Environmental and Social Impact Assessment (ESIA) Study Report for the Proposed Grain Storage Silos on Plot L.R. No. MSA/Block/I/371, Shimanzi area, Mombasa County.

Proponent	Firm of Experts
Kilindini Warehouses Limited, P.O. BOX 8985-80100, MOMBASA.	Envasses Environmental Consultants Limited, Ralli House, P.O. Box 2013-80100, MOMBASA.

Version: Final Report
Date: 18th June, 2020

CERTIFICATION

Certification by Lead Experts

We hereby certify that this Environmental and Social Impact Assessment (ESIA) Study Report has been done under our supervision and that the assessment criteria, methodology and content reporting conform to the requirements of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.

Signed: _____ _____

Names: **Mr. Simon Nzuki** (1350) **Ms. Jane Gitau** (2015)

Contact details

Envasses Environmental Consultants Limited,
P.O. Box 2013-80100, Mombasa &
P.O Box 42259-00100, Nairobi.
Tel: +254 722 347 155
Email: info@envasses.org

Certification by Proponent

We, **Kilindini Warehouses Limited,** confirm that this Environmental and Social Impact Assessment (ESIA) Study Report has been submitted to NEMA with our authority as the project proponent.

Signed for and on behalf of **Kilindini Warehouses Limited**

Name: _____ Signature: _____

Date: _____

Proponent Contact Details

Kilindini Warehouses Limited,
P.O. Box 8985-80100,
Mombasa.

Official Rubberstamp or Seal

ACKNOWLEDGEMENTS

The preparation of this ESIA study report was made possible by a collaborative effort involving the proponent, the consultants and project stakeholders. We acknowledge the proponent who provided project documentation, coordinated site visits and provided the financial resources required by the consultants to undertake the ESIA process. To this end we acknowledge the assistance accorded to the EIA team by Mr. Bakari Mwanzai.

Sampling and analysis of environmental media which included water, noise and air was undertaken by Polucon Services (K) Limited. The consultants are grateful for their invaluable input in the preparation of the ESIA study report.

The staff of Envasses Environmental Consultants assisted the consultants in data and information collection, interpretation and analysis, preparing the proceedings of the consultative meeting and the printing of the final report. In this regard, we acknowledge the input of Ms. Gladys Kasichana and Ms. Rhoda Mutua.

EXECUTIVE SUMMARY

Global food production has reached a record high in recent years. However, as a result of post-harvest food loss, one third of all food produced for human consumption is lost or wasted leading to food insecurity for millions of families across the world. Food losses happen at every stage of the supply chain, as commodities become damaged, spoiled or lost while harvested, handled, processed, stored and transported. These losses are most significant in developing countries. With the ever-increasing need for storage facilities by the World Food Programme (WFP) and shortage of the same, the proponent Kilindini Warehouses Limited proposes to put up grain storage silos on Plot L.R. No. MSA/Block/I/371, Shimanzi area, Mombasa County to address this shortage. Processing and manufacturing industries including bulk grain processing and storage plants are listed as high-risk projects under the Second Schedule (9j) of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. Pursuant to Section 58 of the Act, all high-risk projects listed under the Second Schedule should undergo an Environmental and Social Impact Assessment (ESIA) Study process. Hence, the proponent contracted Envasses Environmental Consultants Limited which is a Firm of Experts Licensed by NEMA to prepare an ESIA Study Report for the proposal. The study report will provide a baseline of the environmental and social conditions of the proposed project area to enable future monitoring of the environmental performance of the proposed project.

The methods adopted for preparing the ESIA study report were guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. Site visits were undertaken in March 2020 for purposes of area reconnaissance, assessing the baseline and environmental risks associated with the proposed project as well as the applicable environmental safeguards and standards. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. As per this Schedule the issues considered by the experts included; ecological and socio-economic issues, landscape changes, land use character and water. Data collection methods included literature review of relevant documents, observations during site visits and photography. The stakeholder engagement process was deterred by the ongoing COVID-19 pandemic that has resulted in a ban of all public gatherings by the Government of Kenya. Alternatives to this will be sought if the situation persists. Baseline Environmental media quality was measured through analysis of water, air and noise in collaboration with a National Environment Management Authority (NEMA) designated laboratory, Polucon Services (K) Limited.

The findings of the ESIA demonstrate that the project is expected to have both positive and negative impacts on the environment. The positive impacts include contribution towards realization of the Kenya Big Four Agenda and the second Sustainable Development Goal which focuses on achieving food security and improved nutrition, increased grain handling capacity, preventing post-harvest losses, earning the proponent income and creating employment opportunities to the local youth thus improving the local economy. Alongside the positive impacts, several environmental and social impacts will arise at different phases of the project cycle. At construction phase, the main potential environmental issues will include sourcing of raw materials from the environment, solid waste generation, water demand and effluent generation, air and noise pollution, occupational safety and health risks and traffic congestion.

The construction of the proposed grain storage silos will require raw materials including building blocks, sand, aggregates, steel, cement, timber, paint etc. The enormous consumption rate of nearly two billion metric tons per year poses a major environmental challenge because of the limited supply of natural resources on hand. The extraction and use of natural resources has significant potential impact on the environment. According to a report on the global environmental impact analysis of the extraction and production of metals plus building materials such as concrete, sand and gravel there are significant impacts in areas like acidification, air and water pollution, climate change, energy demand, human health and

toxicity of water and land. The extraction and burning of fossil fuels and the production of iron, steel and building materials are already major contributors to air pollution and greenhouse gas emissions. The proponent should thus source raw materials from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya and have a procurement plan based on the Bill of Quantities prepared by a Quantity surveyor to avoid potential oversupply of materials and wastage.

The preparatory and construction activities will generate substantial quantities of solid wastes in form of biomass, overburden, domestic waste such as plastic containers and construction materials such as wood and metal cuttings among others which will need to be disposed off appropriately. The proponent should procure and strategically place adequate solid waste collection bins with a capacity for segregation within the site, procure a sizeable central solid waste collection bin with chambers to accommodate separated waste, contract a NEMA licensed waste handler to dispose off the solid waste and ensure compliance with provisions of the Environmental Management and Coordination (Waste Management) Regulations, 2006.

At construction phase, water will be required for drinking, concrete mixing, cleaning, curing of concrete works, dust management and sanitation purposes resulting in an increased demand for water. Water for construction purposes will be sourced an existing borehole. Based on a projected workforce of 100 people and the Population Equivalent (PE) which denotes that one-person resident is expected to produce 150 litres of effluent daily, approximately 15,000 litres of effluent will be generated daily. The workers will utilize the existing sanitary facilities. The facility within which the current proposal will be set uses a system of septic tanks and soak pits to manage its effluent. The proponent should sensitize the workforce on the need to conserve the available water resources, procure and install a bio digester in place of the septic tank-soak pit system and comply with the provisions of the Environmental Management and Coordination (Water Quality) Regulations, 2006.

Both air and noise pollution are inevitable during construction activities. Air pollution will be as a result of dust generated during excavation activities and exhaust fumes from Heavy Commercial Vehicles (HCVs) delivering raw materials to the site. Air pollution has health implications on the workers, visitors to the site and the neighbouring community as it causes respiratory diseases and is a visual irritant. On the other hand, noise pollution will emanate from machinery operations and vehicles delivering materials to the site. The noise levels produced may be above the stipulated Environmental Management and Coordination Act (EMCA) limits and are a health hazard. The proposed mitigation measures include installing appropriate and adequate dust screens around the project site, sprinkling water at the working areas to suppress dust and providing Personal Protective Equipment (PPE) to the workers and visitors to the site. Additionally, the proponent should comply with provisions of the Environmental Management and Coordination (Air quality) Regulations, 2014, the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009, and the Occupational Safety and Health Act, 2007.

Machinery operations, use of construction tools and the actual construction activities are likely to expose the workforce, visitors and the neighbors to health and safety risks such as falling objects, moving machinery or even falls. Additionally, air and noise pollution may also pose safety and health risks to workers, visitors to the site and the neighbors. As a result, the above could cause adverse human health or loss of life. The proponent should register the site as a work place with the Directorate of Occupational Safety and Health Services (DOSHS), provide adequate and appropriate Personnel Protective Equipment (PPE) to all workers and enforce on their use, provide a fully equipped first aid box and trained personnel on site at all times during construction and comply with the provisions of the Occupational Safety and Health Act, 2007.

At operational phase, the main environmental concerns include quality assurance, potential health hazards, grain entrapment/engulfment risks, silo gas formation, air and noise pollution, fire outbreaks and explosions, aflatoxicosis, pest infestation water demand and effluent generation, solid waste generation and energy demand.

The liberalization of trade in Kenya has resulted in substandard commodities flooding the Kenyan market including bulk grains. The Government of Kenya through the Kenya Bureau of Standards and the East African standards harmonization process have established quality standards through a mandatory grain grading system for the purpose of trade within the East African community. To ensure quality of the grains to be stored the proponent should comply with requirements of the relevant Kenya Standard(s) or other standards approved by KEBS.

Agriculture continues to hit the headlines regarding work-based accidents and grain storage silos are a place where there are many risks. Working at height, slips and trips, lone working, entrapment, entanglement in grain moving machinery, risks of poisoning and suffocation from inhaling vapors generated in the silos, risk of intoxication due to the use of fumigants and pesticides and electrocution are just a handful that need to be mitigated. The proponent should thus develop and implement a safety and health policy, have in place an effective emergency response plan, provide adequate and appropriate PPE to workers and enforce on their use and display signage warning of potential hazards at various sections of the silos. Additionally, the proponent should conduct first aid training among the workers and ensure compliance with the provisions of the Occupational Safety and Health Act, 2007.

Grain entrapment/engulfment may occur when workers enter the silos to check on condition of grain or to address problems with grain flow due to spoiled grain or equipment malfunction. As unloading conveyors or augers remove grain through the bottom outlet, a funnel-shaped flow develops on the surface of the grain. Anyone standing on the surface while grain is being removed from below is at risk of being rapidly pulled down toward the outlet in the column of flowing grain. To mitigate such risks, the proponent should target on zero entry into the silos, restrict access to the silos only to authorized personnel, display signage warning of potential engulfment at all entry points to silos and sensitize workers on grain storage hazards and risks involved with entering the silos.

Grain storage structures can develop potentially hazardous atmospheres due to gases produced from fermenting grains. Fermenting or molding grain produce carbon dioxide (CO_2), nitric oxide (NO), and also compounds known to be respiratory irritants such as nitrogen dioxide (NO_2) and nitrogen tetroxide (N_2O_4). While low NO_2 concentrations can cause coughing, labored breathing, and nausea, high concentrations can cause fluid to fill the lungs, which can result in death. The proponent should thus provide good ventilation in and around the silos, sensitize workers to stay out of the silo during the first 2-3 days after filling, provide workers with self-contained breathing apparatus (SCBA) and trained on their use and sensitize workers to ensure that the power supply for all unloading mechanisms are locked out and tagged out of service prior to entering any silo.

The main source of air pollution at operation will emanate from odors from fermenting grains. These odors can become a nuisance, causing temporary symptoms such as headache and nausea but can be lethal when emitted in excess. Fumigants used in pest control and fine grain dust stirred up from the cleaning process are also potential sources of air pollution which have been associated with respiratory ailments. On the other hand, noise pollution will be as a result of operation of the mechanical equipment such as augers, shafts and loading or unloading belts as well as from vehicular movement in and out of the facility. Noise above the stipulated EMCA, OSH and WHO limits are a health hazard. The proposed mitigation measures include provision of adequate and appropriate PPE to workers and enforce on their use, ensuring good ventilation in and around the silos, developing and implementing a dust management program

with instructions to reduce accumulations on ledges, floors, equipment and other exposed surfaces and ensuring compliance with the Environmental Management and Coordination (Air quality) Regulations, 2014, the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

There have been many cases of silos and the associated ducts and buildings exploding. If the air inside becomes laden with finely granulated particles, such as grain dust, a spark can trigger an explosion powerful enough to blow a silo and adjacent buildings apart, usually setting the adjacent grain and building on fire. Overheating and mechanical failure of unloading or loading belts and other mechanical equipment and electrical failure can also cause fire outbreaks. To mitigate against fire risks, the proponent should develop and implement a fire and emergency response plan, procure and provide adequate firefighting equipment and ensure they are serviced quarterly by fire service providers, designate a fire assembly point within the facility and install fire and emergency exits at appropriate locations within the silos.

The dominant insect pests that attack stored grain are the larger grain borer (LGB), *Prostephanus viiruncates* and the maize weevil *Sitophilus zeamais* leading to a total storage weight loss of up to 50%. Cracks, fractures and dark corners in silos can all be conducive for pest infestations. Additionally, the moisture content and temperature in a silos is a contributing factor to insect and pest infestation. Insect and pest infested grains fetch lower prices in the market due to deterioration in quality. To ensure that the grain stored are free from insects and pests, the proponent should develop and implement a pest and insect management plan in collaboration with commercial pest control professionals, schedule thorough clean empty bins, subfloors, aeration ducts, elevators and augers, weatherproof grain storage bins, repair and seal cracks or holes and treat with residual insecticides. Additionally, the proponent should adhere to acceptable grain moisture content and temperature levels at storage and use grain protectants prior to storage.

Water will be required for domestic use in drinking, sanitation and general cleaning. This will exert marginal increase in demand for water estimated at 600litres per day. Water for use in sanitation and general cleaning during this phase will be sourced from an existing borehole whereas water for drinking will be supplied by water vendors. Sanitation facilities will generate seventy percent (70%) of water consumed as effluent which will be managed through the proposed bio digester. The recommended mitigation measures include sensitizing the staff on the need to conserve the available water and compliance with the provisions of the Environmental Management and Coordination (Water Quality) Regulations, 2006.

Solid waste generated will be inform of screenings which are by products of grain cleaning activities and domestic waste such as grain bags, plastics, wrappings, cartons and paper among others. The proponent should thus provide adequate waste collection bins at appropriate sections within the facility, contract a NEMA licensed waste handler to dispose off the waste and comply with the provisions of Environmental Management and Coordination (Waste Management) Regulations, 2006. Energy will be required to power unloading or loading belts, pulleys, shafts among others and lighting. The facility will source its power from the National Grid supplemented by a diesel-powered generator. The recommended mitigation measures include sensitizing the workers to switch off lights when not in use, harnessing solar energy and ensuring regular servicing and maintenance of electrical appliances.

A decommissioning phase is possible in the event of end of project life, closure by government agencies due to non-compliance with environmental and health regulations, an order by a court of law due to non-compliance with existing regulations, natural calamities or change of user of land. Key environmental and social concerns at this phase will be economic decline, demolition waste and safety and health risks. To address these, the proponent will prepare and

submit a due diligence decommissioning audit report to NEMA for approval at least three (3) months in advance.

The proposed project is considered important and beneficial to the economy as it will contribute towards realization of the Kenya Big Four Agenda and the second Sustainable Development Goal which focuses on achieving food security and improved nutrition, preventing post-harvest losses, earn the proponent income and create employment opportunities to the local youth thus improving the local economy. Despite the environmental concerns expected to arise at all phases of the project cycle, the ESIA team has recommended mitigation measures, environmental management plans for all phases of the project cycle and monitoring plans that will address the potential environmental and social impacts.

It is on this basis that we recommend that the project be allowed to proceed alongside conditions which will ensure compliance with the provisions of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMNS

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CO_2	Carbon Dioxide
DOSHS	Directorate of Occupational Safety and Health Services
EA	Environmnetal Audit
EDL	Effluent Discharge License
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
FNSP	Food and Nutrition Security Policy
HCVs	Heavy Commercial Vehicles
ISO	International Standard Organization
ITCZ	Inter-Tropical Convergence Zone
KEBS	Kenya Bureau of Standards
KEPHIS	Kenya Plant Health Inspectorate Services
KPH	Kilometer Per Hour
KS	Kenya Standards
MoH	Ministry of Health
MWSSCL	Mombasa Water Supply and Sanitation Company Limited
NCA	National Construction Authority
NEMA	National Environmental Management Authority
NO	Nitric oxide
NO_2	Nitrogen Dioxide
N_2O_4	Nitrogen Tetroxide
OSHA	Occupational Safety and Healthy Act
PPE	Personal Protective Equipment
SCBA	Self Contained Breathing Apparatus
SDGs	Sustainable Development Goals
TBD	To Be Determined
TORs	Terms of Reference
WFP	World Food Programme
WHO	World Health Organization
WRA	Water Resources Authority
WSBs	Water Service Boards
WSPs	Water Service Providers
WSRB	Water Services Regulatory Board

1 PROJECT BACKGROUND INFORMATION

1.1 Introduction

Global food production has reached a record high in recent years. However, as a result of post-harvest food loss, one third of all food produced for human consumption is lost or wasted leading to food insecurity for millions of families across the world. Food losses happen at every stage of the supply chain, as commodities become damaged, spoiled or lost while harvested, handled, processed, stored and transported. These losses are most significant in developing countries. With the ever-increasing need for storage facilities by the World Food Programme (WFP)and shortage of the same, the proponent Kilindini Warehouses Limited proposes to put up grain storage silos on Plot L.R. No. MSA/Block/I/371, Shimanzi area, Mombasa County to address this shortage.

Processing and manufacturing industries including bulk grain processing and storage plants are listed as high-risk projects under the Second Schedule (9j) of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. Pursuant to Section 58 of the Act, all high-risk projects listed under the Second Schedule should undergo an Environmental and Social Impact Assessment (ESIA) Study process. Hence, the proponent contracted Envasses Environmental Consultants Limited which is a Firm of Experts Licensed by NEMA to prepare an ESIA Study Report for the proposal. The study report will provide a baseline of the environmental and social conditions of the proposed project area to enable future monitoring of the environmental performance of the proposed project.

1.2 Project location

The proposed project will be located in Shimazi area, Mombasa County at **Latitude 4°03'19.57"S and Longitude 39°39'08.03"E** (Figure 1). The project site (Figure 2) lies within the Kilindini Warehouses facility which provides warehousing facilities for WFP (Figure 3). It neighbors Kilindini Harbour to the North West, Grain Bulk Handlers to the West (Figure 4), Manji Food Industries to the East and Grain Industries Limited to the North East. The land use of the area is industrial.

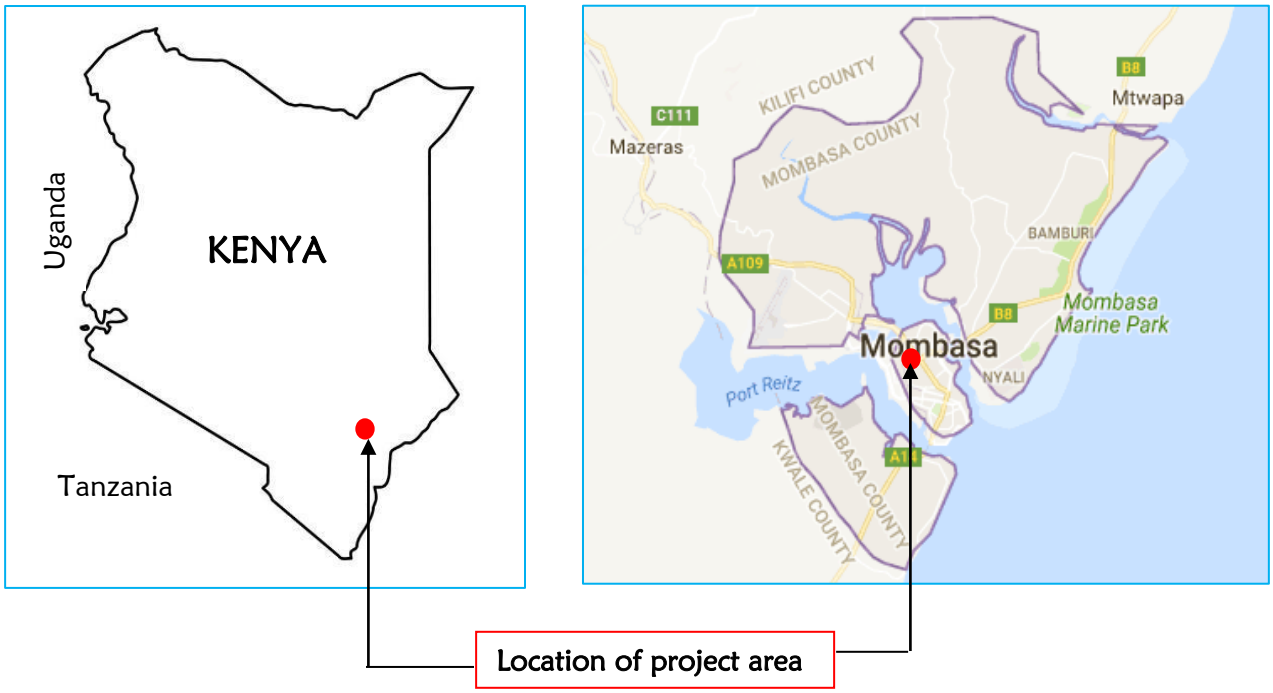

Figure 1: The location of the proposed project area (Source: Google Earth accessed on March 2020).

Figure 3: A section of the proposed project site (Source: Site visit, March 2020).

Figure 2: A section of the facility showing the existing warehouses (Source: Site visit, March 2020).

Figure 4: Grain Bulk Handlers Limited silos neighbouring the proposed project site (Source: Site visit, March 2020).

1.3 Project description and activities

The proposed project will involve construction of a total of 18 grain storage silos with mechanical unloaders and overhead conveyors. Of these, 12 silos will have a capacity to hold 5000 tons of grain each whereas the other will have a capacity of 1170 tons each. At full capacity, the total amount of grain to be stored will be 67020 tons. Auxiliary facilities to support these silos will include a weighbridge, truck parking area, electric and control room and water tanks. The total built up area for the proposal will be 6589M^2.

1.3.1 Equipment and components of silos

1. Receiver system
2. Conveyor system
3. Cleaning system
4. Drying system
5. Aeration system
6. Silo safety systems
7. Bagging station

1.3.2 Working principle

Special equipment is used to facilitate accurate weighing, sampling and testing of grain before transfer to silos for storage.

Receiver system- The silos will have a high capacity receiver system (grain receiver hoppers) needed for efficient transfer of grain from trucks, or tractors and trailers. Ideally, it should be possible to deposit a trailer load and pull away from the unloading area within minutes. An in ground receiver

hopper is typically fitted with a screw conveyor, or auger, to raise grain for conditioning or storage.

Conveyor system- The grain is then conveyed from the receiver grid to a bucket elevator, with gravity fall to a horizontal conveyor for transport to the silo of choice. The height of the bucket elevator is reduced by using a horizontal silo loading conveyor. Bucket elevators are used mainly to lift grain vertically to silos. These usually deliver the grain directly into silos using diverters that direct grain into a gravity chute to the selected silo, or by using belted conveyors to transfer grain horizontally to the various silos. A flat belt between crowned pulleys at the top and bottom of the casing has small buckets attached at regular intervals to carry the grain from the elevator bottom to the top. The capacity depends on the volume of the buckets, the spacing and the speed of the belt. Auger elevators are one of the cheapest methods of elevating grain and can be fixed or portable. These are available in a wide range of lengths and capacities and are usually powered by an electric motor. They are comparatively light in weight, dependable in operation and popular due to good portability. Long augers may be mounted on wheels for easy transport. The angle of operation is adjustable, but the capacity declines as the auger is raised. High moisture content in grain also reduces the capacity of the auger.

Cleaning system- Foreign materials and dust must be removed to eliminate problems further down the grain storage and handling system. A grain conditioner, or scalper will remove foreign particles, weed seeds, small size grain, straw and husk. A dust extraction and collection system will prevent dust entering the environment. All foreign metal objects must be detected and removed before they can cause damage.

Drying system- It comprises several components, namely the dryer itself, the control system, the fuel system, handling equipment to empty and fill the dryer, and also sufficient grain holding capacity for wet grain. This ensures that the grain stored has the required moisture content to avoid rot.

Aeration- This is the movement of small amounts of air through a stored grain mass to prevent deterioration of the grain due to fungi and insects. Aeration keeps the grain at a uniform cool temperature and also removes small amounts of moisture from the grain. Higher, uneven temperatures cause moisture movement and condensation within the stored grain that stimulates fungal growth and insects. Neither fungi nor insects, however, will thrive at the lower temperatures.

Automation systems and controls- These are key elements in the overall distribution system. The automation system is governed by the overall facility design and operational requirements. Each individually controlled device can be linked into a main control panel enabling coordination of the controls between various pieces of equipment. Silos support monitoring equipment are used to track both the temperature and quality of the grains,

1.4 ESIA study approach and methodology

1.4.1 Introduction

The methods adopted for preparing the ESIA Study Report were guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. The consultants prepared a scoping report and Terms of Reference (TORs) as required under Regulation 11 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 and submitted them to NEMA for consideration for approval. The scoping report and TORs were approved on 20th March, 2020 and the consultants began preparation of the ESIA Study Report.

1.4.2 Data collection

The methods for carrying out the study included site visits and observations, literature review of relevant documents and baseline monitoring of environmental media (air, noise and water).

Site visits were undertaken in March 2020 for purposes of area reconnaissance, assessing the baseline environmental conditions of the proposed project site and screening of environmental risks associated with the proposed development as well as the applicable environmental safeguards and standards. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. As per this schedule, the issues considered by the experts included ecological impacts, socio-economic issues, landscape changes, land use character and water (Table 1).

Table 1: Summary of results of the screening criteria.

Criteria	Results
Ecological impacts	– Excavations will occur – No endangered species of trees and plants found at the site – There are indigenous tree species at the site
Social-economic considerations	– Contribution towards realization of the Kenya Big Four Agenda and the second Sustainable Development Goal – Prevention of post-harvest losses – It will help in preparation for disaster relief management by pre-purchasing and stocking grains so as to maximize the effectiveness of humanitarian aid supply chains – Income to the proponent – Employment creation – Revenue to the government through taxes & licenses
Landscape impacts	– The landscape of the area will not be altered and new views created
Land uses	– The proposed project is in line with the existing land use in the area
Water	– The construction and subsequent operations of the proposed project will increase water demand and impact on water resources

1.4.3 Baseline monitoring of environmental media

The proposed development will generate dust and noise pollution during the construction phase. In addition, there will be marginal increase in water demand and effluent generation during the construction and operational phases. For the purposes of obtaining the baseline environmental quality conditions for future monitoring of the environmental performance of the proposal, the consultants engaged Polucon Services (K) Limited, to sample and analyse environmental media which included air, noise and water quality as per the Environmental Management and Coordination Act Regulations. The methodology for sampling and analysis of the environmental media is discussed in the following sections.

1.4.3.1 Ambient air quality measurements

A Fixed-Point monitoring strategy was used to obtain baseline ambient air quality for the proposed project site which was conducted on 1st April, 2020. Air monitoring was conducted in two runs each 30 minutes and the averages for the measurements of Carbon Monoxide, Nitrogen dioxide, Sulfur dioxide and particulate matter (dust particles).

Sampling of gases was done by use of Aeroqual portable air monitors (Figure 5) which uses a mix of sensor technologies. Sampling for Carbon Monoxide, Nitrogen dioxide, Hydrogen sulphide, Sulfur dioxide was done using the gas sensitive electrochemical methods of active and continuous sampling. Particulate suspended matter was sampled using the laser particle sensors. The results interpretation and analysis as well as sampling duration information was used to calculate the gases concentrations.

Figure 5: A portable Seroquel series 500 used in obtaining baseline air quality measurements at the proposed project site.

1.4.3.2 Ambient noise level measurements

Ambient noise measurements were conducted on 1st April, 2020. Prior to recording the noise measurements, an inspection of the monitoring points and implicated activities of the area was undertaken, perimeter walls was identified and noise level meter calibrated. Noise levels were determined by the noise level meter (Figure 6), with an inbuilt, ⅓octave/octave band filter which does real time and octave analysis. The noise level meter was raised 2 meters above the ground and fitted with a ½" electrets condenser microphone with a measurement range of between 30 – 130dB and a frequency range and weighting of 25Hz – 10KHz and A, C & Z respectively. For all measurements taken to establish the ambient noise levels, the equivalent noise level (Laeq), the maximum sound level (Lmax) and the minimum sound level (Lmin) respectively during that measurement period was at one hour interval. Each individual measurement was taken simultaneously with the nature of the noise climate of the area. This involved an auditory observation and identification of noise incidents influencing the noise level meter readings by the surveyor.

Figure 6: Noise level meter TES 1358 C used in obtaining baseline noise levels at the proposed project site.

1.4.3.3 Water quality measurements

Baseline water quality measurements were carried out at the existing borehole within the project site. The water sample was analyzed for drinking water quality as stipulated under the First Schedule of Environmental Management and Coordination (Water Quality) Regulations, 2006.

1.5 Project budget

The total estimated cost of the proposed project is KES 50,000,000.

2 BASELINE CONDITIONS OF THE PROPOSED PROJECT SITE

2.1 Introduction

Baseline conditions of the proposed project site were assessed and documented for the purposes of determining the future impacts of the proposed project on the environment and livelihoods of the local community. The baseline survey was done through literature review, site visits and baseline environmental quality monitoring in collaboration with Polucon Services (K) Limited. This section details on the findings of the survey which will form a basis for impact monitoring plans and improvement of the environmental and social performance of the proposed project during implementation.

2.2 Site status

The proposed project site is currently undeveloped and is being used as a parking area for Kilindini Warehouses Limited. There are containers on site which are used as changing rooms and sheds for the workers. A section of the proposed site is cabro-paved and the other unpaved with grass patches concentrated along the boundary wall (Figure 7).

Figure 7: A section of the proposed project site (Source: site visit, March 2020).

2.3 Demographic characteristics

According to the 2019 population and housing census report, Mombasa County has a total population of 1.19 Million people, up from 1 Million people as per the 2009 census. The main factors attributed to the rapid population growth include increase in fertility rate and improved health services. Rural-urban migration and the continued influx of tourists and foreign investors have also contributed significantly to the growth. Migration from other counties has basically been triggered by employment opportunities in the maritime industry, tourism and the transport sector.

2.4 Topography and climatic conditions

Mombasa is a coastal lowland with extensive flat terrain rising gently 8m to 100m above sea level in the west. Mombasa is a tropical city which is warm most of the year. The climate of Mombasa is greatly influenced by the Migratory Inter-Tropical Convergence Zone (ITCZ) characterized by monsoon winds which create a bimodal rainfall pattern. The long rain season occurs from April to July and the short rains from October to December. The average annual rainfall for the area has been recorded as 1196mm.

Temperatures are fairly constant throughout the year ranging from 23°C to 28°C. The warmest temperatures are generally recorded during the months of November to April (mean daily temperature of 27°C) while slightly cooler temperatures are experienced from May to October (mean daily temperature of 24.5°C). The average annual evaporation rate within the project area is 2300mm and the climate is generally classified as semi to sub-humid as the ratio of rainfall to evaporation ranges from 57-68% (Figure 8).

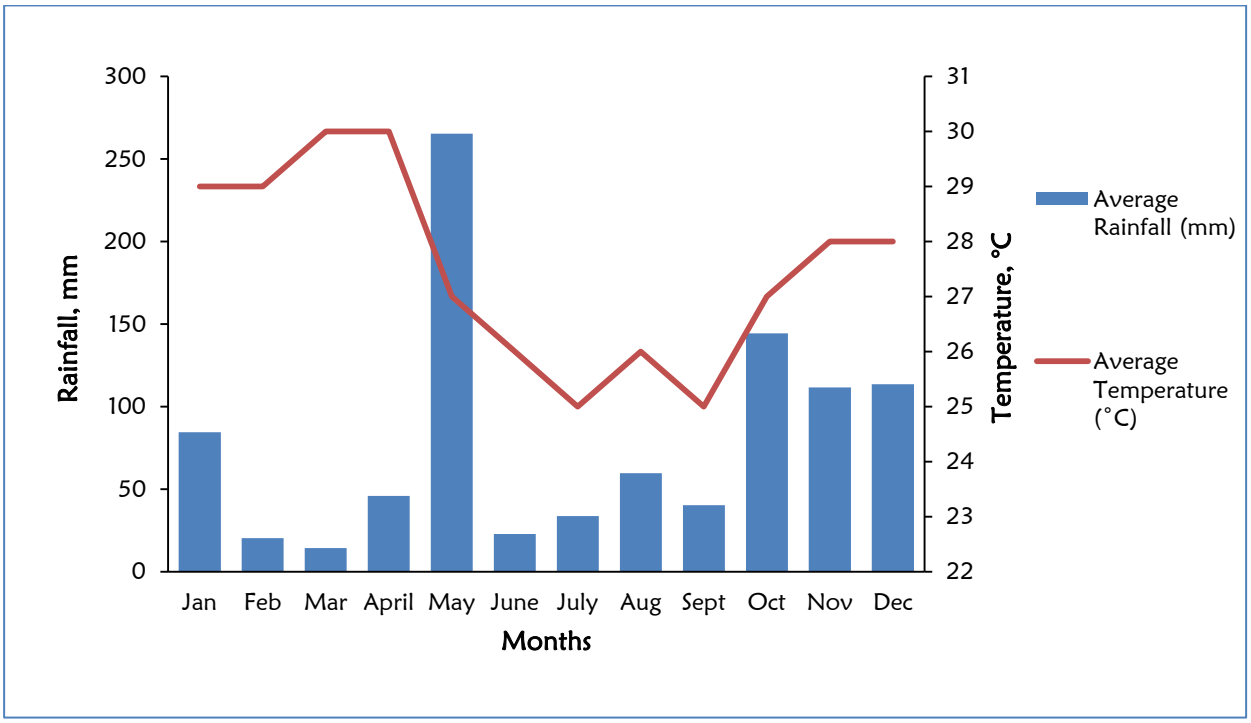

Figure 8: Annual rainfall and temperature distribution for Mombasa county in 2020 (Data Source: World Weather Online).

2.5 Biodiversity

The above climate dictates the type and species of trees as well as vegetation cover which occurs along the Kenyan Coast. The vegetation of the project site is comprised of grasses, shrubs and tree species which include the *Azadirachta indica* (Neem tree) and *Pycnanthus angolensis*. (Figure 9). Some of the planted tree species include palm trees. The fauna is comprised of doves and lizards.


Figure 9: *Pycnanthus angolensis* tree (left) and planted palm trees (right) at the proposed project site (Source: Site visit, March 2020).

2.6 Environmental quality

2.6.1 Water supply in Mombasa County

Kenya is a water stressed country with a low per capita annual freshwater endowment. Access to water and sanitation is low because of limited water resources development and ageing/dilapidated infrastructure. Access to water falls below the Sustainable Development Goal (SDG) targets of universal access. Despite increased investments and improvements in levels of access in the last 5 years, the rapid population increase, urbanization and economic growth strain the existing water resources and infrastructure and hinder efforts towards achieving the sector SDGs.

Water supply in Mombasa County is based mostly on bulk water supply systems deriving water from the Mzima springs, Marere springs and Tiwi Water Supply System through Kaya Bombo Reservoirs. Currently the water demand in the County is at 481,400m^3/day. The proposed grain storage silos will source its water from an existing borehole within the site.

2.6.2 Status of sanitation in Mombasa County

Mombasa has three sewerage treatment plants at Kipevu, Kizingo and Tudor. The Kipevu Sewage Treatment Plant is the largest with a capacity of 17,000m^3/day and serves the households, institutions, hotels and industries such as Kenya Pipeline Company, Kenya Petroleum Refinery Limited, Simba Apparel Export Processing Zone Limited among others in the West Mainland area. Kizingo sewage treatment plant has a capacity of 3,000m^3/day which serves the Mombasa Village Restaurant, Kenya Revenue Authority – Mombasa, Kenya Power Company, Central Police, Mombasa Golf Club, Royal Court Hotel, households in Old Town areas among other institutions within the Island. Tudor sewage treatment plant is a small sewerage scheme that was established to serve the Tudor Estate only.

Currently the sanitation infrastructure in Mombasa County is insufficient to meet the sanitation needs of the growing population and there is need for developing a sanitation system which is environmentally sustainable. Immediate sanitation measures have been developed such as rehabilitation of the existing sewerage system, construction of ablution blocks in public places and sludge handling facilities. The Final Wastewater Master Plan for Mombasa Island describes the development strategy for the long-term sanitation system comprising of a wastewater collection / conveyance system and the treatment / proper disposal of the treated effluent.

The rest of the County depends on privately constructed soak pits and pit latrines which have a potential to pollute water sources. There have been cases of housing estates, industrial establishments and hotels which empty their sewer into storm drains or discharge raw sewage directly into the sea and untreated industrial effluent discharged in the public sewer system. Households in Mombasa generate about 337,000m^3 wastewater per day and the County faces challenges in its disposal (Coast Water Services Board, 2012).

2.6.3 Solid waste management

Solid waste generation in Mombasa is estimated at 700metric tons per day (Envasses, 2009). The waste comprises of organic and inorganic forms. The main waste generation sources are domestic, commercial ventures, hotels, markets, industries and institutions including health facilities. The types of waste that are generated include: Plastic waste including papers and hard plastics, Organic materials including food remnants and wooden debris, rubber, paper, metals, chemicals, glass, biomedical waste.

Waste materials are collected from point sources or municipal dustbins in mixed form and transported to Mwakirunge dumpsite. All types of waste are transported to the site including hazardous types containing pesticides, heavy metals, oils, batteries, acids, domestic and hospital wastes. The distance to site (16km) from the Island, and the lack of adequate facilities for waste has created a waste management problem for Mombasa County including proliferation of illegal dumpsites and indiscriminate dumping at the existing transfer stations.

2.6.4 Energy

Most areas in Mombasa County are connected to the National Grid by Kenya Power. The facility currently uses electricity for lighting and powering machines. It also has a backup generator used during power outages (Figure 10).

Figure 10: A standby generator at Kilindini Warehouses Limited facility (Source: Site visit, March 2020).

2.6.5 Baseline air quality measurements

The gaseous and particulate matter parameters tested at Kilindini Warehouse Limited showed compliance with the Environmental Management and Coordination (Air Quality) Regulations, 2014. (Table 2).

Table 2: Baseline air quality measurements for the proposed project site (Source: Polucon Services (K) Limited, April 2020).

Location		CO mg/m³	NO_2 µg/m³	SO_2 µg/m³	$PM_{2.5}$ µg/m³	PM_{10} µg/m³
Kilindini Warehouses Limited	Run 1	0.25	12	16	38	56
	Run 2	0.31	8	14	48	64
Average		0.28	10	15	43	60
Mean		0.28	10	15	43	60
EMCA (Air Quality) Regulations, 2014		10 mg/m³	150 µg/m³	125 µg/m³	75 µg/m³	150 µg/m³

2.6.6 Baseline noise level measurements

Ambient noise levels at the time of monitoring were slightly higher than the stipulated standards under the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009. This was attributed to the movement of trucks within Kilindini Warehouses Limited and wind at the time of monitoring. However, the ambient noise levels complied with the WHO, World Bank and OSH standards (Table 3).

Table 3: Baseline Noise monitoring measurements for the proposed project site (Source: Polucon Services (K) Limited, April 2020).

Location	Measured Sound levels (dBA) Day time			EMCA Guidelines (Day time)	World Bank (Day time)	World Health Organization (Day time)	Occupational Safety and Health Exposure Limits
	Laeq	Lmax	Lmin	Laeq	Laeq	Laeq	Laeq
Kilindini Warehouses Limited	64.2	81.4	55.0	60	70	85	90
	68.1	87.1	75.9	60	70	85	90

2.6.7 Baseline water quality measurements

As discussed under methodology, water quality measurements results are based on samples obtained from the existing borehole within the project site. The results showed compliance with First Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006 (Table 4).

Table 4: Baseline water quality results of borehole water at the proposed project site (Source: Polucon Services (K) Limited, April 2020).

Test	Method	Results	EMCA Standards for domestic water
pH value	APHA Method 4500 H^+	7.29	6.5-8.5
Ammonia as NH3, mg/L	APHA Method 4500 NH_3	Nil	0.5 Max
Total suspended solids	APHA Method 2540D	<1.0	30 Max
Nitrate as NO_3^-. Mg/L	APHA Method 4500 NO_3^-	4.69	10 Max

*Cadmium as Cd, mg/L	APHA Method 3111B	<0.01	0.01 Max
Zinc as Zn, mg/L	APHA Method 3111B	0.04	1.50 Max
Escherichia coli, cfu/ml	APHA 9221 G	Absent	Nil
Phenols, mg/L	APHA Method 6420A	Nil	Nil
Copper as Cu, mg/L	APHA Method 3111B	<0.01	0.05 Max
*Lead as Pb, mg/L	APHA Method 3111B	<0.01	0.05 Max
Arsenic as As, mg/L	APHA Method 3500-As	<0.01	0.01 Max
Total dissolved solids, mg/L	APHA Method 2540C	580	1200 Max
Selenium as Se, mg/L	APHA Method 3500-Se	<0.01	0.01 Max
Fluoride as F, mg/L	APHA Method 4500 F-C	<1.0	1.50 Max
Nitrite as NO_2^-, mg/L	APHA Method 4500 NO_2^-	<0.003	3.0 Max
Permanganate Value, mg/L	APHA Method 5540C	0.02	1.0 Max

3 ENVIRONMENTAL IMPACTS IDENTIFICATION AND PROPOSED MITIGATION MEASURES

3.1 Overview

The proposed project will have both socio-economic benefits and attendant negative environmental and social impacts. The purpose of the ESIA process is to therefore systematically assess the value of the benefits against the environmental concerns and provide measures to avoid, prevent or reduce the magnitude of the impacts. The following section provides details on these impacts and proposed mitigation measures to address the identified negative environmental and social impacts. The mitigation measures are based on the underlying principle of EIA that everyone is entitled to a clean and healthy environment and a duty to enhance and safeguard the environment.

3.2 Positive impacts of the proposed grain storage silos

The project's direct benefits include but are not limited to the following;

1. **Contribute towards realization of the Kenya's Big Four Agenda and the second Sustainable Development Goal**

Grains constitute the basis for food security for the majority of population in Kenya and Africa at large. Significant volumes are however lost through post-harvest operations during storage. It is reported that 25-30 percent of cereals are lost during market storage according to the East African Grain Council. Silos ensure maximum protection of stored grains thus contribute towards realization of the Kenya Big Four Agenda and the second Sustainable Development Goal – Food Security and Nutrition through increasing food availability.

2. **Prevention of post-harvest losses**

One third of all food produced for human consumption is lost or wasted, equivalent to 1.3 billion tons due to post-harvest food loss leading to food insecurity for millions of families across the world. Achieving zero hunger by 2030 will require that no more food is lost or wasted. By preventing post-harvest losses in food systems, we can increase the availability of food worldwide without requiring additional resources or placing additional burden on the environment. Major food losses happen during storage. Silos present an improved post-harvest handling and storage method that helps in guarding grains against insects, rodents, mould and moisture. They also help reduce losses from spillage and pilferage.

3. **Increased grain handling capacity**

The bulk grain storage facility will enable rapid offloading of cargo ships translating to improved ship turn-around time. This will lower freight and handling costs for WFP and other clients. Rapid clearance and transfer of the bulk grains from the Port of Mombasa to the grain storage silos will also crucially reduce the potential for congestion at the Port.

4. **Price control**

In Kenya, smallholder farmers regularly lose 40 percent of their harvest due to inadequate storage. Consequently, many farmers sell their produce immediately after harvest at a time when prices are low due to high supply. The construction of silos will enable clients to hold on to their produce until prices rise during the lean season thus increasing their income threefold.

5. **Quality storage facility**

Grain silos provide protection from the elements such as moisture thus increase the storage life of the grains. Hermetically sealed metal silos kill storage pests by oxygen deprivation without pesticides and thus products are stored in optimal conditions.

6. Large storage capacity

The proposed silos will provide a large storage space for the grains. It is envisaged that the silos will store up to 67,020 tons of grain. The proponent will need less area to store the same amount of grains than if it were stored in a horizontal warehouse.

7. Increase inventory accuracy

The proposed silos will ensure that products are centrally stored and distributed efficiently and increase inventory accuracy.

8. Provision of employment opportunities

The proposed project will provide employment opportunities to both skilled and non-skilled personnel throughout its life cycle. Already the proponent has employed various consultants to develop the building plans and preparation of the ESIA study report. This will in turn improve the living standards of the local population and the immediate environs.

9. Income to the proponent

The proponent, Kilindini Warehouses Limited will benefit from the proposed project from provision of storage facilities through the charges levied on services to clients.

10. Revenue to the government

The facility will generate revenue to the government in form of taxes levied on goods and /services undertaken by the facility.

3.3 Negative impacts of the proposed project

Alongside the positive impacts, the proposed project is expected to result in a number of negative environmental and social impacts at different phases of the project cycle. These impacts will have to be mitigated appropriately so as to ensure environmental sustainability and the safety and health of all stakeholders.

3.4 Negative impacts of the proposed grain storage silos

Alongside the positive impacts, the proposed project is expected to result in a number of negative environmental and social impacts at different phases of the project cycle. These impacts will have to be mitigated appropriately so as to ensure environmental sustainability and the safety and health of all stakeholders.

3.5 Negative impacts at the construction phase of the proposed development

3.5.1 Environmental risks of obtaining raw materials

The construction of the proposed grain storage silos will require raw materials including building blocks, sand, aggregates, steel, cement, timber, paint etc. The construction industry accounts for a vast majority of the raw materials consumed in Kenya. This enormous consumption rate, nearly two billion metric tons per year, poses a major environmental challenge because of the limited supply of natural resources on hand. The extraction and use of natural resources has significant potential impact on the environment. Non-metallic minerals such as sand, gravel, limestone and crushed rock account for more than half of total materials consumed today. These volumes are expected to grow exponentially by 2060.

A report on the global environmental impact analysis of the extraction and production of metals such as iron, aluminium, copper, zinc, lead and nickel plus building materials concrete, sand and gravel shows significant impacts in areas like acidification, air and water pollution, climate change, energy demand, human health and toxicity of water and land. Within this group of metals and minerals iron, steel and concrete have the highest absolute impacts due to the large volumes used.

The extraction and burning of fossil fuels and the production of iron, steel and building materials are already major contributors to air pollution and greenhouse gas emissions.

Recommended mitigation measures

1. Source raw materials from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya
2. Have a procurement plan based on the Bill of Quantities prepared by a Quantity surveyor to avoid potential oversupply of materials and wastage
3. Sensitize personnel on wastage of construction materials. Remnants should be collected and recycled as much as practical

3.5.2 Solid waste generation

The solid waste generated at construction phase will be in form of biomass, overburden, construction materials such as wood and metal cuttings and domestic waste. During construction works which entail pile driving for silo bins foundation works, about 100 workers may work at a time. If per capita waste generation is 300 gm per day, the quantity of domestic solid waste will be 30 Kg in a day. These will need to be disposed off appropriately as poor solid waste disposal can create breeding grounds for disease causing pathogens.

Recommended mitigation measures

1. Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the construction site
2. Sensitize construction workers on the process of solid waste collection, segregation and proper disposal
3. Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste
4. Recycle and reuse materials as far as practical
5. Contract a NEMA licensed waste handler to dispose off the solid waste
6. Comply with the provisions of the Environmental Management and Coordination (Waste Management) Regulations, 2006

3.5.3 Water demand and effluent generation

At construction and installation phase, water will be required for drinking, concrete mixing, cleaning, curing of concrete works, dust management and sanitation purposes resulting in an increased demand for water. Water for construction purposes will be sourced an existing borehole. Based on a projected workforce of 100 people and the Population Equivalent (PE) which denotes that one-person resident is expected to produce 150 litres of effluent daily, approximately 15,000 litres of effluent will be generated daily. The workers will utilize the existing sanitary facilities. The facility within which the current proposal will be set uses a system of septic tanks and soak pits to manage its effluent.

Recommended mitigation measures

1. Sensitize the workforce on the need to conserve the available water resources
2. Monitor the amount of water being abstracted from the borehole
3. Procure and install a bio digester to manage the effluent in place of the septic tank-soak pit system
4. Comply with the provisions of the Environmental Management and Coordination (Water Quality) Regulations, 2006

3.5.4 Air pollution

Air pollution will be as a result of dust generated during excavations, concrete mixing activities and exhaust fumes from heavy commercial vehicles accessing the site. The vehicle exhausts are known to contain Sulphur Dioxide, Carbon Monoxide and hydrocarbons and together with dust generated constitute major pollutants which can affect air quality. The most relevant pollutant considered is particulate matter because of its potentially significant increase during the construction phase. Air pollution will have health implications on the workers, visitors and the neighboring community as it causes respiratory diseases and is a visual irritant.

Recommended mitigation measures

1. Install appropriate and adequate dust screens around the project site
2. Sprinkle water on the construction site to suppress dust
3. Procure, provide and enforce the use of dust masks to workers and visitors to the project site
4. Comply with the provisions of the Environmental Management and Coordination (Air Quality) Regulations, 2014

3.5.5 Noise pollution

The construction works, delivery of building materials by heavy trucks and the use of machinery including concrete mixers and metal grinders among others may lead to high levels of noise and vibration within the construction site and the surrounding area. The noise levels produced may be above the stipulated EMCA limits and may lead to hearing impairments to the workers, visitors to the site and the neighbors. Construction sites can only emit noise levels of up to 75 dB(A) during the day and 65dB (A) at night as per the Second Schedule of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

Recommended mitigation measures

1. Procure and provide adequate PPE such as earplugs to workers and visitors to the site
2. Service machinery and equipment regularly to ensure that they are in good condition
3. Sensitize truck drivers to avoid unnecessary hooting or running of vehicle engines
4. Comply with provisions of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

3.5.6 Occupational safety and health risks

Machinery operations, use of construction tools and the actual construction activities are likely to expose the workforce, visitors and the neighbors to safety and health risks such as falling objects, moving machinery or even falls. The proposed project will also expose the workers, neighbors and visitors to the site to health and safety risks from air and noise pollution. All these risks have a potential to cause injury, permanent disability or even death.

Recommended mitigation measures

1. Register the site as a workplace with Directorate of Occupational Safety and Health Services
2. Obtain insurance cover for the workers
3. Procure and provide adequate and appropriate PPE to workers and visitors to the site and enforce on their use
4. Provide the correct equipment to employees for the jobs assigned and trained on their use
5. Moving parts of machines and sharp surfaces should be securely protected with guards to avoid unnecessary contacts and injuries
6. Provide a fully equipped first aid box, first aid services and emergency vehicle at the site
7. Comply with the provisions of the Occupational Safety and Health Act, 2007

3.5.7 Traffic congestion

Heavy Commercial Vehicles (HCVs) delivering construction materials to the site are likely to increase traffic along the Beira Road in case of stalling and breakdowns.

Recommended mitigation measures

1. Prepare and implement a traffic management plan
2. Ensure that all machinery owned by the proponent are parked within the site
3. Offload construction materials on the site and not on the road reserves to ensure smooth flow of traffic
4. Sensitize drivers to observe the speed limit of 30 KPH along the access road
5. Comply with the Traffic Act, 2016

3.6 Negative impacts at the operational phase of the proposed grain storage silos

3.6.1 Quality assurance

With the liberalization of trade in Kenya, importers are free to import all kinds of products into the country. This has resulted in substandard commodities flooding the Kenyan market including bulk grains. A number of Kenyan industries have been closed and employment opportunities have been lost as a result of this. Since the acute poisoning of the 125 persons in 2004, it has been an on-going challenge to bring the contaminated grain problems in Kenya under control. The Government of Kenya through the Kenya Bureau of Standards and the East African standards harmonization process have established quality standards. This means that there is a mandatory grain grading system for the purpose of trade within the East African community (EAS2:2005) which is also implemented on the Kenyan domestic market by the Kenya Bureau of Standards (known as KS-EAS2:2005).

Recommended mitigation measures

1. The proponent should ensure compliance with requirements of the relevant Kenya Standard(s) or other standards approved by KEBS

3.6.2 Potential health hazards

Agriculture continues to hit the headlines regarding work-based accidents and grain storage silos are a place where there are many risks. Working at height, slips and trips, lone working, entrapment, entanglement in grain moving machinery, risks of poisoning and suffocation from inhaling vapors generated in the silos, risk of intoxication due to the use of fumigants and pesticides and electrocution are just a handful that need to be mitigated. Aside from the adverse effects they have on human health, these risks can lead to loss of life.

Recommended mitigation measures

1. Develop and implement a safety and health policy at the workplace
2. Develop and implement an emergency response plan
3. Sensitize employees to adhere to work procedures to minimize accidents
4. Provide adequate and appropriate PPE to workers and enforce on their use
5. Display signage warning of potential hazards at various sections of the silos
6. Conduct first aid training among the workers and provide well-stocked first aid kits at different sections in the facility
7. Provide and keep an accident/ incident register
8. Conduct risk assessment audits annually and implement measures to reduce the risk posed to those working in and around the silos
9. Comply with the provisions of the Occupational Safety and Health Act, 2007

3.6.3 Grain entrapment/engulfment risks

Grain entrapment/engulfment may occur when workers enter the silos to check on condition of grain or to address problems with grain flow due to spoiled grain or equipment malfunction. As unloading conveyors or augers remove grain through the bottom outlet, a funnel-shaped flow develops on the surface of the grain. Anyone standing on the surface while grain is being removed from below is at risk of being rapidly pulled down toward the outlet in the column of flowing grain. Additionally, an engulfment can occur as a result of spoiled grain which forms solid masses, crusts, horizontal grain bridges and vertical grain walls that can collapse under a person's weight, resulting in the victim being buried by falling and shifting grain.

Recommended mitigation measures

1. Target on zero entry into the silos. The most common reason victims enter bins is to address problems associated with spoiled grain and thus grains should be stored at the correct moisture content and temperature to prevent conditions favorable for grain to spoil and clump together
2. Restrict access to the silos only to authorized personnel
3. Display signage warning of potential engulfment at all entry points to silos
4. Sensitize workers on grain storage hazards and risks involved with entering the silos
5. Workers entering a grain silo should be equipped with a body harness which is tethered to a lifeline manned by at least two other individuals outside of the bin
6. Workers should never enter a silo of flowing grain
7. Lock out/tag out any and all power equipment (such as augers) before entering the silo

3.6.4 Silo gas formation

Grain storage structures can develop potentially hazardous atmospheres due to gases produced from fermenting grains. Fermenting or molding grain produce carbon dioxide (CO_2), nitric oxide (NO), and also compounds known to be respiratory irritants such as nitrogen dioxide (NO_2) and nitrogen tetroxide (N_2O_4). However, individual reactions to silo gas depend on the concentration of inhaled gas and length of exposure. While low NO_2 concentrations can cause coughing, labored breathing, and nausea, high concentrations can cause fluid to fill the lungs, which can result in death.

Recommended mitigation measures

1. Provide good ventilation in and around the silos
2. Sensitize workers to stay out of the silo during the first 2-3 days after filling
3. Use a gas meter to check for adequate oxygen content in the silos and the presence of toxic gases like carbon monoxide and oxides of nitrogen
4. Workers should be provided with self-contained breathing apparatus (SCBA) and trained on their use
5. Display appropriate signage warning people of the potential for silo gases such as "Danger-Deadly Silo Gas"
6. Prior to entering any silo at any time, make sure that the power supply for all unloading mechanisms are locked out and tagged out of service

3.6.5 Air pollution

The main source of air pollution at operation will emanate from odors from fermenting grains. A major contributor to the odor is dimethyl disulfide which has been identified as a key component of the emitted volatiles. This is often accompanied by hydrogen sulfide, dimethyl sulfide and dimethyl trisulfide which is particularly odiferous. These odors can become a nuisance, causing temporary symptoms such as headache and nausea but can be lethal when emitted in excess. Fumigants used in pest control and fine grain dust stirred up from the cleaning process are also

potential sources of air pollution which have been associated with respiratory ailments. Additionally, there will be exhaust fumes emitted from vehicles accessing the facility and by the standby generator.

Recommended mitigation measures

1. Provide adequate and appropriate PPE such as dust masks to workers and enforce on their use
2. Provide good ventilation in and around the silos
3. Install dust control systems and dust holding bins required to prevent the hazard of dust explosions during the cleaning process
4. Develop and implement a dust management program with instructions to reduce accumulations on ledges, floors, equipment and other exposed surfaces
5. Comply with the provisions of the Environmental Management and Coordination (Air Quality) Regulations, 2014

3.6.6 Noise pollution

Noise pollution will be as a result of operation of the mechanical equipment such as augers, shafts and loading or unloading belts as well as from vehicular movement in and out of the facility. Kilindini Warehouses Limited is located in a Commercial Zone thus corresponds to the prescribed levels for Zone E in the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 which demonstrates sound level limits of 60 dB(A) Leq, during the day and 35 dB(A) at night. Noise above the stipulated EMCA, OSH and WHO limits are a health hazard. However, the proposed project site is located in a commercial zone and adjacent to a similar but larger scale development thus the noise levels produced are likely to be insignificant due to the background noise.

Recommended mitigation measures

1. Provide adequate and appropriate PPE to workers and enforce on their use
2. Service mechanical equipment regularly to ensure that they are in good condition
3. Comply with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

3.6.7 Aflatoxicosis

Under sub-optimal storage conditions, harmful microorganisms and mycotoxins may develop which could cause severe damage to human and animal health. These biological factors can also cause reduction in the nutritive value of stored products. One such common toxin is aflatoxin produced by the fungus *Aspergillus flavus* that grow on certain crops e.g. maize. Moisture and heat stress is commonly associated with most aflatoxin outbreaks

Consumption of high levels can be fatal and chronic exposure has been linked to liver cancer, suppressed immune response and child stunting. In 2004 for instance, 125 Kenyans died after consuming aflatoxin infested food. Sound agronomic practices and post-harvest practices must be followed to reduce or prevent contamination or buildup once the crop is harvested and stored

Recommended mitigation measures

1. Suppress potential aflatoxin conditions such as keeping moisture in stored grain below 12-13 percent and keeping insect activity to a minimum
2. Remove all broken corn, dust and foreign material that can provide a source of contamination
3. Check and repair storage silos to prevent moisture leaks from faulty joints or other problems

4. Mow around the silos to discourage insect/rodent activity
5. Inspect and probe the grain held in the silos every 3 to 4 weeks to check for insect activity, high temperatures, mold growth or sprouting at the top of the grain

3.6.8 Fire outbreaks and explosions

There have been many cases of silos and the associated ducts and buildings exploding. If the air inside becomes laden with finely granulated particles, such as grain dust, a spark can trigger an explosion powerful enough to blow a silo and adjacent buildings apart, usually setting the adjacent grain and building on fire. Sparks are often caused by (metal) rubbing against metal ducts; or due to static electricity produced by dust moving along the ducts when extra dry. Overheating and mechanical failure of unloading or loading belts and other mechanical equipment and electrical failure can also cause fire outbreaks. The international standard, ISO 8456, gives special safety rules for storage equipment for loose bulk materials to ensure fire risks are minimized. The facility within which the proposed silos will be set already has measures in place to ensure fire safety. These include fire extinguishers that are regularly serviced (Figure 11), a designated fire assembly point and precautionary signs such as the "No Smoking" sign. There's however a need to beef up the existing measures to avert the likelihood of occurrence of fires and or to combat fire outbreaks when they occur.

Figure 11: Existing fire extinguishers located at strategic areas of Kilindini Warehouses Limited facility (Source: Site visit, March 2020).

Recommended mitigation measures

1. Insure the silos with an insurance company to safeguard against loses from fire risks
2. Develop and implement a fire and emergency response plan
3. Procure and increase the number of firefighting equipment such as fire extinguishers, fire hose reels, smoke detectors, fire alarms and fire hydrants and place them at appropriate locations within the silos
4. Ensure firefighting equipment are serviced quarterly by fire service providers
5. Install fire and emergency exits at appropriate locations within the silos
6. Enforce a 'no smoking' rule

7. Ensure good ventilation is maintained within the silos
8. Train staff on fire safety and have fire marshals on standby
9. Conduct fire drills biannually and fire safety audits annually
10. Undertake regular inspection and maintenance of electrical installations

3.6.9 Insect and pest infestation

In Kenya, the dominant insect pests that attack stored grain are the larger grain borer (LGB), *Prostephanus runcates* and the maize weevil *Sitophilus zeamais*. The average loss due to insect pests in maize alone is estimated at 4% to 5% with a total storage weight loss of up to 50%. Cracks, fractures and dark corners in silos can all be conducive for pest infestations. Additionally, the moisture content and temperature in silos is a contributing factor to insect and pest infestation. Insect and pest infested grains fetch lower prices in the market due to deterioration in quality.

Recommended mitigation measures

1. Develop and implement a pest and insect management plan in collaboration with commercial pest control professionals
2. Thoroughly clean empty bins, subfloors, aeration ducts, elevators and augers
3. Weatherproof grain storage bins, repair and seal cracks or holes and treat with residual insecticides.
4. Fumigate if the perforated floor or aeration duct screens can't be removed, cleaned, and treated
5. Adhere to acceptable grain moisture content and temperature levels at storage
6. Use grain protectants prior to storage such as Chlorpyrifos-methyl, malathion, and pirimiphos-methyl that may be applied in dust or liquid forms

3.6.10 Water demand and effluent generation

Water will be required for domestic use in drinking, sanitation and general cleaning. This will exert marginal increase in demand for water estimated at 600litres per day. Water for use in sanitation and general cleaning during this phase will be sourced from an existing borehole whereas water for drinking will be supplied by water vendors. Sanitation facilities will generate seventy percent (70%) of water consumed as effluent which will be managed through the proposed bio digester.

Recommended mitigation measures

1. Sensitize the staff on the need to conserve the available water
2. Monitor the quality of effluent discharged from the proposed bio-digester in compliance with the Third Schedule of Environmental Management and Coordination (Water Quality) Regulations, 2006
3. Apply for and obtain an Effluent Discharge License (EDL) from NEMA
4. Comply with the provisions of the Environmental Management and Coordination (Water Quality) Regulations, 2006

3.6.11 Solid waste generation

Solid waste generated will be inform of screenings which are by products of grain cleaning activities and domestic waste such as grain bags, plastics, wrappings, cartons and paper among others. Poor disposal of solid wastes degrades environmental quality and should thus be properly managed.

Recommended mitigation measures

1. Provide adequate waste collection bins at appropriate sections within the facility
2. Sell the screens to feed lots
3. Sensitize workers on proper waste management
4. Contract a NEMA licensed waste handler to dispose off the waste

5. Comply with the provisions of Environmental Management and Coordination (Waste Management) Regulations, 2006

3.6.12 Energy demand

Power consumption in grain storage silos is high since the silos are operated and monitored through electronically controlled devices. All the systems in the silos including the loading and unloading systems, drying system, conveyance system among others require electricity to function. It is estimated that an average of 10kwh of power is required for each metric ton of grain. The facility will source its power from the National Grid supplemented by a diesel-powered generator.

Recommended mitigation measures

1. Sensitize workers to switch off lights when not in use
2. Keep records and analyze Kenya Power bills to identify areas of unnecessary use
3. Harness solar energy
4. Undertake energy audits every 3 years
5. Ensure regular servicing and maintenance of electrical appliances

3.7 Possible decommissioning of the proposed grain storage silos

A decommissioning phase is possible in the event of end of project life, closure by government agencies due to non-compliance with environmental and health regulations, an order by a court of law due to non-compliance with existing regulations, natural calamities and change of user of land. The proponent should prepare and submit a due diligence decommissioning audit report to NEMA for approval at least three (3) months in advance.

The following environmental and social concerns will manifest at this phase;

1. Economic decline
2. Solid waste generation
3. Effluent generation
4. Safety and health risks

3.7.1 Economic decline

In the event of decommissioning of the grain storage silos, the proponent will incur huge financial loses and the employees will also lose their livelihoods. In addition, the government will lose revenue earned from the operations of the silos. This will lead to economic decline.

Recommended mitigation measures

1. Train employees on alternative livelihoods prior to decommissioning
2. Prepare and issue recommendation letters to employees to seek alternative employment opportunities
3. Comply with labor laws by paying the employees their terminal dues

3.7.2 Solid waste generation

Demolition works and dismantling of equipment and fixtures will result in generation of large quantities of solid waste. The waste generated will include glass, metal and wood cuttings, roofing waste and building rubbles among others. If not properly managed, these generated wastes will pose safety and health risks and environmental pollution.

Recommended mitigation measures

1. Obtain demolition permits from the County Government of Mombasa
2. Recover re-usable materials for sale or use in other project sites
3. Contract a NEMA licensed waste handler to dispose off the demolition waste

4. Comply with Environmental Management and Coordination (Waste Management) Regulations, 2006

3.7.3 Effluent generation

Demolition activities will result in effluent generation from the proposed bio-digester and will need to be disposed off appropriately.

Recommended mitigation measures

1. Contract a NEMA licensed sewage handler to manage the effluent
2. Comply with the Environmental Management and Coordination (Water Quality) Regulations, 2006

3.7.4 Safety and health risks

Safety and health risks during demolition are likely to emanate from accidental falls and cuts, injuries from demolition tools and machinery use. Additionally, noise and air pollution from demolition works could pose safety and health risks to workers, neighbors and visitors to the site.

Recommended mitigation measures

1. Install signage to forewarn people of the on ongoing demolition activities
2. Provide adequate PPE and enforce on their use throughout the demolition works
3. Avail first aid kits on site throughout the entire period
4. Ensure workers are given the correct hand tools and equipment for the jobs assigned
5. Comply with the provisions of the Occupational Safety and Health Act, 2007

3.8 Impact identification, prediction and analysis

Potential project impacts are predicted and quantified to the extent possible. The magnitude of impacts on resources such as water and air or receptors such as people, communities, wildlife species and habitats is defined. Magnitude is a function of the following impact characteristics;

1. Type of impact (direct, indirect, induced)
2. Size, scale or intensity of impact
3. Nature of the change compared to baseline conditions (what is affected and how)
4. Geographical extent and distribution (e.g. local, regional, international)
5. Duration and/or frequency (e.g. temporary, short-term, long term, permanent)

Magnitude describes the actual change that is predicted to occur in the resource or receptor. The magnitude of an impact takes into account all the various impact characteristics in order to determine whether an impact is negligible or significant. Some impacts can result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact and are characterized as having a negligible magnitude (Table 5).

The levels of impacts are defined using the following terms

1. **Negligible impact (very low)-**Where a resource or receptor would not be affected by a particular activity or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background variations
2. **Less than significant impact (Low**) – Is a minor impact where a resource or receptor would experience a noticeable effect but the impact magnitude is sufficiently low (with or without mitigation) and /or the resource or receptor is of low sensitivity. In either case, a less than significant impact must be sufficiently below applicable standard threshold limits.
3. **Potentially significant impact (moderate)-**A moderate impact that meets applicable standards but comes near the threshold limit. The emphasis for such moderate impacts is to

demonstrate that the impact has been reduced to a level that is as minor as reasonably practicable so that the impact does not exceed standard threshold limits.

4. **Significant impact (high)** – One where an applicable standard threshold limit would or could be exceeded, or if a highly valued or very scarce resource would be substantially affected.

Table 5: Risk and impact significance matrix for the proposed grain storage silos.

Environmental impact	Magnitude of impact at construction	Magnitude of impact at operation
Sourcing of raw materials	2	0
Water demand and effluent generation	2	2
Solid waste generation	2	2
Quality assurance	0	2
Occupational safety and health risks	1	3
Air and noise pollution	1	2
Grain entrapment/engulfment risks	0	2
Silo gas formation	0	2
Fire outbreaks and explosions	0	2
Aflatoxicosis	0	2
Pest infestation	0	2
Traffic congestion	2	2
Energy demand	1	2

Legend

Magnitude	Impact score
Negligible	0
Low	1
Moderate	2
High	3

3.9 Public consultations and findings

3.9.1 COVID-19 and its risks to the stakeholder meetings

It should be noted that the stakeholder engagement process was at risk due to the prevailing global pandemic of COVID-19 where the Kenya Government has responded by banning public gatherings. Due to this scenario, public consultation meetings could not be held in compliance with the Ministry of Health (MoH) guidelines on prevention of the spread of the virus.

Public consultations were however undertaken using informal interviews and questionnaires administered to the neighbors and stakeholders to collect and document their concerns regarding the construction and subsequent operation of the proposed project. In adherence to the health directive on COVID-19, a social distance of 1.5 meters between the interviewer and interviewee was observed, wearing of masks during the interviews and sanitization post interviews and where possible, the questionnaires were filled in by the interviewer(Figure 12). A total of 15 questionnaires were administered in June 2020. The main comments are summarized in table 6 below.

Figure 12: A member of the ESIA Study team interviewing stakeholders and neighbours to the proposed project site while adhering to the government directives on prevention of the spread of COVID-19(Source: Public consultations, June 2020):

Table 6: Summary of comments obtained from neighbors and stakeholders of the facility

No.	Respondents profile			Comments
	Name	Tel contact	ID No:	
1.	Evelyne Nyandimu	0723424676	20804679	– Employment opportunities to the local youths – Storage of grains – Elimination of habitat for thugs – Noise pollution traffic congestion – Construction to be done at night hours
2.	Stephen Kimani	0705422101	83844708	– Employment opportunities – Dust emission – Noise pollution – Pests infestation – Use dust screens and arrestors
3.	Zakayo Kishuke	0720374159	22648355	– Employment opportunities – Dust emission at construction phase
4.	Abdi Fatah	0791714150	36638875	– Employment opportunities – Noise and air pollution – Install dust screens and arrestors
5.	Elite Tours Ltd	0701815584		– Employment opportunities – No objection
6.	Ahmed Omar	0702311404	35182126	– Air and noise pollution – Install dust screens – Operation to be done at night
7.	Shogoni Nadors	0722222682	34693877	– Employment opportunities – Industrial development – Noise and air pollution – Find the best way to reduce pollution

8.	Thomas Ayega	0769985605	23748108	– Employment opportunities – No objection
9.	Agnes Nafula	0726123156	21059337	– Loss of casual jobs due to machine installation – Air and noise pollution during construction
10.	Abdi ahmed	0780164115	31821755	– Air pollution – Install dust arrestors
11.	Amritial p Bimis	0733888333	84522985	– No objection – Employment opportunities
12.	Abdi Hirsi Yusuf	0722301375	25335453	– Employment opportunities – Noise pollution
13.	Justin S Olale	0726663684	21668654	– Noise and air pollution
14.	Jonah Songok	0706591797	P0539360 9A	– Employment opportunities – Air and noise pollution – Install dust screens and sprinkle water on access road
15.	Manji Food Industries Ltd	0722203626	NA	– Employment opportunities – Noise pollution – Dust from grains – Road damage and congestion – Emergence of pestilence
16.	Redempta C/o Cargill (K) Ltd	041-2225701	MV-4931	– Economic growth – Job opportunities – Noise and air pollution – Traffic congestion during operation

3.10 Analysis of project alternatives

Analyzing project alternatives is important as it allows the proponent to evaluate possible project options that could mitigate the environmental risks identified during the ESIA process through prevention, elimination of the risks all together or reduction of the severity of an impact. The analysis will also assist NEMA and lead agencies in decision making by either approving the project as proposed or advising the proponent on the need for a particular alternative such as an alternative site. In the current proposal, the alternatives identified are discussed in detail below.

3.10.1 The 'No Project' alternative

The "No Project" alternative has the advantage of retaining the status quo, meaning that the predicted environmental impacts will not occur and is ideally the best-case scenario for mitigation. This alternative is however not viable owing to the fact that the project is being implemented in line with the Kenya's Big Four Agenda and the United Sustainable Development Goals (SDGs) No. 2. The status quo denies the government a chance to contribute towards the realization of the Kenya Big Four Agenda – Food Security and Nutrition and creation of job opportunities. The "No project" alternative is therefore not considered viable in the light of the benefits and deprivations of the project.

3.10.2 The 'Yes Project' alternative

This option envisages that the proposal will be implemented thus was considered as the most viable because of the following reasons;

1. Quality storage facility providing protection from the elements such as moisture thus increase the storage life of the grains.
2. Contribute towards realization of the Kenya Big Four Agenda-Food security and nutrition
3. Large storage capacity up to 67,020 tons of grain.
4. Prevention of post-harvest losses experienced during storage
5. Provision of employment opportunities for both skilled and unskilled personnel
6. Income to the proponent through the charges levied on services to clients.
7. Revenue to the government in form of taxes levied on goods and /services undertaken by the facility.

3.10.3 Alternative project site

An alternative site could be considered for the proposed project if the proposed project activities would present serious environmental challenges that cannot be effectively managed. However, the proposed mitigation measures are considered adequate to minimize the impacts to levels that do not warrant significant environmental damage. Apart from the proximity of the proposed silo to the Mombasa Port, the project site is an ideal distribution location. Additionally, the proposed project is in line with the existing land use activities hence this alternative is therefore not viable.

3.10.4 Alternative project

An alternative project such as constructing additional warehouses and offices for use by the proponent could be possible since there is adequate space at the project site. However, the proposed silos will also have a larger capacity for bulk grain handling and storage as compared to warehouses. The proposed project is thus deemed viable economically as compared to constructing additional warehouses and offices. Thus an alternative project does not arise.

3.10.5 Alternative storage technique

There are multiple bulk grain storage techniques ranging from warehousing where grain is packed into jute bags/ plastic woven bags and stacked in warehouses to hermetic bag storage. The proposed grain storage technique-use of silos presents the most modern technology of bulk grain handling and storage. It has a unique system of loading, storage and offloading grain ensuring low spillage levels and low dust emissions. It is possible to mechanize all operations thus rapid and smooth handling of cargo. It can also store grain for a long time. It is therefore the best proven technology for bulk grain handling and storage hence the analysis of alternative technology does not arise.

4 ENVIRONMENTAL MANAGEMENT PLAN

4.1 Introduction

The preceding section identified and analyzed the potential environmental and social impacts of the proposed project and proposed mitigation measures to address the impacts. Under this section, three Environmental Management Plans (EMPs) are proposed to guide the proponent in implementing the mitigation measures. These are EMPs for the construction, operational and decommissioning phases of the project. Each of the EMP is organized into five sections comprising of the environmental impact, the recommended mitigation measures, responsibility, timeframe and budget.

The approach for mitigation follows the precautionary principle which aims at first avoiding the impact, minimizing the impact by limiting the degree or magnitude of the action, rectifying the impact by repairing, rehabilitating, or restoring the affected environment, reducing or eliminating the impact over time and lastly compensating for the impact by replacing or providing substitute resources or environments.

4.2 Environmental Management Plan for the construction phase

For the construction phase EMP (Table 7), the main environmental issues include environmental risks for sourcing raw materials, solid waste generation, water demand and effluent generation, air and noise pollution, occupational safety and health risk and traffic congestion. The timeframe for implementation is considered to be time it will take for the proponent to complete the construction of the grain storage silos.

4.3 Environmental Management Plan for the operation phase

At the operational phase of the project (Table 7), major environmental concerns will be potential health hazards, grain entrapment/engulfment risks, silo gas formation, air and noise pollution, fire outbreaks and explosions, aflatoxicosis, pest infestation, water demand and effluent generation, solid waste generation and energy demand. The timeframe for implementation is considered to be time the grain storage silos will be in operation.

4.4 Environmental Management Plan for the decommissioning phase

A decommissioning phase is possible in the event of end of project life, closure by government agencies due to non-compliance with environmental and health regulations, an order by a court of law due to non-compliance with existing regulations, natural calamities and change of user of land. The key issues at this phase will be the wastes generated by demolition activities and safety and health risks (Table 7).

Table 7: Environmental Management plan for the construction, subsequent operation and possible decommissioning phase of the proposed project.

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
Construction phase				
Sourcing of raw materials	Source raw materials from sites that are licensed by NEMA	Proponent/contractor	During construction	Nil
	Have a procurement plan based on the Bill of Quantities	Proponent/contractor	During construction	Nil
	Sensitize personnel on wastage of construction materials	Proponent/contractor	During construction	Nil
Solid waste generation	Procure and strategically place adequate solid waste collection bins with a capacity for segregation	Proponent/contractor	Prior to commencement	100,000
	Sensitize construction workers on proper waste management	Proponent/contractor	Continuous	Nil
	Procure a sizeable central solid waste collection bin with chambers to accommodate separated waste	Proponent/contractor	Prior to commencement	200,000
	Recycle and reuse materials as far as practical	Proponent/contractor	Throughout construction	
	Contract a NEMA licensed waste handler to dispose off the solid waste	Proponent/contractor	Prior to commencement	Tender
	Comply with the Waste Management Regulations, 2006	Proponent/contractor	Continuous	Nil
Water demand and effluent generation	Sensitize the workforce on the need to conserve the available water resources	Proponent/contractor	Continuous	Nil
	Monitor the amount of water being abstracted from the borehole	Proponent/contractor	Continuous	Nil
	Procure and install a bio digester to manage the effluent	Proponent/contractor	During construction	200,000
	Comply with Water Quality Regulations, 2006	Proponent/contractor	Continuous	Nil
Air pollution	Install appropriate and adequate dust screens around the project site	Proponent/contractor	Throughout construction	1,000,000
	Sprinkle water on the construction site to suppress dust	Proponent/contractor	Daily	20,000
	Procure, provide and enforce the use of dust masks to workers and visitors to the project site	Proponent/contractor	Throughout construction	50,000
	Comply with Air Quality Regulations, 2014	Proponent/contractor	Continuous	Nil
Noise pollution	Procure and provide adequate earplugs to workers and visitors to the site	Proponent/contractor	Throughout construction	50,000
	Service machinery and equipment regularly to ensure that they are in good condition	Proponent/contractor	Throughout construction	Nil
	Sensitize truck drivers to avoid unnecessary hooting and	Proponent/contractor	Throughout	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	running of vehicle engines		construction	
	Comply the Noise and Excessive Vibration Pollution (Control) Regulations, 2009	Proponent/contractor	Continuous	Nil
Occupational safety and health risks	Register the site as a workplace with DOSHS	Proponent	Prior to commencement	Nil
	Obtain insurance cover for the workers	Proponent/contractor	During construction	1,000,000
	Procure and provide adequate and appropriate PPE to workers and visitors to the site and enforce on their use	Proponent/contractor	At project commencement	800, 000
	Provide the correct equipment to employees for the jobs assigned and trained on their use	Proponent/contractor	During construction	Nil
	Ensure moving parts of machines and sharp surfaces are securely protected with guards	Proponent/contractor	Prior to commencement	Nil
	Provide a fully equipped first aid box, first aid services and emergency vehicle at the site	Proponent/contractor	Throughout construction	500,000
	Comply with the Occupational Safety and Health Act, 2007	Proponent/contractor	Continuous	Nil
Traffic congestion	Prepare a traffic management plan	Proponent/contractor	Prior to commencement	Nil
	Ensure that all machinery owned by the proponent are parked within the site	Proponent/contractor	Throughout construction	Nil
	Offload construction materials on the site and not on the road reserves	Proponent/contractor/ Truck drivers	Throughout construction	Nil
	Sensitize drivers to observe the speed limit of 30 KPH along the access road	Truck drivers	Throughout construction	Nil
	Comply with the provisions of the Traffic Act, 2016	Proponent/contractor	Throughout construction	Nil
Operational phase				
Quality assurance	Ensure compliance with requirements of the relevant Kenya Standard(s) or other standards approved by KEBS	Proponent/KEBS	Throughout operations	TBD
Potential health hazards	Develop and implement a safety and health policy at the workplace	Proponent	Prior to operations	10,000
	Develop and implement an emergency response plan	proponent	Continuous	Nil
	Sensitize employees to adhere to work procedures to	Proponent	Continuous	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	minimize accidents			
	Provide adequate and appropriate PPE to workers and enforce on their use	Proponent	Continuous	200,000
	Display signage warning of potential hazards at various sections of the silos	Proponent	At operations	10,000
	Conduct first aid training among the workers and provide well-stocked first aid kits at different sections in the facility	Proponent	Continuous	30,000
	Provide and keep an accident/ incident register	Proponent	Continuous	1,000
	Conduct risk assessments audits and implement measures to reduce the risk posed to those working in and around the silos	Proponent	Annually	50,000
	Comply with the Occupational Safety and Health Act, 2007	Proponent	Continuous	Nil
Grain entrapment/ entrapment	Target on zero entry into the silos	Proponent	Continuous	Nil
	Restrict access to the silos only to authorized personnel	Proponent	Continuous	Nil
	Display signage warning of potential engulfment at all entry points to silos	Proponent	Continuous	5,000
	Sensitize workers on grain storage hazards and risks involved with entering the silos	Proponent	Continuous	10,000
	Workers entering a grain silo should be equipped with appropriate PPE	Proponent	Continuous	50,000
	Workers should never enter a silo of flowing grain	Proponent/Workers	During operations	Nil
	Lock out/tag out any and all power equipment before entering the silo	Proponent/Workers	During operations	
Silo gas formation	Provide good ventilation in and around the silos	Proponent	Prior to operations	Nil
	Sensitize workers to stay out of the silo during the first 2-3 days after filling	Proponent	During operations	Nil
	Use a gas meter to check for adequate oxygen content in the silos and the presence of toxic gases	Proponent	During operations	Nil
	Workers should be provided with SCBA and trained on their use	Proponent	During operations	50,000
	Display appropriate signage warning people of the potential for silo gases	Proponent	At operations	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	Lock and tag out of service power supply for all unloading mechanisms Prior to entering any silo	Proponent/Workers	Throughout operations	Nil
Air pollution	Provide adequate and appropriate PPE to workers and enforce on their use	Proponent	Continuous	100,000
	Provide good ventilation in and around the silos	Proponent	Prior to operations	Nil
	Install dust control systems and dust holding bins	Proponent/Contractor	Prior to operations	100,000
	Develop and implement a dust management plan to reduce accumulations	Proponent	Prior to operations	10,000
	Comply with the Air Quality Regulations, 2014	Proponent	Continuous	Nil
Noise pollution	Provide adequate and appropriate PPE to workers and enforce on their use	Proponent	Continuous	100,000
	Service mechanical equipment regularly to ensure that they are in good condition	Proponent	During operations	Nil
	Comply the Noise and Excessive Vibration Pollution) (Control) Regulations, 2009	Proponent	Continuous	Nil
Fire outbreaks and explosions	Insure the silos with an insurance company to safeguard against loses from fire risks	Proponent	At operations	1,000,000
	Develop, clearly display and implement a fire and emergency response action plan	Proponent	Prior to operations	Nil
	Procure and increase the number of firefighting equipment	Proponent	Prior to operations	500,000
	Ensure firefighting equipment are serviced quarterly	Proponent	quarterly	Tender
	Install fire and emergency exits at appropriate locations within the silos	Proponent	Prior to operations	Nil
	Enforce a 'no smoking' rule	Proponent	During operations	Nil
	Ensure good ventilation is maintained within the silos	Proponent	During operations	Nil
	Train staff on fire safety and have fire marshals on standby	Proponent	Biannually	20,000
	Conduct fire drills and fire safety audits	Proponent	Biannually	50,000
	Undertake regular inspection and maintenance of electrical installations	Proponent	Continuous	Nil
Aflatoxicosis	Suppress potential aflatoxin conditions	Proponent	Continuous	Nil
	Remove all broken corn, dust and foreign material that	Proponent	Before storage	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	can provide a source of contamination			
	Check and repair storage silos to prevent moisture leaks	Proponent	Continuous	Nil
	Mow around the silos to discourage insect/rodent activity	Proponent	Continuous	Nil
	Inspect and probe the grain held in the silos every 3 to 4 weeks	Proponent	Continuous	Every 3 to 4 weeks
Insect and pest infestation	Develop and implement a pest and insect management plan in collaboration with commercial pest control professionals	Proponent	At operations	TBD
	Thoroughly clean empty bins, subfloors, aeration ducts, elevators and augers	Proponent	At operations	Internal costs
	Weatherproof grain storage bins, repair and seal cracks or holes and treat with residual insecticides	Proponent	At operations	Internal costs
	Fumigate if the perforated floor or aeration duct screens can't be removed, cleaned, and treated	Proponent	At operations	Internal costs
	Adhere to acceptable grain moisture content and temperature levels at storage	Proponent	At operations	Nil
	Use grain protectants prior to storage	Proponent	At operations	Internal costs
Water demand and effluent generation	Sensitize the workforce on the need to conserve the available water	Proponent	Throughout operations	Nil
	Monitor the quality of effluent discharged from the proposed bio-digester	Proponent	Quarterly	20,000
	Apply for and obtain an EDL from NEMA	Proponent	Annually	30,000
	Carry out regular inspection and maintenance of the water distribution network to ensure zero leaks and damages	Proponent	Continuous	Nil
	Comply with the Quality Regulations, 2006	Proponent	Continuous	Nil
Solid waste generation	Provide adequate waste collection bins at appropriate sections within the facility	Proponent	Prior to operations	100,000
	Sensitize workers on proper waste management	Proponent	Continuous	Nil
	Contract a NEMA licensed waste handler to dispose off the solid waste	Proponent	Prior to operations	Tender
	Comply with the Waste Management Regulations, 2006	Proponent	Continuous	Nil
Energy demand	Sensitize workers to switch off lights when not in use	Proponent	Continuous	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	Keep records and analyze KPLC bills to identify areas of unnecessary use	Proponent	Continuous	Nil
	Harness solar energy	Proponent	At operations	Tender
	Undertake energy audits	Proponent	Every 3 years	100,000
	Ensure regular servicing and maintenance of electrical appliances	Proponent	Continuous	Tender
Decommissioning phase				
Economic decline	Train employees on alternative livelihoods prior to decommissioning	Proponent	3 months prior to decommissioning	Nil
	Prepare and issue recommendation letters to the workers to seek alternative employment opportunities	Proponent	Prior to decommissioning	Nil
	Comply with labor laws by paying the employees their terminal dues	Proponent	Prior to decommissioning	TBD
Solid waste generation	Obtain demolition permits from the County Government of Mombasa	Proponent/contractor	Prior to decommissioning	5,000
	Recover re-usable materials for sale or use in other project sites	Proponent/Contractor	During decommissioning	Nil
	Contract a NEMA licensed waste handler to dispose off the demolition waste	Proponent/Contractor	Prior to decommissioning	Tender
	Comply with the Waste Management Regulations, 2006	Proponent/Contractor	Throughout decommissioning	Nil
Effluent generation	Contract a NEMA licensed waste handler to dispose the effluent generated	Proponent/Contractor	Prior to decommissioning	Tender
	Comply with the Water Quality Regulations, 2006	Proponent/Contractor	Throughout demolition	Nil
Safety and health risks	Install signage to forewarn people on ongoing demolition activities	Proponent/Contractor	During decommissioning	10,000
	Provide and enforce the use of PPE throughout the demolition works	Proponent/Contractor	Throughout decommissioning	50,000
	Avail first aid kits on site throughout the entire period	Proponent/Contractor	Throughout decommissioning	10,000
	Ensure workers are given the correct hand tools and	Proponent/Contractor	Throughout	Nil

Environmental concerns	Recommended mitigation Measures	Implementing party	Timeframe	Cost (KES)
	equipment for the jobs assigned		decommissioning	
	Comply with the Occupational Safety and Health Act, 2007	Proponent/Contractor	Throughout decommissioning	Nil

5 ENVIRONMENTAL MONITORING PLAN

5.1 Introduction

An Environmental Monitoring Plan is proposed to assist the proponent in mitigating possible adverse impacts arising from the proposed development and enhance the positive benefits arising from the project through implementation of the proposed mitigation measures. The purpose of the monitoring plan is to ensure that the impacts do not exceed legal standards specified under the different legislations. Implementation of the monitoring plans will ensure that the negative impacts of the project are lessened throughout the project cycle. For the proposed project, the following monitoring plans are proposed.

1. Air quality monitoring plan
2. Noise monitoring plan
3. Occupational safety and health monitoring plan
4. Water quality monitoring plan
5. Solid waste monitoring plan

5.1.1 Air quality monitoring plan

5.1.1.1 Introduction

Air pollution during the construction phase will be in form of dust and emissions whereas during operations will be as a result of fumigants used to control pests, fermenting grains and fine grain dust. Air pollution above acceptable limits is toxic to ecological systems and to human health. The purpose of the air quality monitoring plan is to ensure that the concentrations of air pollutants are within the standards prescribed under the Environmental Management and Coordination (Air Quality) Regulations, 2014. In addition, the results will be used to evaluate if the adopted air pollution controls and management are effective.

5.1.1.2 Monitoring parameters

The monitoring parameters and the specified target values are stipulated under the First Schedule of the Environmental Management and coordination (Air Quality) Regulations, 2014 (Table 8).

Table 8: Ambient air quality tolerance limits as per the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014.

Pollutant	Time weighted average	Industrial area
Sulphur oxides (SO_x)	Annual Average*	80 $\mu g/m^3$
	24 hours**	125 $\mu g/m^3$
Oxides of Nitrogen (NO_x)	Annual Average*	80 $\mu g/m^3$
	24 hours	150 $\mu g/m^3$
Nitrogen Dioxide	Annual Average	150 $\mu g/m^3$
	24 hours	100 $\mu g/m^3$
Suspended Particulate Matter (SPM)	Annual Average	360 $\mu g/m^3$
	24 hours	500 $\mu g/m^3$
Respirable particulate matter (< 10μm) (RPM)	Annual Average*	70 $\mu g/m^3$
	24 Hours**	150 $\mu g/Nm^3$
$PM_{2.5}$	Annual Average	35 $\mu g/m^3$
	24 Hours	75 $\mu g/m^3$
Lead (Pb)	Annual Average*	1.0 $\mu g/Nm^3$
	24 hours**	1.5 $\mu g/m^3$
Carbon monoxide/ Carbon dioxide	8 hours	5.0 mg/m^3
	One hour	10 mg/m^3
Hydrogen Sulphide	24 hours**	150 $\mu g/m^3$
Non methane hydrocarbons	Instant Peak	700ppb

Pollutant	Time weighted average	Industrial area
Total VOC	24 Hours**	600 $\mu g/m^3$
Ozone	One hour	200 $\mu g/m^3$
	8 hour (Instant Peak)	120 $\mu g/m^3$

5.1.1.3 Monitoring location

Air quality monitoring should be carried out within the project site during the construction phase and chimney outlets of the silos during the operational phase.

5.1.1.4 Monitoring frequency

Air quality monitoring should be done on a quarterly basis in collaboration with a NEMA designated laboratory.

5.1.2 Noise monitoring plan

5.1.2.1 Introduction

Potential sources of noise pollution will emanate during construction activities and operation of mechanical equipment such as augers, shafts and loading or unloading belts. Noise levels above the stipulated EMCA limits and may lead to hearing impairments which may reduce the workmanship of the employees. The purpose of noise monitoring plan is to therefore ascertain the extent of the impact due to the construction activities and subsequent operation of the silos in compliance with the First and Second Schedule of the Environmental Management and Coordination (Noise and Excessive Vibrations pollution) (control) Regulations, 2009 (Table 8 and Table 9).

5.1.2.2 Monitoring parameters

Noise levels will be metered in dB (A) as stipulated in the Noise Exposure Standards (Schedules) as shown in Table 9-11 below. Kilindini Warehouses Limited is located in a Commercial Zone. The facility corresponds to the prescribed levels for Zone E in the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 above which demonstrates sound level limits of 60 dB(A) Leq, during the day and 35 dB(A) at night.

Table 9: The Maximum permissible intrusive noise levels as stipulated under the First Schedule of Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

Zone		Sound Level Limits dB (A) Leq, 14 h		Noise Rating Level (NR) Leq, 14 h	
		Day	Night	Day	Night
A	Silent Zone	40	35	30	25
B	Place of worship	40	35	30	25
C	Residential: Indoor Outdoor	45 50	35 35	35 40	25 25
D	Mixed Residential (with some commercial and places of entertainment)	55	35	50	25
E	Commercial	60	35	55	25

Day: 6.01 a.m. – 8.00 p.m. (Leq, 14 h) Night: 8.01 p.m. – 6.00 a.m. (Leq, 10h)

Table 10: The guidelines for International Ambient Noise Levels (World Bank and World Health Organization Noise permissible levels).

Receptor	Maximum allowable Leq (hourly) in dB(A)			
	World Bank		World Health Organization	
	Day time 0700-2200 Hrs	Nighttime 2200-0700 Hrs	Day time 0700-2200 Hrs	Nighttime 2200-0700 Hrs
Residential, Institutional and Educational	55	45	50	45
Industrial and Commercial	70	70	85	85

Table 11: The Occupational Health and Safety Exposure Limits for Noise Emissions.

Sound Level dB(A)	Maximum Permitted Duration (hours/day)
80	16
85	8
90	2
100	1
105	0.5
110	0.25
115	1/8
>115	0
Hearing Protectors (Ear Mufflers)	
Sound Level dB(A)	Maximum Class of Hearing Protectors
85-95	C
96-105	B
106 and over	A

5.1.2.3 Monitoring location

Noise monitoring should be carried out within the project site during the construction phase and peak noise producing sections of the silos during operations.

5.1.2.4 Monitoring frequency

Noise monitoring should be done on a quarterly basis in collaboration with a NEMA designated laboratory. Noise levels will be measured in dB (A).

5.1.3 Occupational safety and health monitoring plan

5.1.3.1 Introduction

Potential safety and health risks during construction and operational phases will emanate from the use of machinery, noise and air pollution, entrapment and suffocation in grain, falls from structures, entanglement in grain moving machinery, toxic atmospheres as a result of fumigation and fermenting grains, electrocution, fire outbreaks and grain dust explosions. As a result, the above could cause adverse human health or loss of life. The purpose of the monitoring plan is to assess existing controls alongside potential health and safety risks in order to develop an effective plan of action and to ensure compliance with Occupational Safety and Health Act, 2007.

5.1.3.2 Monitoring strategy

The monitoring schedule regarding occupational safety and health will basically involve

- Conducting occupational safety and health reviews and reports.
- Hazard identification by analyzing activities that can be an immediate threat or cause harm over a period of time.
- Ensuring that all accidents and incidents occurring at the site are promptly reported and investigated.
- Keeping statistics of accidents, incidents and dangerous occurrences and ensuring that reportable cases are filed with the health, safety and environment officer.
- Routine inspections of the facility and equipment.
- Visual inspection as well as interviewing key personnel to identify areas of improvement.
- Undertaking and reviewing of fire, energy and risk assessment reports
- Review of safety awareness, fire drills and fire safety training requirements.
- Evaluation of the effectiveness of health and safety training to the workforce.
- Action plans related to significant findings of the risk assessment.
- Having emergency evacuation plans and emergency routes and safety signage among others.

5.1.3.3 Monitoring frequency

The proponent should undertake medical surveillance and provide new PPE to the employees every 6 months, conduct health and safety and fire audits annually, offer fire trainings and drills quarterly and ensure that all serviceable equipment are serviced on time.

5.1.4 Water quality monitoring plan

5.1.4.1 Introduction

The potential sources of water quality degradation will be effluent generated from sanitation facilities. The proponent should thus put in place a consistent water quality monitoring plan targeting the quality of effluent discharging from the proposed bio-digester. The objective of the water quality monitoring plan is to provide data and information to manage the effluent in order to comply with the standards prescribed under the Third Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006.

5.1.4.2 Monitoring parameters

The monitoring parameters and the specified target values are stipulated under the Third Schedule of Environmental Management and Coordination (Water Quality) Regulations, 2006 (Table 12).

Table 12: Water Quality Monitoring Parameters and the standards prescribed under the Environmental Management and Coordination (Water Quality) Regulations, 2006.

Parameter	EMC (Water Quality) Regulations, 2006 Standards
pH Value	6.5-8.5
BOD; mg/L	30max
COD; mg/L	50 max
Total Suspended Solids; mg/L	30 max
Ammonia-NH+; mg/L	100 Max
Total Dissolved Solids; mg/L	1200 Max
E. *Coli* Colonies; count/100ml	Nil
Total coliform; count/100ml	1000/100ml

5.1.4.3 Monitoring locations

Water quality sampling will target the last discharge point of the proposed bio-digester.

5.1.4.4 Monitoring frequency

Water quality monitoring should be undertaken quarterly in collaboration with a NEMA designated laboratory.

5.1.5 Solid waste monitoring plan

5.1.5.1 Introduction

Solid waste will emanate from construction activities and during the operational phase of the proposed grain storage silos. Poor disposal of solid waste causes environmental pollution and therefore may pose health risk to the workers, neighbors and visitors to the facility. The purpose of the monitoring plan is to ensure solid waste is managed in such a way that it protects both the public health and the environment.

5.1.5.2 Monitoring frequency

The frequency of solid waste monitoring will differ from the collection to the disposal stage. Collection and storage can be done on a daily basis whereas disposal can be undertaken weekly. Table 13 describes the outline for which the activity will be monitored but can be adjusted depending on the amount generated.

Table 13: Sample outline for solid waste monitoring plan.

Activity	Frequency	Critical levels (Tons)	Target	Responsibility
Collection	Daily			
Storage	Daily			
Management	Daily			
Disposal	Weekly			

5.1.5.3 Monitoring strategy

The solid waste monitoring plan will document the collection, storage and disposal of solid waste from the proposed grain storage silos. There is need to code each of the collection points, note the capacity and critical levels, frequency of disposal and the personnel and contractor responsible.

6 GOVERNANCE FRAMEWORK

6.1 Introduction

The Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 requires that environmental guidelines and standards which include the Kenyan government policies and strategies, National legislation and the Institutional arrangements to render them, should be incorporated in an ESIA report. The legal and institutional frameworks provide important precautions for protection and conservation of the environment and ensuring community health and safety. Under this section, the ESIA will therefore review the applicable sets of laws and institutions which are tasked with the protection and conservation of the environment and specifically the environmental compliance requirements for the proposed grain storage silos.

6.2 Policy Framework

6.2.1 National Environment Policy, 2013

Kenya has a National Environment Policy prepared and approved in 2013 by the Ministry of Environment, Water and Natural Resources. Its overall goal is to provide better quality of life in Kenya for present and future generations through sustainable management and use of the environment and natural resources. This policy elaborates the use of environmentally - friendly development strategy that integrates and promotes cohesion of development and environmental policies and enhances transfer of environmentally sound technologies.

6.2.2 National Food and Nutrition Security Policy, 2011

The Food and Nutrition Security Policy (FNSP) provides an overarching framework covering the multiple dimensions of food security and nutrition improvement. It has been purposefully developed to add value and create synergy to existing sectoral and other initiatives of government and partners. It recognizes the need for multi-public and private sector involvement, and that hunger eradication and nutrition improvement is a shared responsibility of all Kenyans. The policy and associated actions will remain dynamic to address contextual changes and changing conditions over time. This policy is framed in the context of basic human rights, child rights and women's rights, including the universal 'Right to Food'. The broad objectives of the FNSP are; to achieve good nutrition for optimum health of all Kenyans, increase the quantity and quality of food available, accessible and affordable to all Kenyans at all times and to protect vulnerable populations using innovative and cost-effective safety nets linked to long-term development.

Other policies related to the proposed project include;

1. **Sustainable Development Goals (SDGs)** - The Sustainable Development Goals (SDGs) include a significant number of interconnected objectives related to agriculture and food. SDG 2 focuses explicitly on food by seeking to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture", but multiple other goals relate to challenges in the food system. SDG 1 focuses on poverty reduction, where agriculture and food has a key role to play.

2. **Kenya Vision 2030** - It is the national long-term development blueprint to create a globally competitive and prosperous nation with a high quality of life by 2030 in a clean and secure environment. It aims to transform Kenya into a newly industrializing middle income country. The Vision is anchored on the economic, social, and political pillar. Given the central role the agricultural sector plays in the economy, the achievement of national food security is to be a key objective.

3. **Integrated Strategic Urban Development Plan (Mombasa Vision 2035)** - The overall aim is to promote and provide a sustainable Development of Mombasa enabling it to

accommodate the needs of existing and future residents, and also to facilitate its prime function as commercial and trading hub.

6.3 Legislative Framework

6.3.1 The Constitution of Kenya, 2010

The Constitution of Kenya 2010 is the supreme law of the land. Under Chapter IV, article 42 provides for the right to a clean and healthy environment for all. Further, Chapter V of the Constitution deals with Land and Environment. Specifically, Part 2 elaborates on the obligations of the proponent in respect to protection of the environment and enforcement of environmental rights.

Article 238 (1) provides that one of the principles of national security is the protection of all the citizens of Kenya, their rights, freedoms, property, peace, stability, prosperity and other national interests. Some of the rights of all Kenyans that are protected include the right to be free from hunger, to have adequate food of acceptable quality and uninterrupted supply of clean and safe water in adequate quantities at all times. When Kenyans suffer from hunger and malnutrition, peace cannot be guaranteed as this could lead to food riots. When access to food and safe water is guaranteed to all Kenyans at all times, this would enhance national security and Kenyans would attend to other national issues on national development.

Relevance to the proposed project

- The proponent should ensure that operations do not infringe on the right to a clean and healthy environment for all.
- The proponent must ensure that the operations are carried out in an ecologically, economically and socially sustainable manner.
- The proponent is entitled to a fair administrative decision-making process from NEMA and other State organs.

6.3.2 The Environmental Management and Co-ordination Act (EMCA) Cap. 387 of the Laws of Kenya

The Act is the framework environmental law and aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with the National Environment Policy, 2013.

Relevance to the proposed project

Section 58 of the Act requires proponents of a development likely to have deleterious effects on the environment to prepare and submit an ESIA report to NEMA for consideration for decision making. This study report is prepared to comply with the provisions of this section. In addition, several Regulations have been enacted by the line Ministry to operationalize the Act as discussed below.

1. **Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003**

   These Regulations guide the preparation of ESIA including how experts should conduct the ESIA process and guidelines and standards to be met by the reports. The Regulations were reviewed in 2016 to align them to the Kenya Constitution 2010. They were also recently amended (2019) to address challenges that have been reported since they were gazetted. This report complies with the provisions of these Regulations.

2. **Environmental Management and Coordination (Waste Management) Regulations, 2006**
   The Regulations focuses on management of solid wastes, industrial wastes, hazardous wastes, toxic substances and radioactive substances. It is aimed at addressing the impact of solid waste pollution on the environment which become important sources of disease-causing pathogens. In compliance with these Regulations, the proponent will ensure proper waste disposal throughout the project cycle and procure the services of a NEMA licensed contractor for solid waste management.

3. **Environmental Management and Coordination (Water Quality) Regulations, 2006**
   These Regulations address the challenges of pollution of water resources and conservation. It consists of VI parts and eleven schedules dealing with protection of sources of water for domestic use to miscellaneous provisions. For the proposed development, the proponent and contractor should implement measures to prevent water pollution from construction activities and effluent discharge at operational phase. Once the development is operational, the proponent will apply and obtain an EDL from NEMA annually.

4. **Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009**
   These Regulations were gazetted to manage noise levels to levels that do not cause a disturbance to the public. The operations at the site including construction works, machinery operation and truck movement are likely to generate noise above the acceptable limits within the neighborhood. Appropriate Personnel Protective Equipment will be provided for employees engaged in activities that may produce noise above the acceptable limits within the project area (in excess of 60dB (A).

5. **Environmental Management and Coordination (Air Quality) Regulations, 2014**
   These regulations were aimed at controlling, preventing and abating air pollution to ensure clean and healthy ambient air. Excavation and levelling activities will generate dust that will need to be monitored and managed during the construction phase of the grain storage silos.
   Further, air pollution at operation will emanate from odors from fermenting grains. A major contributor to the odor is dimethyl disulfide which has been identified as a key component of the emitted volatiles. The proponent is obliged to address any source of air pollution from the construction and operations of the grain storage silos.

6.3.3 ISO 8456:1985

The international standard ISO 8456 concerning storage equipment for large quantities of bulk solid materials, gives special safety rules for storage equipment for loose bulk materials, such as hoppers, silos, storage bins and bunkers, and bin gates. These safety rules apply regardless of the use for which the equipment is intended. It makes it necessary to use suitable pressure re-stabilising devices for silos and hoppers which, due to their loading and unloading methods, are subject to internal pressure variation. These devices, usually known as pressure relief valves, are basically valves that allow air into and out of the silo and therefore guarantee the safety of the silo if there is a change in internal pressure.

Relevance to the proposed project

The proponent should comply with the safety rules outlined in this International Standard.

6.3.4 The Public Health Act, 2012

This is the primary act in Kenya which deals in food safety. The Department of Public Health safeguards the health of consumers through food safety and quality control, surveillance,

prevention and control of food borne diseases/illnesses. The Act empowers the counties to enforce food and environmental hygiene. Effective enforcement of food safety laws is necessary to minimize the frequency of food-borne diseases, social burdens of health care, enhance *per capita* revenues and productivity, food security, and, threats to tourism and foreign trade.

Relevance to the proposed project
The proponent should ensure compliance with Act by providing clean, healthy and safe environment during the construction and operation of the grain storage silos.

6.3.5 The Food, Drugs and Chemical Substances Act, 2013
This Act provides rules for the placing on the market of food, drugs for man and animal and chemical substances, establishes the Public Health (Standards) Board and makes otherwise provision for the control of the quality and safety of food, drugs and chemical substances to be placed on the market of Kenya.

This Act states in part that:
Any person who sells any food that:
(a) Has in or upon it any poisonous or harmful substance; or
(b) Is unwholesome or unfit for human consumption; or
(c) Consists in whole or in part of any filthy, disgusting, rotten, decomposed or diseased substance or foreign matter; or
(d) Is adulterated,
Shall be guilty of an offence

Relevance to the proposed project
The proponent shall ensure that all activities comply with the provisions of this Act.

6.3.6 Agricultural Produce (Export) Act, 2012
An Act of Parliament to provide for the grading and inspection of agricultural produce to be exported, and generally for the better regulation of the preparation and manufacture thereof.

It states that no person shall export, or cause or permit to be exported, or attempt to export, any agricultural produce for which rules are made unless and until such produce has been inspected, or inspected and branded, in manner prescribed by such rules. In addition, no person shall export, or cause or permit to be exported, or attempt to export— (a)the produce of any animal intended for human consumption, which is infected with any disease rendering such produce unfit for such consumption; or (b)agricultural produce intended for human consumption which at the time of presentation for export is unfit for such consumption; or (c)agricultural produce which owing to its condition or for any other reason is unlikely to be brought to its destination in a sound or good marketable state. (2) The question whether any produce is or is not in such a condition as would render it subject to the prohibitions contained in this section shall be determined by the inspector according to the instructions given generally or specifically by the Director.

Relevance to the proposed project
The proponent should comply with the provisions of this act throughout its operations.

6.3.7 Pest Control Products Act, 2009
An Act of Parliament to regulate the importation, exportation, manufacture, distribution and use of products used for the control of pests and of the organic function of plants and animals and for connected purposes. This Act regulates the production and placing on the market of a product, device, organism, substance or thing that is manufactured, represented, sold or used as a means for

directly or indirectly controlling, preventing, destroying, attracting or repelling any pest and establishes a Pest Control Products Board for this purpose.

6.3.8 Occupational Safety and Health Act, 2007

It is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. Although the OSHA, 2007 repealed the Factories and Other Places of Work Act Cap. 514 of the Laws of Kenya, it inherited all the subsidiary legislation issued under Cap. 514. Examples of subsidiary legislation inherited include:

- Docks Rules L.N. 306 of 1962
- Eyes Protection Rules L.N. 44 of 1978
- Building Operations and Works of Engineering Construction Rules L.N. 40 of 1984
- Electric Power Special Rules L.N. 340 of 1979
- First Aid Rules L.N. 87 0f 1964
- Cellulose Solutions Rule L.N. 87 of 1964
- Health and Safety Committee Rules L.N. 31 of 2004
- Medical Examination Rules L.N. 24 of 2005
- Noise Prevention and Control Rules L.N. 25 0f 2005
- Fire Risk Reduction Rules L.N. 59 0f 2007
- Hazardous Substances Rules L.N. 60 of 2007

Relevance to the proposed project

The proponent should provide the workers with adequate and appropriate PPE and enforce their use at throughout the construction phase.

6.3.9 The Water Act, 2016

The Constitution acknowledges access to clean and safe water as a basic human right and assigns the responsibility for water supply and sanitation service provision to the 47 established counties. The purpose of the 2016 Water Act is to align the water sector with the Constitution's primary objective of devolution. The Act establishes several organs to ensure development and sustainable use of water resources. These include the Water Resources Authority (WRA), the Water Sector Trust Fund (WSTF), Water Resources Users Associations (WRUAs), Water Services Providers (WSPs) and Water Works Development Agencies among others (Table 14).

Table 14: Water Resources Management Institutions and their roles as established under the Water Act, 2016.

Institution	Role
Water Service Boards (WSBs)	Development and maintenance of regional water provision infrastructure
Water Service Providers (WSPs)	Provision of reticulated supply
Water Resources Authority (WRA)	The Authority is responsible, among other things, for the issuance of permits for boreholes
Water Services Regulatory Board (WSRB)	License all providers of water and sewerage services who supply water services to more than twenty households

Relevance to the proposed project

The Water Act provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services.

6.3.10 The Physical and Land Use Planning Act, 2019

The Act provides for the planning, use, regulation and development of land and for connected purposes. It was enacted to ensure that every person engaged in physical and land use planning

shall promote sustainable use of land and livable communities which integrates human needs in any locality. The Act allows the County Government to prepare a local physical and land use development plan in respect of a city, municipality, town or unclassified urban area.

Relevance to the proposed project
The proponent will obtain pertinent approvals and requisite operational licenses from the County Government of Mombasa.

6.3.11 The National Construction Act, 2014
The National Construction Authority (NCA) was established through an Act of Parliament with the role to oversee the construction industry and coordinate its development. The Authority accredits and registers contractors as well as certifies skilled construction workers and site supervisors and regulates their professional undertakings. The Authority promotes and ensures quality assurance in the construction industry through standardization and improvement techniques and materials.

Relevance to the proposed project
The proponent will ensure compliance with the provisions of the Act throughout the construction process.

6.3.12 The County Government Act, 2012
The new constitution grants County Governments the powers to grant or to renew business licenses or to refuse the same. To ensure implementation of the provisions of the new constitution, the County Governments are empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and well-being of the general public.

Relevance to the proposed project
The Act gives right to access private property at all times by the County Government officers and servants for inspection purposes.

6.4 Institutional arrangements
To implement the above legal framework the government has established a number of institutions with varying mandates of implementation. These include;

1. The National Environment Management Authority (NEMA) to implement the Environmental Management and Coordination Act and associated Regulations.
2. The National Construction Authority to oversee the construction industry and its development.
3. The Directorate of Occupational Safety and Health Services (DOSHS) to implement the Occupational Safety and Health Act alongside the subsidiary legislation.
4. The County Government of Mombasa to implement the County Government Act, its by-laws and the Public Health Act.
5. The Water Resources Authority to implement the Water Act.
6. The Public Health Department to implement the Public Health Act and coordinate the multiple institutions (agencies) involved in food safety management.
7. Kenya Plant Health Inspectorate Services (KEPHIS) to offer inspectorate services on all matters related to plant health and quality control of agricultural inputs and produce and to implement regulations/procedures for importation/exportation of any form of plant materials
8. Kenya Bureau of Standards (KEBS) to ensure quality assurance

7 CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

The proposed project is considered important and beneficial as it will contribute towards achieving food security and improved nutrition in line with the second Sustainable Development Goal and the Kenya's Big. Additionally, it will increase grain handling capacity, help in preventing post-harvest losses, create employment opportunities to the local youth, earn the proponent an income and generate revenue to the government.

Alongside the positive impacts, several environmental and social impacts will arise at different phases of the project cycle. The main concerns include quality assurance, waste generation, increased demand for environmental resources, noise and air pollution, safety and health risks, grain entrapment risks, silo gas formation, fire outbreaks and explosions, aflatoxicosis and pest infestation. These impacts are found mitigatable and hence the ESIA proposes a comprehensive Environmental Management Plans and Monitoring plans to improve the environmental performance during the entire project cycle.

7.2 Recommendations

The main recommendation of the EIA is the need for concerted implementation of the EMP and Monitoring Plans by the proponent. These include;

1. Installing waste receptacles at the site with a capacity for waste segregation
2. Procuring the services of a NEMA registered waste handler to dispose off the solid waste
3. Installing a bio digester to manage effluent
4. Provision of adequate and appropriate PPE to workers and visitors to the site
5. Developing and implementing a safety and health policy at the workplace
6. Displaying signage warning of potential hazards at various sections of the silos
7. Restricting access to the silos only to authorized personnel
8. Providing good ventilation in and around the silos
9. Developing and implementing a fire and emergency response plan
10. Complying with the requirements of the relevant Kenya Standard(s) or other standards approved by KEBS
11. Complying with the provisions of ISO 8456:1985
11. Complying with the Environmental Management and Coordination (Air Quality) Regulations, 2014
12. Complying with the Environmental Management and Coordination (Water Quality) Regulations, 2006
13. Complying with the Environmental Management and Coordination (Waste Management) Regulations, 2006
14. Complying with the Occupational Safety and Health Act, 2007

On the basis of a commitment by the proponent to implement the proposed mitigation measures and the Environmental Management Plan, we recommend the issuance of an EIA License as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya and Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003.

8 REFERENCES

1. FAO 1970; Handling and storage of food grains in tropical and subtropical areas by D.W. Hall
2. Government of Kenya Policies
   - National Environmental Policy, 2013
   - National Food and Nutrition Security Policy, 2011
3. Other relevant policies
   - Kenya Vision 2030
   - Sustainable development goals
   - Integrated Strategic Urban Development Plan (Mombasa Vision 2035)
4. Government of Kenya Statutes:
   - The Constitution of Kenya 2010
   - Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya
   - Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003
   - Environmental Management and Coordination (Air Quality) Regulations, 2014
   - Environmental Management and Coordination (Noise and excessive vibration) (Pollution) Regulations, 2009
   - Environmental Management and Coordination (Waste Management) Regulations, 2006
   - Environmental Management and Coordination (Water Quality Regulations, 2006
   - The County Government Act, 2012
   - The National Construction Act, 2014
   - The Occupational Safety and Health Act, 2007
   - The Physical and Land use Planning Act, 2019
   - The Public Health Act, 2012
   - The Water Act, 2016
5. Documents provided by the proponent

9 LIST OF ANNEXTURES

1. Copy of certificate of lease for Kilindini Warehouses Limited
2. Copy of Certificate of Incorporation for Kilindini Warehouses Limited
3. Copy of PIN Certificate for Kilindini Warehouses Limited
4. Copy of approval of the scoping report and Terms of Reference for the study
5. Copies of the development plans for the proposed silos
6. Copy of the baseline water quality analysis report
7. Copy of the baseline air quality and noise monitoring report
8. Copies of filled in questionnaires
9. Copy of NEMA practicing license for the firm, Envasses Environmental Consultants Limited
10. Copies of NEMA practicing licenses for Lead Experts, Mr. Simon Nzuki & Ms. Jane Gitau