, rising to more than 90 percent in some arid countries. If planning does not adequately address environmental or social needs related to water abstraction, impacts on downstream ecosystems and livelihoods of communities that rely on fisheries can occur.

7.2.13.2 Sugar cane water use

Although sugar cane is an efficient converter of biomass from water, it still needs about 1500-2000mm/ha/year and ranks among a group of crops noted for their significant water consumption (along with rice and cotton). It is a deep-rooted crop, which remains in the soil all year round and is able to extract soil water to depths well below one metre. In areas where sugar cane growth relies on rainfall, the crop can influence river flows as it intercepts run-off from the catchment into rivers and taps into ground water resources.

7.2.13.3 Irrigation inefficiency

Poor management of irrigation system can result in significant losses of water such that only a certain percentage of water withdrawn for farming reaches the crop and the rest is

[4] Sugar and the Environment - Encouraging Better Management Practices in sugar production

lost from irrigation channels by evaporation and through run- off from the field. To this end, KSL is proposing to put in place a re-routing system in which any run-off water will be channeled back to the river. Prior to reaching the river, the water will pass through a wetland created on site to improve aeration, absorb nutrients such as phosphates and nitrates. This measure will reduce nutrient loading in the water courses. Further, KSL will partly use furrow and the rest of the field will have drip irrigation.

7.2.13.4 Over-irrigation and pollution

Inefficient irrigation usually leads to high water withdrawal and is generally coupled with the runoff of polluted irrigation water containing sediment, pesticides and nutrients.

7.2.13.5 Water use in processing

Cane factories use large amounts of water to wash off the considerable quantity of soil removed with the roots at harvest. A water balance for the processing facility is attached as **Appendix 3**, as part of the project mass balance.

7.2.14 Irrigation and human health

Over-irrigation or inefficient irrigation systems that leave water standing in fields can enhance the incidence of water-borne parasitic infections such as Bilharzia (***schistosomiasis***).

7.2.15 Intensive use of chemicals

Intensive sugar cane production uses high levels of pesticides (herbicides, insecticides, fungicides, nematicides, rodenticides, plant regulators, defoliants or desiccants), with herbicides representing about 50 percent of pesticides used. A wide variety of pesticides are used in the cultivation of sugar crops. When inefficient irrigation systems are used, the overflow can contain a considerable amount of agrochemicals, thereby affecting groundwater resources and receiving natural water courses.

7.2.16 Overuse of fertilizers

Inorganic fertilizers typically supply nitrogen, phosphorus and/or potassium in mineral form. Environmental impacts generally arise because the nutrients in the fertilizers are not entirely taken up by the crop but move into the environment. The overuse of

fertilizers on cane is typical of farming in general. The overflow can contain a considerable amount of artificial fertilizers when inefficient irrigation systems are used. This can lead eutrofication in natural water courses.

7.2.17 Discharge of mill effluents

When sugar mills are annually cleaned, a tremendous amount of matter is released, which 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.

The production of alcohol from cane can also result in significant pollution as the by-product, known as 'vinasse', which is in some cases discharged into rivers. Every litre of alcohol produced from sugarcane produces 13 litres of vinasse.

7.2.18 Air pollution form the burning of bagasse

The most significant pollutant emitted by bagasse-fired boilers is particulate matter, caused by the turbulent movement of combustion gases with respect to the burning bagasse and resultant ash. Emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx) are lower than conventional fossil fuels due to the characteristically low levels of sulfur and nitrogen associated with bagasse.

Auxiliary fuels (typically fuel oil or natural gas) may be used during startup of the boiler or when the moisture content of the bagasse is too high to support combustion; if fuel oil is used during these periods, SO_2 and NOx emissions will increase. Soil characteristics such as particle size can affect the magnitude of particulate matter (PM) emissions from the boiler. Cane that is improperly washed or incorrectly prepared can also influence the bagasse ash content. Upsets in combustion conditions can cause increased emissions of carbon monoxide (CO) and unburned organics, typically measured as volatile organic compounds (VOCs) and total organic compounds (TOCs).

7.2.19 Impacts on groundwater

Leaks and spills of agrochemicals and fertilizers can infiltrate and affect groundwater resources. This is especially a greater risk if chemicals and fertilizers are not stored on a concrete and bunded area.

7.2.20 Impacts of waste disposal on soil and groundwater

Inappropriate disposal of waste such as molasses, bagasse, waste from the mill, empty containers of agrochemicals is a public health concern and can contaminate soil and if infiltrated into the ground can contaminate groundwater resources. Poor disposal of municipal solid waste can be a nuisance due to fly strike and odour.

7.2.21 Socio-economic impact of land-use change

Once the project is fully operational, the local people will not be able to access the area for the collection of natural resources such as firewood, caterpillars, water, medicine, fruit and house construction materials. Traversing though the estate to access other locations of the estate will not be allowed. The existing access routes within the estate will no longer be used. These will be replaced with internal roads for the farm.

7.2.22 Occupational health hazards

During the construction period, employees will be subjected to occupational health and safety risks arising from accessing heights, handling sharp equipment and machinery, ergonomic risks from lifting heavy loads and air pollution from dust.

During the operational phase, safety and health risks will arise from the handling of chemicals, machinery and equipment. Ambient air pollution may also be caused by fly ash from the burning of bagasse. The high temperatures experienced in the boiler is another risk that KSL will need to address.

8 CONSULTATION AND PUBLIC PARTICIPATION

A number of consultative meetings were held with provincial and district leaders, traditional leadership, the community in order to capture the views of the community as well as interested and affected parties (IAPs).

The scoping meetings were held with various stakeholders with a view to scope the project and prepare terms of reference (ToRs) for the EIA study. Focus group discussions, in-depth interviews and informal discussions with residents near the project area were used for stakeholder consultation meetings.

The public consultative meetings were held on the following dates and venues:

Table 8-1.Consultative meetings

Meeting	Venue	Date
Consultative meeting with civic leaders and government officials	Kawambwa District Council	7 March 2017
Consultative meeting with His Royal Highness Senior Chief Mushota and the local community	Senior Chief Mushota's Palace	7 March 2017
His Royal Highness Chief Chama and Indunas	Chief Chama's Palace	8 March 2017
Community near Chief Chama's palace	Chama Primary School	8 March 2017
Chibote community	Chibote Primary School	8 March 2017

Photo 8-1. Kawambwa DC making opening remarks during scoping meeting

Photo 8-2. Consultation at Senior Chief Mushota's Palace

Photo 8-3. Consultative meeting at Chama Primary School

Photo 8-4: Community consultation at Chibote

8.1 Social problems

The scoping exercise indicated that the most significant social problems that relates to the community in the project area are the following:

a) Employment opportunities should be offered preferably to the local residents;
b) Other than the offer of employment opportunities, the residents wished to know how else they would benefit from the project;
c) The compensation for the loss of the land and indigenous trees, which belonged to the chiefdom, but will no longer be accessed by the local residents;
d) Impact of HIV/AIDS amongst the workforce and the surrounding areas

8.2 Social Actions

The social actions for the identified social problems are discussed below:

8.2.1 Employment opportunities

Priority for employment opportunities will be given to the local residents unless the required expertise cannot be found locally. To this end, with the help of the village headmen/women, a register of employable individuals will be created. This register will be drawn from all the nearby villages to ensure that as many people as possible benefit from the project.

8.2.2 Other benefits

KSL will undertake a community social responsibility (CSR) whose details of the exact measures to be undertaken will be developed on consultation with the local people and once the project is underway. The CSR initiatives will be need based, that is, suggested by the locals instead of being proposed by KSL

8.2.3 Compensation for the loss of land

The loss of land that has been given up by the chiefdom for the Luena Farm will be compensated by the economic development that will take place through the establishment of a sugar plantation which will not only offer employment

opportunities but will provide business opportunities through the out-grower scheme.

8.2.4 HIVAIDS

To mitigate against the spread of the HIV/AIDS, KSL will only use the locals from the local area. In addition, sensitisation among the workforce on the dangers of the epidemic will form the subject of regular safety talks that will be held with the local people.

9 PROPOSED MITIGATION MEASURES

The following are the proposed mitigation measures for the preliminary impacts identified in the previous sections.

9.1 Enhancement of positive impacts

9.1.1 Employment creation

Implementation of this project will involve the use of both skilled and unskilled labour from the planting phase up to operation phase. Management intends to use the locals unless the required expertise cannot be found locally.

The employment opportunities will not only involve men but will include a good number of women.

Provision of employment contributes to raising the socio-economic well-being of the people and thereby reducing poverty levels.

9.1.2 Paying of taxes

The operation of this project will contribute to enhancing the nation's economy through the paying of taxes in form of duty, rates and pay as you earn remittances to the central and local governments as the case may be.

9.1.3 Contracting of service suppliers

A number of services suppliers will be contracted to supply services and products such as saplings, consulting, and general planning for the successful management of the project.

It is management's policy to use companies registered in Zambia for the provision of these services.

9.2 Management of Negative Impacts

9.2.1 Generation of waste

The principal objective of waste management program will be to minimize the pollution of the environment as well as to utilize the waste as a resource. This goal will be achieved in a way that is environmentally and financially sustainable.

The main wastes from the project during clearing is vegetative waste which will be used for various purposes; some of which will be used as soil cover to prevent soil erosion and also as compost.

During the processing of cane, bagasse will be used to generate power while molasses will be used as feedstock and the production of ethanol.

9.2.2 Overuse of water

To avoid overuse of water, the effectiveness of irrigation strategies will be assessed by an analysis of Water Use Efficiency (WUE) which is the ratio of crop yield to water consumed by the crop. The key to improving water productivity will be to match the irrigation system to the soil type, climate, farm management and affordability.

Irrigation scheduling, including the use of tensiometres to monitor soil moisture, and tail-water recycling (where water-runoff from field is collected and reused for irrigation) will also ways of improving irrigation management.

One of the main benefits of implementing better irrigation systems is increased water use efficiency, meaning that more water will be available for other needs, such as those of the environment or communities.

Enhancing water use efficiency not only benefits the environment, but provides a range of financial benefits to the farmer including reduced water and/or electricity costs and yield increases.

9.2.3 Soil erosion and loss of soil nutrient

A wide range of measures to maintain or improve soil quality include trash mulching in cane cultivation, terracing, contour and strip planting of cane on slopes, maintenance of ‘live barriers’ (hedgerows, riparian zones), and modified (reduced or minimum) tillage.

The use of green cane harvesting rather than pre-harvest cane burning and 'trash-blanketing' (where the cane leaves are cut from the plant and left on the soil as a mulch while the stalks are taken away for processing) provides a range of environmental benefits. Any disadvantages of these methods to the farmer (increased harvesting costs, complications in irrigation and fertiliser application, slowing of tiller emergence) appear to be significantly outweighed by the benefits (elimination of aerial pollution and direct burning impacts on soil, improved soil and water conservation, enhancement of soil organic matter, weed suppression and increased yields).

Compared with other arable systems, sugar cane can represent a relatively effective cover crop as the crop tends to remain in the ground for a number of years producing an extensive root system and a closed canopy that protects the soil from the erosive effects of rain.

However, on sloping land the risk of soil erosion is still high. These areas will be taken out of production and replanting with tree crops. This will improve water retention and provide a more gradual water release. Where land is kept in cane cultivation, cane terracing (where a soil lip is built at the edge of each terrace) of slopes will be adopted - the steeper the slope, the narrower terraces and cane rows will be aligned at right angles to the slope.

To further prevent soil erosion on slopes, cane strip planting will be practiced. Under this practice, strips of cane rows at different stages of development are established in adjacent terraces. Mature and maturing strips provide barriers against erosion from the relatively bare strips (those with cane at the earliest stages of development, or where harvesting has just occurred). Strip planting will be used on all slopes greater than two per cent.

9.2.4 Increased fertilizer use

There is a direct economic incentive for farmers to reduce fertilizer inputs, as these represents significant costs and over-use of Nitrogen fertilizer reduces sugar yield. KSL will adopt a more site- specific assessment of fertilizer requirements, cultivation of leguminous green manure crops during fallow

periods or in rotation, and the use of organic manure (combinations of nitrogen-fixing micro-organisms and organic amendments. The use of organic manure in place of chemical fertilizers, has potential to reduce inorganic fertilizer requirements by 20-25 percent and reduce the risk of nitrate leaching.

Crop logging, used to monitor plant weight and leaf nutrient content will be used in sugar cane cultivation to assess the foliar nutrient levels and adjust the fertiliser rate or other elements only if needed.

9.2.5 Overuse of agrochemicals

The indiscriminate use of pesticides creates a number of problems, such as development of resistance in pests, upsurge of secondary pests because of elimination of natural enemies, pollution of the environment making it hazardous for human beings and animals and moreover, they are expensive and increase the cost of crop production.

To achieve a reduction in the amount of agrochemicals used, KSL will adopt biological control and Integrated Pest Management (IPM) where there is a greater emphasis on non-chemical control methods, particularly for insect pests. IPM combines biological control with a variety of other appropriate physical, chemical and mechanical control methods to achieve a more holistic and sustainable approach to pest control.

Control of the pests will be based on a sound knowledge of the biology of the pest species and included identification of resistant cultivars and optimum planting times, rational pesticide use, biological control, close monitoring of the situation in the crop and the use of pheromones for trapping or mating disruption.

9.2.6 Reducing pollution from sugar mills

The sugar mill will be sited downwind of populated areas to minimise nuisance from gaseous emissions and isolated from natural ecosystems to minimise the impacts of effluent discharge on water bodies.

9.2.6.1 Reducing fly ash production

Bagasse will be dried prior to its use as boiler fuel, which increases the efficiency of burning and reduces emissions. Basic dust control measures will be incorporated in the production process. Mechanical collectors and wet scrubbers will be used to control particulate emissions from bagasse-fired boilers.

9.2.6.2 Reduced gas and odour production

Using hydrogen peroxide in place of sulphur dioxide in the sugar mill will reduce air pollution and result in a higher quality white sugar product while requiring no new equipment.

9.2.6.3 Reducing effluent discharge

A range of techniques is available for treating sugar mill effluents, including the treatment of mill sludge with micro-organisms that accelerate the rate of decomposition.

Effluent discharge from the sugar mill will be reduced by recycling treated effluents as make-up water for cooling towers and spray ponds.

9.2.7 Protection of riparian vegetation

Riparian vegetation will be protected and left intact. Natural riparian vegetation plays a particularly important ecological role, providing habitat for wildlife, and influencing water quality and temperature, stream morphology, and ecosystem dynamics. It can also provide a buffer between agricultural systems and waterways. The planting and maintenance of indigenous vegetation in riparian habitats can reduce sediment loads and agrochemical concentrations in waters running off from cane fields.

The characteristics of field margins and adjacent land parcels are also important influences on biodiversity and abundance in cultivation systems.

9.2.8 Use of byproducts through better management practices

The following management practices will be explored to reduce waste generated at the farm and factory and to develop sustainable management practices:

9.2.8.1 Filtration

Fly ash extracted from boiler chimney gas can be used as a filtration aid in the sugar mill and can also be used for the removal of certain pesticides from wastewater.

9.2.8.2 Chemical production

Bagasse is a potentially valuable cellulose source for the production of chemicals, such as pentosans (including furfural) and allied substances.

9.2.8.3 Yeast production

Molasses produced in the processing of cane sugar is an important raw material for the fermentation industry and in the production of yeasts.

9.2.8.4 Alcohol production

Alcohol will be produced as a by-product of the sugar production process, through the fermentation of molasses.

9.2.8.5 Fuel production

Juice extracted from cane will be fermented directly and the products distilled to produce alcohol for fuel (bioethanol). The primary argument in favour of bioethanol as a fuel is that it results in less air pollution than fossil fuels. Other potential advantages include the renewable nature of bioethanol, reduced dependence on foreign oil, enhanced local employment opportunities and the creation of 'added value' in a sugar industry.

9.2.8.6 Electricity production

Steam and electricity will be produced from the burning of bagasse; this process has the potential to increase the sustainability of sugar production.

9.2.9 Impact on public health

To prevent the transmission of diseases such as HIV/AIDS, and other STIs the following measures will be undertaken:

Prevention will be the key intervention measure and therefore sensitization campaigns on HIV/AIDS will be carried out on a regular basis among the workforce and extended to the community. Distribution of condoms to sexually active persons will be carried out.

9.2.10 Impact on landscape and aesthetics

The local topography is generally flat and no major levelling will be carried out to have a significant impact on landscape. To prevent significant impact on aesthetics especially after the cutting of trees is done, reforestation through the planting of suitable plant species will be done. The suitable type of species to be planted will be indigenous but will be identified after consultation with FD.

10 ENVIRONMENTAL MANAGEMENT PLAN

Environmental management will be carried out at all stages of the project; the design and planning stage, construction phase and operational phase. Planning and design of the project has been undertaken with a view to minimising or avoiding adverse environmental impacts and maximising benefits. Mitigation measures to be implemented with activities during the construction and operational phases were identified in the previous section.

The Environmental Management Plan seeks to serve as a useful management tool to ensure successful implementation of these measures, monitoring and subsequent audits by outlining duties and responsibilities of key stakeholders with respect to environmental management at all project phases.

It is unlikely that the project will cause significant adverse environmental effects, provided that recommendations, including implementation of mitigation measures as identified in the previous section, are incorporated.

Many of the environmental issues related to the project have been considered in the design phase, thus they form part of the mitigation measures. As such, these form part of the plan, and are summarised in **Table 10-1** below

Table 10-1: Environmental Action Plans

What Needs to Be Managed	Why does it Need to be Managed	ID No.	How Should it be managed	Project Stage	Monitoring Indicator	Responsibility	Cost
Filling the demand – supply of energy gap	Opportunity for recycling bagasse (sugar processing waste) to produce power; Zambia is currently experiencing a shortage of energy	1.	Use the bagasse from the sugar processing unit to produce 30MW	Operation	megawatts of energy produced	Plant Manager	Operational and investment cost
Production of organic manure	Mechanized tillage and intensive use of chemicals and inorganic fertilizers leads to soil degradation	2.	Apply the produced organic manure to enrich to enrich the soil	Operation	#kg of organic manure produced and #Ha to which manure will be applied	Farm Manager	Operational and investment cost
Social services development	Provision of social amenities to the locals improves the working morale of the people and is a social investment that helps with community buy-in	3.	Consult with the locals pressing social amenities to invest in	Construction – operation	Amount of money spent on CSR	General Manager	To be determined after consultation
Local employment	Ensure that the locals are offered first priority during the recruitment exercise	4.	Ensure that employment opportunities are first offered to locals, except for jobs that require specialization	Construction – operation	# locals employed; ratio of locals to expatriates	HR Manager	No cost
	Offer of employment opportunities to women improves household income	5.	Ensure that the right balance with regard to the local employment and gender is observed.	Construction – operation	Ratio of men employed to women employed	HR Manager	No cost
Service suppliers	The use of local service suppliers increases their competence and maximizes their ability to carry out related works	6.	Use companies registered in Zambia for the provision of services and supply of products	Throughout the project stages	# local companies used suppliers	General Manager	No cost
Use of byproducts	To reduce waste generated at the farm and factory and to develop sustainable management practices	7.	▪ Use fly ash extracted from boiler chimney gas as a filtration aid in the sugar mill. ▪ Use molasses for alcohol production ▪ Produce electricity from the burning of bagasse.	Operational phase	#kg fly ash used #litres of ethanol produced #MW power generated	Plant Manager	Operational costs
Soil degradation	Degraded soil requires intensive use of inorganic fertilizers and lowers crop yield	8.	Apply organic manure to degraded soils to start soil enrichment	Operational phase	#Ha to which organic manure is applied	Farm Manager	To be determined based on degraded soil
Soil erosion	The clearing of vegetation for the	9.	Apply trash mulching, terracing,	Operational	#ha of land	Farm	To be

What Needs to Be Managed	Why does it Need to be Managed	ID No.	How Should it be managed	Project Stage	Monitoring Indicator	Responsibility	Cost
	planting of sugar increase the erosive potential of soil, reducing soil quality and quantity		contour and strip planting of cane on slopes; maintenance of 'live barriers' (hedgerows, riparian zones); and modified (reduced or minimum) tillage.	phase	replenished	Manager	determined based on degraded soil
Soil compaction	Soil compaction increases bulk density and soil strength, restricting the rooting ability of the crop, and decreases porosity and water infiltration rate	10.	Use modified (reduced or minimum) tillage as well as green can harvesting rather than pre-harvest cane burning and 'trash-blanketing'	Operation stage	#ha of land replenished	Farm Manager	To be determined based on degraded soil
Water use	Water use efficiency ensures that more water will be available for other needs, such as those of the environment or communities, and also provides a range of financial benefits to the farmer including reduced water and/or electricity costs and yield increases.	11.	Employ analysis of Water Use Efficiency and match the irrigation system to the soil type, climate, farm management and affordability. Irrigation scheduling, use tensiometers to monitor soil moisture, and tail-water recycling	Operation phase	Ratio of crop yield to water consumed by the crop	Farm Manager	K10,000 for tensiometers
Use of fertilizers	There is a direct economic to reduce fertilizer inputs, as these represents significant costs and over-use of Nitrogen fertilizer reduces sugar yield.	12.	Adopt a more site- specific assessment of fertilizer requirements, cultivation of leguminous green manure crops during fallow periods or in rotation, and the use of organic manure. Adjust fertilizers rate by using crop logging to monitor plant weight and leaf nutrient content to assess the foliar nutrient levels	Operation phase	% reduction in the use of inorganic fertilizers	Farm Manager	K100,000/ year
Use of chemicals	Inefficient use of pesticides creates resistance in pests, upsurge of secondary pests because of elimination of natural enemies, pollution of the environment making it hazardous for human beings and animals and moreover, they are expensive and increase the cost of crop production.	13.	Adopt biological control and Integrated Pest Management where there is a greater emphasis on non-chemical control methods.	Operation phase	% reduction in the use of agrochemicals used	Farm Manager	K125,000/ year
Waste generation	Unsustainable waste management practices pollute the soil, surface and groundwater resources	14.	Utilize the waste produced as a resource by using vegetative waste as soil cover to prevent soil erosion and also as compost.	Construction - operational phase	Amount of waste reused; Amount of	Farm Manager/ Plant Manager	K75,000/ year

What Needs to Be Managed	Why does it Need to be Managed	ID No.	How Should it be managed	Project Stage	Monitoring Indicator	Responsibility	Cost
			Use bagasse to generate power and molasses as feedstock and the production of ethanol.		ethanol produced		
Riparian vegetation	Natural riparian vegetation provides habitat for wildlife, and influences water quality and temperature, stream morphology, and ecosystem dynamics. Riparian habitats reduce sediment loads and agrochemical concentrations in waters running off from cane fields.	15.	Riparian vegetation will be protected and left intact, leaving a buffer of 25m on either side	Operational phase	Distance of watercourse to agricultural systems; Chemical and physical quality of water	SHE Manager	No cost
Effluent discharge	Untreated effluent affects the chemical, physical and biological quality of watercourses	16.	▪ Site the sugar mill isolated from natural ecosystems to minimise the impacts of effluent discharge on water bodies. ▪ Treat sugar mill effluents with micro-organisms that accelerate the rate of decomposition ▪ Reduce effluent discharge by recycling treated effluents as make-up water for cooling towers and spray ponds.	Operational phase	Quality of effluent discharged	SHE Manager	K35,000/ year
Air pollution from the boiler	Air pollution affects public health and the deposition of fly ash on local environs can cause ecological disturbance and be a nuisance	17.	▪ Site the sugar mill downwind of populated areas ▪ Reduce fly ash production by drying bagasse prior to its use as boiler fuel ▪ Reduce gas and odour production by using hydrogen peroxide in place of sulphur dioxide in the sugar mill	Operational phase	Quality of gaseous emissions	SHE Manager	K25,000/ year
HIV/AIDS	To prevent the spread of HIV/AIDS among the workforce and prevent the loss of skilled manpower as a result of contracting HIV/AIDS	18.	Educate and sensitize workers on the dangers of HIV/AIDS and promote self-protection, abstinence from casual sex and the use of condoms	Construction	# advocacy campaigns	SHE Manager	K5,000
		19.	Use local employment unless the required expertise cannot be obtained locally	Construction	% local employment	SHE Manager	No cost
		20.	Identify and work with an experienced	Construction	Engagement	SHE	No cost

What Needs to Be Managed	Why does it Need to be Managed	ID No.	How Should it be managed	Project Stage	Monitoring Indicator	Responsibility	Cost
			NGO involved in the prevention of HIV/AIDS		contract	Manager	
Generation of waste	Prevent impact of waste on public health due to inappropriate waste management practices	21.	Ensure that no littering occurs at work sites	Construction	Absence of litter	All Supervisors	No cost
		22.	Reuse materials from excavation of the ground and foundation works for earthworks and landscaping	Construction	#kg material reused	Contractor	No cost
		23.	All solid wastes will be stored in designated receptacles on site and removed from the site by a licensed waste handler to an approved waste disposal site.	Throughout the project phase	# waste receptacles on site	All Supervisors	K40,000
		24.	Keep the site in a safe, neat and sanitary condition	Throughout the project phase	# complaints	Project Manager	Operational cost
	Construction waste is a major contributor to landfill.	25.	Reduce waste from construction through building design and construction planning and monitoring processes	Construction	Amount of waste reduced	Project Manager	K80,000
		26.	Minimise construction waste through designs based on product and material sizes which minimize cutting and waste. Examples include designing walls to align with brick or block sizes and avoiding diagonal tiling layouts which generate wastage.	Construction	Amount of waste reduced	Project Manager	No cost
	Reduce loss of land to landfill by encouraging recycling through provisions that makes it easy to undertake recycling.	27.	Store easy-to-use receptacles for capturing and storing different types of waste at the point at which the waste is generated	Construction - operation	# waste receptacles on site	Project Manager/ Contractor	Refer to item 23
Biodiversity	Ensure that the construction of the buildings takes into account biodiversity to maintain local ecosystem services and provide natural amenities which support health and well being	28.	Enhance biodiversity through careful planning and landscaping strategies by increasing the amount of vegetation on a site through planting local plant species, planted terraces and balcony gardens as well as vertical vegetation such as creepers to replace vegetation lost during construction.	Construction	Area replanted	SHE Manager	K50,000

What Needs to Be Managed	Why does it Need to be Managed	ID No.	How Should it be managed	Project Stage	Monitoring Indicator	Responsibility	Cost
		29.	Planting will be of locally indigenous or low water requirement species.	Construction	# local species used	SHE Manager	Included in item 28
		30.	Maintain a buffer of 25m on the water courses to protect riparian vegetation	Throughout the project cycle	Distance of buffer	Contractor	K250,000
Occupational Health and Safety	Uphold OHS standards to assure the safety of workers	31.	Ensure that adequate OHS measures are put in place, made available to workers and adhered to.	Throughout the project	OHS policy and measures	Project Manager	Operational costs
		32.	Implement regular training in OHS. Ensure that these form daily safety talks before beginning works	Throughout the project	# training sessions held	Project Manager	Operational cost
		33.	Provide appropriate and adequate PPE for the workers	Throughout the project	Amount of money spent on procuring PPE	Project Manager	K90,000
Public Safety	Guarantee the safety of the people during construction and operation	34.	Ensure that no unauthorised persons access the construction site. Restrictions will require specific mitigation actions such as gates, perimeter fence, in addition to providing security.	Throughout the project	Length of fenced perimeter and # of gates	Contractor	No cost
		35.	Erect and maintain warning signs	Throughout the project	# warning signs erected	Contractor	K2,500
		36.	Construct and maintain speed retarders on access roads	Throughout the project	# speed retarders	Contractor	K4,000
Buildings and infrastructure	Ensure that all anthropogenic structures that remain after the project decommissioning and closure stage will be physically stable	37.	If there is no use for the building post the operation phase, the following measures will be applied to the structures: ▪ Breaking out of concrete foundation; ▪ Removal of all steel frames; ▪ Dig up and removal of all below ground electricity cables; ▪ Clear materials handling areas of all raw materials; ▪ General site cleanup. ▪ Site levelling and re-profiling	Closure	Area of site rehabilitated	Project Manager	K3,500,000

What Needs to Be Managed	Why does it Need to be Managed	ID No.	How Should it be managed	Project Stage	Monitoring Indicator	Responsibility	Cost
			to re-establish the natural drainage pattern across the site ▪ Re-vegetate with indigenous grasses and trees				

11 SOCIAL MANAGEMENT PLAN

This section discusses KSL's Social Management Plan (SMP). In this SMP KSL has stated its social commitments in the management of the social environment.

The purpose of this SMP is to address social and cultural impacts arising from the establishment and operation of the project. The specific objectives are:

a) To manage the influx of people to the area;
b) To promote Corporate Citizenship and integrate these values into all project operations;
c) To minimize negative consequences and optimize opportunities from the operational stage through to decommissioning and closure; and
d) To promote co-operation between the company and stakeholders.
e) To explain the Company's policies on environmental issues to the community and wider public, via public consultation and other avenues.

11.1 Influx of non-locals to the area

The influx of people to the area seeking business and employment opportunities may affect and possibly disrupt the social and cultural fabrics of the local community. During the consultative meetings, the locals expressed concern that there is potential for increase in the number of people from other parts of Zambia, who may get their jobs and business opportunities.

This has potential to increase stress on public services such as schools and health care provision. The impact on natural resources may increase in view of the fact that the locals depend on firewood for their energy.

As far as it is practicable to do so, and depending on qualifications and experience, KSL will give first priority of employment opportunities to the locals unless the required expertise cannot be found locally.

11.2 Loss of revenue

The decommissioning and closure of project operations will bring to an end the source of income for the employees. The closure can negate positive developmental changes that have occurred in the local economy and may have an impact on the living conditions of the people if sustainability measures are not put in place to prepare employees and the locals for life beyond project operations.

11.3 Loss of employment and economic opportunities

The decommissioning and subsequent closure of the project will imply the loss of some 500 permanent employment and 3000 seasonal employment opportunities. The loss of job opportunities will result in loss of farm revenue from the out-growers and subsequently impact on the livelihoods of the people around the project site.

Vision setting, psycho-social counselling and multi-skilling programs shall be implemented for all categories of employees upon employment. KSL will encourage communities to form associations in an effort to promote business enterprises amongst the locals. The company will also build the capacity of local contractors and suppliers in order to enhance their efficiency and competitiveness.

KSL will also implement a contractor engagement strategy that ensures local contractors are employed, subject to their ability to carry out the work. This action will improve contractor competency and managerial capacity of local contractors.

KSL will implement a local procurement strategy that supports local economic development. In line with this, the Company will distribute information material through its logistics office explaining the procedures for doing business with KSL.

11.4 Potential In-Migration

Currently, the project area is a typical rural area, sparsely populated and with very little infrastructure. Along with the establishment of the project, this is likely to change as people get to the area for economic reasons – employment opportunities and ready markets for groceries and garden produce.

The population of influx of people has potential to negatively impact on the provision of services (e.g. over-stretched school classroom space and health facilities) as well as the environment (deforestation due to increased charcoal burning activities).

In consultation with the local authorities and the traditional authorities, KSL will develop an Influx Management Plan for the ‘accelerated urbanisation’ that will be experienced noticed. This requires building capacity for urban planning and development regulation. An Influx Management Plan will require collaborating with central and local government to develop a local integrated development plan and along with this plan providing investment in infrastructure and social services in designated locations. Further, it will be important to offer, as a matter of priority, employment opportunities to the locals.

11.5 Employee welfare

The Company will offer competitive salaries and conditions of service commensurate with other companies operating in Zambia with same tax regimes. The Company will provide training and development programmes for employees so that they acquire transferable skills that can be used elsewhere after cessation of project operations.

The HIV/AIDS awareness and prevention programme will be implemented in consultation with local NGOs and government initiatives.

11.6 Public Safety

In order to prevent unauthorised access into the site, particularly the factory, and ensure the safety of both employees and the locals, KSL will develop closed gate approach and anyone accessing the factory and ancillary facilities will do so through the security manned gate.

11.7 Land use

KSL will ensure that there is minimum destruction of the existing natural environments so as to prevent ecological disturbance and minimise landuse changes. The company will engage in natural resource management to assist in the conservation of trees within the project area. This will involve the prevention and discouragement of unnecessary cutting down of trees and clearing of vegetative cover.

The existing trees are necessary for providing shed and shielding against noise and dust pollution. They also play a role in maintaining local biodiversity.

11.8 Public Consultation

Public consultation will be carried out throughout the life of the project and regular consultative meetings with stakeholders will be carried out to develop amicable and trusting relationships between KSL and the local population.

11.9 Public complaints

To further enhance the relationship with the local community, a complaints register will be kept at the premises to document any complaints received about the activity.

The complaints register will include:

- time, date and nature of the complaint
- how the complaint was made
- details of the complainant
- response and investigation into the complaints and action taken
- details of the person who investigated the complaint.

11.10 Social responsibility

KSL, through its Social Investment Programme, will consult with the locals on areas of assisting the locals in areas of need.

Table 11-1: Socio-economic and Cultural Management Plan

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
Influx of People to Luena						
Increased population due to increased employment opportunities	To minimise increased use of local resources as a result of increase in intensity of human activity in surrounding areas as people look for employment opportunities.	1	Depending on qualifications and experience, KSL will give first priority of employment opportunities to the locals unless the required expertise cannot be found locally.	2017	Closure	HR Manager
	Address the 'accelerated urbanisation' that is likely to occur in the area	2	Develop and operationalise an Influx Management Plan by building capacity for urban planning and development among key stakeholders	2018	Closure	General Manager
		3	Collaborate with central and local government to develop a local integrated development plan	2018	Closure	General Manager
Employment and Economic Opportunities						
Employment opportunities and local economy	Local employment guarantees an opportunity for improved livelihoods and economic development to the local community	4	Depending on qualifications and experience, KSL will give first priority of employment opportunities to the locals unless the required expertise cannot be found locally.	2018	Closure	Human Resource Manager
		5	Use the employment local register when employing the local people	2018	Closure	Human Resource Manager
	To promote business enterprises amongst the locals	6	Encourage communities to form associations through which to work with the company.	2018	Closure	Community Development Manager
		7	Provide training to the locals in entrepreneurship and	2018	Closure	Training Manager

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
			business management at the Centre of Excellence.			
SME Development	Support the development of Local Economic Development.	8	Create a deliberate policy of inclusion of local entrepreneurs as suppliers of goods and services. Procurement procedures, required standards and contractual obligations shall be communicated to local businesses	Construction	Closure	Community Development Manager
		9	Promote a range of micro and medium scale enterprises in the area through the out-grower scheme	Construction	Closure	Community Development Manager
		10	Support the improvement of local livelihoods in the Luena area by promoting the out-grower scheme and building the capacities of the existing ones through coaching and mentoring programmes	Construction	Closure	Community Development Manager
		11	Promote a Local Contractor Development programme with the aim of promoting local procurement	Construction	Closure	Community Development Manager
Community Income Generating Projects for vulnerable groups (e.g. women and youth)	Poverty levels are high in the project area and require livelihood uplift and poverty reduction interventions	12	Identify vulnerable community groups including women and youths for training and skilling in viable livelihood skills and income generating activities. Successful trainees will be assisted to implement the acquired knowledge and skills to improve their livelihoods	Construction	Closure	Community Development Manager
Contractor engagement	To improve contractor competence and	13	Develop and implement a contractor engagement	Construction	Closure	Contracts

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
	managerial capacity		strategy that ensures local contractors are employed, subject to their ability to carry out the work.			
		14	Design quality standards that contractors shall adhere to	Construction	Closure	Contracts
		15	Develop and implement a local procurement strategy that supports local economic development	Construction	Closure	Contracts
		16	Distribute information material through the Contracts Office explaining the procedures for doing business with KSL.	Construction	Closure	Contracts
Workers retirement and disengagement preparation	To minimise negative impacts on livelihood due to retrenchment or retirement	17	Psycho-social counselling and multi-skilling programs will be implemented for all categories of employees during employment	Construction	Closure	Human Resource Manager
Education and Training	To ensure employees receive skills relevant to their work	18	Put in place a training program for all its staff	Construction	Closure	Human Resource Manager
Employee Welfare and Health						
Employee welfare	To boost employee morale and productivity through improved conditions of service	19	Offer competitive conditions of service commensurate with other agro companies operating in Zambia with same tax regimes.	Construction	Closure	Human Resource Manager
		20	Develop and implement an employment policy which emphasizes on “Equal employment Opportunities”	Construction	Closure	Human Resource Manager
	To ensure employees receive skills helpful to	21	Provide training and development programmes for	Construction	Closure	Human Resource Manager

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
	their work		employees so that they acquire transferable skills that can be used elsewhere after closure of mine operations.			
HIV/AIDS	To prevent the further spread of infection and minimise the effects of HIV/AIDS on the workforce	22	The HIV/AIDS awareness and prevention programme will continue and implemented in consultation with local NGOs and government initiatives.	Ongoing	Closure	SHE Manager
Land-use						
Land use change and natural resource conservation	To ensure that there is minimum destruction of the existing natural environs so as to prevent ecological disturbance and minimise land-use changes.	23	KSL will engage in natural resource management by discouraging unnecessary cutting down of trees and clearing of vegetative cover.	Construction	Closure	SHE Manager
		24	Raise awareness amongst employees on the importance of natural resource conservation	Construction	Closure	SHE Manager
		25	Discourage settlements in the project area	Construction	Closure	Security Manager
Public Safety						
Site security and public safety	To prevent unauthorised access into the project site and ensure the security of employees and the safety of locals	26	Develop and uphold a closed gate approach and anyone accessing the site does so through the security manned gate.	Construction	Closure	Manager - Security
Public Consultation						
Consultation with the public.	To build an amicable relationship with stakeholders and communicate KSL policy on social and	27	Public consultation and regular consultative meetings with stakeholders throughout the life of the project will be carried out	Construction	Closure	Communications Manager

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
	environmental policy to the public.					
	Develop External Communication Plan for Government, NGOs, and Media etc.	28	Develop an External Communication Plan for Government, NGOs, and Media etc.	Construction	Closure	Communications Manager
Public Complaints						
Public complaints	To address public complaints and enhance relationship with the local community	29	Keep a complaints register to document any complaints received about the project operations.	Construction	Closure	Communications Manager
Social Responsibility						
Social benefits for the locals	To provide social benefits for the locals	30	KSL will consult with the locals on areas of assisting the locals in areas of need such as sanitation, education, health, water supply, infrastructure development	Construction	Closure	Community Development Manager
	To minimise impact on local economy due to loss of revenue as a result of mine closure by preparing the locals for life beyond mining operations	31	Develop Social Investment Programme (SIP) that looks at community development projects supporting education, gender development, agriculture, health and other social programmes.	Construction	Closure	Community Development Manager

12 OCCUPATIONAL HEALTH AND SAFETY PLAN

KSL will develop a Safety and Health Policy, in line with the overall vision of the parent company, NBVL, in which the company will commit itself to continuously identify and implement safe and healthy ways to do the job and also to maintain a high degree of emergency preparedness.

Based on this policy, an occupational health and safety (OHS) plan will be developed in order to assist the company operations. These measures will ensure compliance with Zambian OHS legislation and standards that apply to the factories and will create a safe workplace thereby protecting employees from accidents and sickness.

Table 12-1: Occupational Health and Safety Plan

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
General OHS Management	Ineffective OHS management can increase the health and safety risks to employees.	1.	Develop and implement risk assessment methods to support effective OHS planning and management.	Construction	Closure	SHE Manager
		2.	Develop and implement procedures for monitoring, measuring and reporting OHS indicators.	Construction	Closure	SHE Manager
Safety Training	Inadequate provision of safety training can lead to increased risk of workplace accidents, injuries and fatalities.	3.	Review OHS capacity development and training needs at all levels of the organisation	2018	Closure	SHE Manager
		4.	Provide appropriate OHS training in accident prevention, safe lifting practices, emergency response systems and procedures, use of personal protective equipment, and proper control and maintenance of equipment and facilities to relevant employees at all levels of the organisation	Construction	Closure	SHE Manager
		5.	Provide safety briefings to reduce the risk of workplace accidents, injuries and fatalities	Construction	Closure	SHE Manager
Noise	Exposure to noise levels above 85 dBA can lead to adverse health effects	6.	Noise monitoring will be undertaken as part of a workplace risk assessment procedure.	Construction	Closure	SHE Manager
		7.	Personnel will use appropriate hearing protection when exposed to noise levels above 85 dBA.	Construction	Closure	SHE Manager
		8.	Company machinery and equipment will be well maintained to minimise noise levels	Construction	Closure	Maintenance Manager
Workplace air quality	Exposure to elevated levels of dust can bring about respiratory ailments. Inhalation or ingestion of dust can lead to adverse health effects.	9.	Issue respiratory protection to all employees working in areas where particulates may exceed the threshold limit values.	Construction	Closure	SHE Manager
		10.	Introduce dust suppression / control measures to reduce airborne dust	Construction	Closure	SHE Manager
		11.	Conduct routine inspections to ensure that appropriate respiratory protection equipment is in	Construction	Closure	SHE Manager

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
			good working condition and being used correctly			
General employee health	To ensure adequate health facilities for employees since a health workforce contributes to efficiency	12.	Deal with health emergencies through First Aid and Company Clinic. The facilities will be equipped with medical material, medicines and vaccines and be adequately staffed.	Construction	Closure	SHE Manager
	Inadequate provision of sanitary facilities can increase health risks to employees.	13.	Provide well-equipped sanitary facilities for employees. Workers will be encouraged to observe high standards of hygiene, particularly those employees exposed to dust, or reagents/chemicals.	Construction	Closure	SHE Manager
	Reduce the further spread of HIV/AIDS	14.	Employees will also be encouraged to test for HIV, informed and counselled with regard to HIV/AIDS	Construction	Closure	SHE Manager
	To use health and safety data to evaluate and improve the efficiency and effectiveness of the health and safety programme	15.	Keep a record of employee medical examinations, specific surveillance records and medical history.	Construction	Closure	SHE Manager
General employee safety	Inadequate provision of PPE can increase the risk of workplace accidents, injuries and fatalities.	16.	Provide employees with adequate PPE such as hardhats, safety boots, overalls, ear and eye protection, dust masks and gloves	Construction	Closure	SHE Manager
	Death or personal injury of employees may arise due to accidents involving electricity.	17.	Ensure that all electrical equipment are grounded, well insulated and conform to applicable codes.	Construction	Closure	Maintenance Manager
	To ensure that adequately trained staff are notified in the event of injury or illness	18.	Post and regularly update contact phone numbers of persons and services to be notified in the event of an emergency.	Construction	Closure	SHE Manager
First Aid	Inadequate First Aid provision can lead to a reduction in the capacity to deal with emergency situations.	19.	Provide adequate First Aid equipment and facilities throughout the mine and appropriately train staff to deal with injury or illness of emergency nature.	Construction	Closure	SHE Manager

What needs to be managed	Objective	Item No.	Management Action	Timing		Responsibility
				Start	End	
Warning and safety signs	Inadequate provision of appropriate warning and safety signs can increase the number of accident incidents, injuries and fatalities in risk areas.	20.	Erect and post hazard signs around the mine to warn employees and visitors of potential dangers	Construction	Closure	SHE Manager
Emergency Fire and Rescue Services	To put in place systems and procedures for responding to and handling emergencies	21.	Provide fire prevention, fire containment, fire fighting provision and rescue services	Construction	Closure	SHE Manager
		22.	Ensure that there is a Field Response Team (FRT) at all work places	Construction	Closure	SHE Manager
		23.	Provide specialist training on emergency response to the FRT	Construction	Closure	SHE Manager
Health & Safety Records	To use health and safety data to evaluate and improve the efficiency and effectiveness of the health and safety programme	24.	Maintain records of all significant environmental matters monitoring data, occupational illnesses, spills, fires and other emergencies	Construction	Closure	SHE Manager
		25.	Discuss health and safety statistics during management meetings	Construction	Closure	SHE Manager

13 ENVIRONMENTAL MONITORING PLAN

KSL will implement a monitoring plan, specifically an environmental monitoring plan, in and around the project area partly to uphold sound environmental practice but also to comply with the requirements of the Zambian Environmental Management Act. The environmental monitoring will include the following:

- Noise;
- Ambient air quality;
- Surface water quality;
- Biodiversity quality;
- Groundwater quality;
- Soil contamination; and
- Weather.

13.1 Objectives

The general objectives for monitoring and assessment will be to:

- supply information on the performance of the operation to assess if it meets environmental targets – legal compliance, internal targets or guidelines;
- provide target thresholds for a component out of compliance and to initiate a reaction;
- supply information on control and efficiencies;
- provide a baseline for the understanding of the operation's impact on the environment and to measure improvements; and
- provide trends in environmental measurements.

13.2 Environmental monitoring plan

Table 13-1: Waste Management Monitoring

Type of Monitoring	Parameter	Frequency		Responsibility
		Weekly	Monthly	
Implement a comprehensive waste monitoring program	Types and volume of waste generated and stored: • Hazardous waste • Health Care Waste • Domestic	√	Do monthly reconciliation	SHE Manager

	Types and volumes of waste disposed: • Hazardous waste • Health Care Waste • Domestic waste	√	Do monthly reconciliation	SHE Manager
	Types and volumes of waste reused or recycled: • Hazardous waste • Domestic	√	Do monthly reconciliation	SHE Manager
	Disposal methods for different types of waste	√	Do monthly reconciliation	SHE Manager
	Compliance with waste related environmental legislation	√	Do monthly reconciliation	SHE Manager

13.2.1 Surface Water Monitoring

13.2.1.1 General Objective

The general objective is to prevent the discharge or application of any poisonous, toxic, erotoxic, obnoxious or obstructing matter, radiation or other pollutant or permit anyone to dump or discharge such matter or pollutant into the aquatic environment.

13.2.1.2 Specific Objectives

The specific objective is to maintain the water quality standard at baseline level or better with a view to preventing the pollution of water.

13.2.1.3 Water pumped from Kalungwishi and Mupoposhi River

The objective of monitoring this water will be:

- to record the volume of water being pumped from the River.

13.2.1.4 Effluent discharged into the open environment

The objective of monitoring this water will be:

- to monitor and record the quality of effluent being discharged into the open environment; and
- to monitor compliance with effluent standards and permit limits.

13.2.1.5 Water courses within the project area

Monitoring of surface water in the local streams will be carried out to determine the impact project operations may have on surface watercourses.

Analytical Parameters

Field Measurements

During sample collection, the following field measurements will be undertaken for a number of physico-chemical parameters: Temperature, pH, electrical conductivity (specific conductance), dissolved oxygen, redox potential and alkalinity.

It is important to capture this data at the time of sampling because the parameters may change rapidly after sampling.

Alkalinity measurements will be conducted in the field, or at least on the day that the sample will be collected since alkalinity is a moderately unstable parameter and can change relatively rapidly after sampling, particularly due to changes in temperature and pressure associated after sampling.

Laboratory measurements

The following parameters will be monitored: TDS, Turbidity, pH, EC, TSS, TDS, Cu, Fe, SO_4, NH_4, Cl, NO_3, total phosphates, Totcol, ECol, Al, Mn, Mg, K, Na, Ca, Se, Zn, Nitrite

Analysis for total metals will be done, as the Effluent Discharge criteria are evaluated against the total concentrations. However, the analysis of dissolved metal/solute concentrations are also important, so as to distinguish between concentrations that are associated with suspended particulate matter and those that occur as dissolved species. This distinction is important for geochemical interpretation and for identifying likely source and transport mechanisms of elevated parameters.

Frequency

Monitoring of the above parameters will be on a monthly basis. The results of this monitoring will be submitted to ZEMA on a bi-annual basis. The sampling frequency will be reviewed depending on the results of the sampling campaign.

13.2.2 Groundwater Quality Monitoring

Groundwater contamination may occur as a result of infiltration/seepage of contaminated water or leaks into sub-soils.

The yet to be drilled boreholes will be used to monitor groundwater quality around the project area.

13.2.2.1 Analytical Parameters

The groundwater parameters to be analysed: TDS, Turbidity, pH, EC, TSS, TDS, Cu, Fe, SO_4, NH_4, Cl, NO_3, total phosphates, Totcol, ECol, Al, Mn, Mg, K, Na, Ca, Se, Zn, Nitrite

13.2.2.2 Frequency

Sampling from boreholes will be done on a quarterly basis.

13.2.2.3 Quality Assurance / Quality Control Analysis for water monitoring

- The sampling protocol QA/QC will include spiked samples and duplicate samples to provide a measure of the reproducibility of the collected samples. In addition some samples will be sent to an independent accredited laboratory for independent analysis.

- All instruments used for field measurements will be well maintained and calibrated prior to use. Calibration records will be maintained in order to demonstrate continued compliance and reliability of the instruments.

- Conduct trend analysis – this will be conducted as data arrives to identify any ongoing variation in water quality, to ensure that sample data has not been mixed up, and to ensure the analyses are conducted to an acceptable quality; and

- Comparison of pH and EC as measured on site and at the laboratory. This provides a quick confirmation that the sample hasn't substantially changed composition and that the values measured at the lab are similar to those measured in the field.

- Interpreting several key geochemical processes from major ion compositional changes, and completing ion balances on water samples so as to provide a measurement of the accuracy of the laboratory analysis procedures; this is because

large ion balance errors provide an indication of poor analysis or complex sample matrices.

13.2.3 Water level monitoring in Kalungwishi River

Water levels in Kalungwishi River will be monitored to determine and quantify impacts to altered surface flows or natural processes due to water abstraction.

The monitoring of the fluctuations in the surface water will help identify potential impacts resulting from project operations and natural processes. Reference sites will be included in the monitoring program

The hydrological conditions within river system will be monitored for an extended period (including low flows, i.e. May to September).

13.2.4 Soil Monitoring

To evaluate the level of contamination in and around the vicinity of the project area, a semi-annual soil monitoring programme will be implemented. The samples will be collected using recognized international procedures for soil sampling and samples will be assessed for various chemical characteristics that will include pH and heavy metals.

Vegetation will also be sampled to assess possible entry of contaminants into the food chain. Any evidence of contamination will be identified and remedial action executed to reduce this contamination.

A more extensive sampling process exercise will be carried out at closure to determine the extent of contamination. The sampling will go beyond the license boundaries of the mine.

13.2.4.1 General Objectives

To provide recommendations based on soil analysis in times of accidental spills, and to protect soils from contamination and suggest appropriate remedial measures.

13.2.4.2 Specific objectives

To assess the chemical, biological, and physical properties of soils, especially after disasters.

13.2.4.3 Sampling after emergency

Special sampling to be carried out on request after accidental spills of chemicals and other contaminants on soils. The contaminants are likely to affect transition soils that occur along the profuse network of water courses existing within the area.

13.2.4.4 Plant and soil analysis periodic monitoring

This will be done to track changes of on-going activities where direct impacts on soils and plants are compared to initial environments.

13.2.4.5 Responsibility

The sampling and analysis will be the responsibility of the SHE Manager.

Table 13-2**:** Soil sampling sites

Location	**Frequency**
Farmed area	Once yearly
Chemical and fertilizer storage Facility	Once yearly
Processing Facility	Once yearly

13.2.5 Ambient Air Quality Monitoring

Dust emissions that are likely to impact on air quality could arise from the factory, cleared surfaces, and driving on unpaved roads.

In order to fully describe deposition patterns, long-term and detailed dust monitoring would be required. Dust patterns are often characterised by few or occasional short-lived dusting events comprising high levels of dust deposition largely caused by particular, and possibly infrequent, combinations of wind and rainfall conditions. At other times dust deposition from the site itself may be low or insignificant, but a receptor is still likely to be subject to background and other dust sources. As such it will be important to be able to differentiate dust from multiple sources (and therefore a need to monitor for direction, colour and possibly mineralogy) and to correlate this with site specific meteorological data.

13.2.5.1 Monitoring methods

Dust monitoring will be conducted for both health and nuisance purposes. The different monitoring methods can be divided into two categories - ***active systems*** and ***passive systems***. The nature of the two types of systems mean that active systems are more suited to measuring over minutes, hours and days whereas passive systems are best suited for measuring over days weeks and months.

13.2.5.2 Objective

To assess the potential for dust nuisance effects.

13.2.5.3 Practical considerations

After the baseline is established, consideration will be given to the location and number of monitoring stations, the duration and frequency of monitoring and the choice of monitoring gauge.

Once the appropriate number of monitoring stations has been chosen, and the general locations selected, attention will be given to specific installation details, the need to prevent interfering sources, accessibility, vandalism and accidental damage.

13.2.6 Workplace Noise

All equipment (including that of contractors) will be subject to a routine maintenance programme to ensure it is in good working order and to minimise noise levels.

Occupational noise levels that exceed 85dB are hazardous to employee hearing over prolonged periods of time. Therefore, KSL will adopt the international standard of 85 decibels (dB) for exposure of its employees to noise over a 12-hour shift. Employees will wear approved ear protection equipment in workplaces where noise levels exceed 85 dB.

HSE personnel will monitor the use of ear protection equipment. Quarterly assessments will then be conducted to monitor occupational noise exposure.

13.2.7 Meteorological Monitoring

Meteorological monitoring will involve the recording of climatic conditions at project site including rainfall, evaporation rates and wind information. Variables to be monitored include wind direction and speed, rainfall, humidity, temperature, barometric pressure, rainfall data, solar radiation and evapo-transpiration, time and date of highs/lows.

13.2.8 Erosion and sediment control monitoring

Erosion and sediment loss will be monitored using several methods such as:

- Visual assessment of erosion as a preventative measure carried out on a routine basis, which will provide rapid evidence of where control measures need repair or implementation;
- Inspection of surface run-off control structures;
- Sampling and analysis of run-off water quality before and after discharge to receiving waters

13.2.9 Biodiversity monitoring

The objectives of biodiversity monitoring will be:

- To make an inventory of terrestrial and aquatic species and habitats present in the project area as well as noting their mutual relationships.
- To re-vegetate sites whose vegetation has been removed or damaged due to project activities.
- To identify cause-and-effect relationships and changes in the biological community.
- To monitor the use of timber and to ensure that it is harvested sustainably at its source.

KSL will continue to systematically collect all the plants in the area and develop a complete record of the ecological and plant diversity of the area.

The following aspects will be monitored:

Table 13-3: Monitoring biodiversity changes

Aspect to be monitored	Monitoring Objectives	Frequency
Biodiversity changes	To monitor changes in biodiversity abundance and density • Amphibian diversity and conservation • Insect diversity and conservation • Avifauna diversity and conservation • Mammal diversity and conservation • Reptile diversity and conservation	Yearly
Species loss and/ extinction	To monitor species abundance and diversity especially for rare or endangered species. • Loss of ecosystem services such as forest products (fruits, mushrooms, caterpillars, and other forest products), protection of water resources, soils formation and protection, pollution breakdown and absorption, maintenance of ecosystems, and cultural values.	Yearly
Habitat degradation/ loss	To monitor habitat degradation / loss	Yearly
Habitat improvement/ creation	To monitor habitat improvement /creation	Yearly
Species introduction	To monitor introduction of alien species in the environment	Yearly
Progressive Site Rehabilitation	To monitor the re-vegetation programme in the cleared areas and mine operational areas • Erosion control species planted • Native plant colonization • Reintroduction of native species	Yearly
Plant diversity and conservation	• Plant species richness • Plants of special conservation concern	Yearly

14 CONCLUSION AND RECOMMENDATIONS

The environmental assessment has given rise to the main issues that will need to be considered in the drafting of the EIA report.

The main issues relate to:

- Land use impact
- Influx of the people to the area
- Increase in traffic in Luena
- Impact of fertilizers and agrochemicals on human health, water and biodiversity
- Management of surface runoff
- Impact of HIV/AIDS amongst the workforce and the surrounding areas
- Replenishment of soil nutrients

KSL has developed management measures for addressing the significant environmental and social impacts. Management plans have also been developed to address social and cultural impacts arising from the establishment and operation of the proposed project. The specific objectives will be to:

- To promote Corporate Citizenship and integrate these values into all project operations;
- To minimize negative consequences and optimize opportunities from planning stage through to decommissioning and closure;
- To promote co-operation between the company and stakeholders; and
- To explain the Company's policies on environmental issues to the community and wider public, via public consultation and other avenues.

In line with the mitigation measures proposed and the associated management plans, not forgetting the improvement in livelihoods among the communities, the impact on the national economy, KSL thus proposes that the project be considered for approval.

15 DECLARATION OF AUTHENTICITY OF REPORT CONTENTS

We certify that this Scoping Report for the proposed Sugar Plantation development project by Kawambwa Sugar Limited was prepared consistent with the level of effort involved based on the information available at the time of preparation and the data supplied by outside sources. This scoping report conforms to the requirements of the Environmental Impact Assessment Regulations, SI 28 of 1997 with regard to the development of Environmental and Social Management Plans.

Danny Mwango

16 REFERENCES

- Cornland D. W et al, 2001, Sugarcane Resources for Sustainable Development: A Case Study in Luena, Zambia, Stockholm Environment Institute
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- WWF, Sugar and the Environment - Encouraging Better Management Practices in sugar production