ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED CONSTRUCTION OF WATER PAN AND INSTALATION OF IRRIGATION SYSTEM AT CHANGARA, ANGURAI EAST WARD, TESO NORTH SUB-COUNTY, BUSIA COUNTY.

In accordance with
Environmental Management and Coordination Act (EMCA), CAP 387,
Environmental (Impact Assessment & Audit) Regulation, 2003.

CERTIFICATION.

We do hereby submit the Environmental and Social Impact Assessment Report for the proposed development of water pan and installation of Irrigation system. To our knowledge all information contained in this report is accurate and a truthful representation of all findings as relating to the proposed project as per project description by the proponent.

PROPONENT

Name	Contact Person and Mobile Number	Signature and Date
COUNTY GOVERNMENT OF BUSIA, DEPARTMENT OF AGRICULTURE AND ANIMAL RESOURCES.	MR. OKISEGERE	

ESIA/EA EXPERT

Name of Expert	Details	Signature of and Date

ACKNOWLEDGEMENT

The assessment team wishes to thank the proponent and the entire Community of Changara at large for the cooperation and assistance accorded to the ESIA consultancy team during the field visits and public participation in provision of relevant pertinent data /or information and documents for the proposed project.

EXECUTIVE SUMMARY

1.0 Introduction

Kenya's economy is largely rural-based and heavily dependent on its natural resource base. Water resources usually play a key role in the economy for all sectors including urban and rural consumption, energy generation, agricultural and livestock development, industry and tourism. Kenya is classified by the U.N. as a chronically water-scarce country. The country's natural endowment of freshwater is highly limited, with an annual renewable freshwater supply of about 647 cubic meters per capita, significantly below the 1,000m3 capita set as the marker for water scarcity. Despite this, the UN Sustainable Development Goal Six (SDG-6) aims at ensuring access to safe and affordable water for all by year 2030. This is in line with Article 43 of the National Constitution of Kenya which provides for the access to clean and safe water for all. Similarly, one of the flagship activities for Kenya Vision 2030 is aimed at achieving universal access in water and sanitation services by 2030. All these targets call for equitable sharing of scarce water resources among the 47 counties in the country.

The Environmental and social Impact Assessment findings presented in this report provides a critical examination of issues considered important in fulfilling the requirements of a clean, secure, sustainable and healthy environment. The report is aimed at establishing the impacts of the development of water pan and installation of an irrigation system on the environment and the community as proposed by the Department of Agriculture and animal Resources under the Climate Smart-Agriculture Programme.

The Objectives of the project are;

i. To Increase land area under crop production hence improve crop yields
ii. To Increase food security
iii. To Provide water for animal watering
iv. To Reduce distance covered by residence to reach water points
v. To improve the living standards of the community

2.0 Scope, Objective and Criteria of the Environmental and Social Impact Assessment Study.

The Kenya Government policy on all new projects, programmes or activities requires that an Environmental and social Impact Assessment (EIA) is carried out at the planning stages of the proposed project to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation and decommissioning of the proposed development. The scope of this project, therefore, covered:

i. The baseline environmental conditions of the area,
ii. Description of the proposed project,
iii. Provisions of the relevant environmental laws,
iv. Identification and discuss of any adverse impacts to the environment and the community anticipated from the proposed project,
v. Appropriate mitigation measures,
vi. Provision of an Environmental Management Plan (EMP) outline.

The overall objective of the project is to ensure that all environmental and social concerns are integrated in all the development activities in order to contribute to the sustainable development. Specifically the objectives are:

i. To identify potential environmental impacts, both direct and in direct
ii. To assess the significance of the impacts
iii. To propose preventive mitigating and compensative measures for the significant negative impacts of the project on the environment
iv. To generate baseline data for monitoring and evaluation of how well the mitigating measures are being implemented during the project cycle.
v. To present information on impact of alternative
vi. To present the results of the ESIA that can guide informed decision making
vii. To prepare EMP for the proposed project and decommissioning plan.

3.0 Terms of Reference (TORs)

The consultant incorporated the following terms of reference but not limited to;

a) Location of the proposed project

b) A concise description of the national environmental legislative and regulatory framework, baseline information and any other relevant information related to the project.
c) The objectives of the project.
d) The technology, procedures and processes to be used, in the implementation of the project.
e) The materials to be used in the construction of the project.
f) The products, by-products and waste to be generated by the project.
g) A description of the potentially affected environment and the society
h) The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
i) Analysis of alternatives including project site, design and technologies.
j) An environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment.
k) Provide an action plan for the prevention and management of the foreseeable accidents and hazardous activities in the course of the project implementation.
l) Propose measures to prevent health hazards and to ensure a secure and habitable working environment for the project staff.

4.0 Methodology

The methodology used in the study consisted of the following:

i. Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule 2 of EMCA, CAP 387 laws of Kenya.
ii. A site reconnaissance and visual survey to determine the baseline information of the project area
iii. Analysis of the project documents
iv. Discussion with the proponent , the community and the entire Project Team
v. Assessment of the site to detail the various existing and likely impacts.
vi. Assessment of health and safety issues
vii. Seeking public views through interviews, public meeting (baraza) and questionnaires.
viii. Proposal of mitigation measures to minimize any anticipated negative impacts.
ix. Preparation and submission of the ESIA report

5.0 Environmental Impacts

a) Positive impacts

- Employment opportunities
- Increased local incomes
- Economic growth
- Improved water supply
- Reduction in water fetching time
- Habitat support for migrant birds
- Water bird breeding
- Agricultural support
- Improved downstream water quality

b) Negative impacts

The potential negative environmental impacts of the proposed project and possible mitigation measures are summarized below;

Impact	**Proposed Mitigation Measure**
Noise and vibration	▪ Formulate an inspection and maintenance Program for the machines and equipment on site. ▪ Implement both engineering and administrative controls for machines and equipment to reduce noise pollution at the site.
Catchment erosion and reservoir siltation and long-term nutrient build-up and reservoir eutrophication	▪ The Proponent in collaboration with other partners should undertake education and awareness on proper land use practices around the Pan catchment areas.
Air Pollution: Dust generation.	▪ Sprinkling of water at the site and access roads during dry conditions to suppress fugitive dust
Solid waste	▪ Integrated Solid Waste Management to be encouraged ▪ Adhere to the provisions of the Waste Management Regulations of 2006

Soil pollution	▪ Provide spill kits on site and train worker on how to use them ▪ Provide drip trays where spills are likely to occur from machines and vehicles under repair
Air Pollution: Fumes	▪ Use of low sulphur diesel for diesel powered vehicles and equipment. ▪ Proper maintenance of machinery and vehicles ▪ Prohibit open burning of any kind of waste on site
Risk of Occupational accidents and diseases.	▪ Set up a health and safety committee and periodic site inspections, training and annual safety audits. ▪ Provide appropriate PPEs to workers and visitors to the site ▪ Adhere to the provisions of the occupational Health and Safety Act of 2007.
Soil erosion during construction	▪ Put in place soil erosion control measures ▪ Limit construction to the project area alone
Land Degradation	▪ Limit excavations to areas marked for development ▪ Apply a layer of selected backfill material on the access roads
Vegetation clearance	▪ Ensure vegetation is only cleared in areas where the pan will be dug and Trees to be protected in-situ to be clearly identified and communicated to the construction staff.
Insecurity	▪ Employ construction workers who possess valid certificate of good conduct ▪ Formulate a comprehensive security plan and implement it. Contract a reputable security firm to be in charge of security at the site. ▪ Liaise with the neighbors and the local administration in security management

Table 1: Summary of Environmental and Social Impact Mitigation Measures

Recommendations

Several measures have been suggested to prevent or minimize the negative environmental impacts and to maximize the positive ones using a comprehensive Environmental Management Plan. The measures mainly focus on the following points:-

- Use of alternative materials or products which are less damaging to the environment
- Reduction of impacts of waste through minimization of waste generation, recycling, reuse and responsible disposal
- Use of appropriate technologies to mitigate environmental impacts of various activities
- Ensuring compliance with relevant safety, health and environmental regulations
- Reduction of exhaust emissions through proper planning of vehicle movements and use of lead free fuel.

Conclusion

Considering the positive socio-economic and environmental benefits that will accrue as a result of the proposed development, and the ESIA study having found no major/significant impacts to arise from the development, it is our recommendation that the project be allowed to proceed with the understanding that the proponent will adhere to the mitigation measures recommended herein and will further still implement the proposed Environmental Management Plan (EMP) to the latter. An initial environmental audit will also be carried within a period of 12 months after commencement of the operations to check compliance to the set policies, standards and laws and the proponent will contract a licensed firm to provide Environmental Health and Safety Services for the construction phase of the proposed development.

LIST OF ACRONYMS

CPP	CONSULTATION AND PUBLIC PARTICIPATION
NEMA	NATIONAL ENVIRONMENTAL MANAGEMENT AUTHORITY
ESIA	ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
EA	ENVIRONMENTAL AUDIT
EMCA	ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT
EMP	ENVIRONMENTAL MANAGEMENT PLAN
TOR	TERMS OF REFERENCE
PPG (E)	PERSONAL PROTECTIVE GEAR (EQUIPMENT)
OSHA	OCCUPATIONAL SAFETY AND HEALTH ACT

LIST OF TABLES

LIST OF PLATES

TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

1.0 Introduction

Kenya's economy is largely rural-based and heavily dependent on its natural resource base. Water resources usually play a key role in the economy for all sectors including urban and rural consumption, energy generation, agricultural and livestock development, industry and tourism. Kenya is classified by the U.N. as a chronically water-scarce country. The country's natural endowment of freshwater is highly limited, with an annual renewable freshwater supply of about 647 cubic meters per capita, significantly below the 1,000m^3 capita set as the marker for water scarcity.

Kenya's Water Resources (Amounts in m^3)	
Total Renewable Water	30,700,000,000
Total Water Demand	32,955,000,000
Annual Water Demand per Capita	792
Annual Renewable Resources Available per Capita	713
Renewable Amount from Surface Water	30,200,000,000
Renewable Amount from Groundwater	3,500,000,000
Renewable Amount of Overlap of Groundwater and Surface Water	3,000,000,000

Table 1: Water Resources situation in Kenya

Despite this, the UN Sustainable Development Goal Six (SDG-6) aims at ensuring access to safe and affordable water for all by year 2030. This is in line with Article 43 of the National Constitution of Kenya which provides for the access to clean and safe water for all. Similarly, one of the flagship activities for Kenya Vision 2030 is aimed at achieving universal access in water and sanitation

services by 2030. All these targets call for equitable sharing of scarce water resources within the country.

The National Policy on Water Resources Management and Development (Sessional Paper No.1 of 1999) was formulated to provide directions for effective water resource management as key to both basic human needs and sustainable economic development. In the recent past, the National Water Policy (2012) was formulated to take cognizance of the existing water resources situation in the country and provide direction for action in a unified national perspective. One of the key obligations in the National Water Policy (2012) is the need to increase per capita water availability above the international benchmark of 1000 m^3 by 2030. In May 2013 through Executive Order No. 2/2013 the Ministry of Environment Water and Natural Resources (MEWNR) was established and mandated to undertake protection, conservation and development of environment and natural resources for sustainable development.

In April 2015 Ministry of Environment Water and Natural Resources (MEWNR) was again split to form the current Ministry of Water and Irrigation (MWI), giving recognition to the crucial role played by the irrigation sub-sector in national development. The vision of the ministry is to ensure water resources availability and accessibility by all while the mission is to contribute to national development by promoting and supporting integrated water resource management to enhance water availability and accessibility.

The proposed project entails construction of water pan of 56,000m^3 and installation of irrigation system at Akobwait Sub – location, Changara Location, Angurai Division, Teso North sub-County, Busia County. The project is expected to benefit more than 6,000 people in Angurai East Ward.

The Kenya Government policy on projects of such nature and scale, programmes or activities requires that an Environmental and Social Impact Assessment Study be carried out at the planning stages of the proposed undertaking to ensure that significant impacts on the environment are taken into consideration during the design, construction, operation and decommissioning of such projects, programmes or activities.

Therefore, in compliance with the law and to avoid unnecessary conflicts that may retard development in the country, the proponent undertook this Environmental Impact Assessment and incorporated environmental concerns as required.

Plate 1: Proposed Site for the Construction of the water pan, Changara, Teso North Sub-County.

1.2 Objectives of the EIA

Environmental Impact Assessment (EIA) is a process having the ultimate objective of providing decision makers with an indication of the likely environmental consequences of a proposed activity. The main objectives of this EIA therefore include the following:

i. To identify and evaluate the significant environmental impacts of the project
ii. To evaluate the impacts of the various alternatives on the project
iii. To propose mitigation measures for the significant negative impacts of the project on the environment.
iv. To generate baseline data for monitoring and evaluating impacts, including mitigation measures during the project cycle.
v. To seek the views and concerns of all stakeholders in regards to the proposed project.

vi. To highlight environment issues with a view to guiding policy makers, planners, stake holders and government agencies to make environmentally and economically sustainable decisions

vii. To incorporate Environmental Management Plans and monitoring mechanisms

1.3 Terms of Reference (TOR)

The following are the Terms of Reference for the proposed project as developed by the lead expert in conjunction with the project proponent;

i. Assessment and description of location/site, objectives, scope, nature of the proposed project,

ii. Analysis of the proposed project activities during the proposed project cycle; construction, operation, decommissioning phases,

iii. Establish the suitability of the proposed project in the proposed location,

iv. Review and establish all relevant baseline information as will be required by NEMA (Physical, Biological and Social Cultural and economic) and identify any information gaps,

v. Description and analysis of policy legal and institutional framework including but not limited to Kenyan policies, laws, regulation and guidelines which have a bearing on the proposed project and will also serve as benchmarks for monitoring and evaluation, and future environmental audits,

vi. In-depth description of the proposed project and associated works together with the requirements for carrying out the works,

vii. Analysis of the designs, technology, procedures and processes to be used, in the implementation of the works,

viii. Consultation and Public Participation (CPP): Identify key stakeholders and affected persons; hold a public meeting and provide /collect written evidence i.e. minutes,

ix. Identify and analyze proposed project alternatives including but not limited to: Scale and extent; project site alternatives, no project alternatives, design alternatives, material alternatives and technologies alternatives,

x. Identify, predict and carry out in-depth analysis all actual potential and significant impacts on flora, fauna, soils, air, water, the social, cultural and community settings; the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated to be generated by the proposed project, both positive and negative throughout the project cycle,

xi. Recommend sufficient mitigation measures for all the potential negative impacts identified,

xii. Analyze occupational health and safety issue associated with the proposed project,

xiii. Develop an Environmental Management Plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.

1.4 Scope of the study

The EIA study will involve the following;

a) A description of the project
b) Documentation of all baseline information
c) Socio-economic study to get the views of different stakeholders using:
    i. Questionnaires
    ii. Interviews
    iii. Public meeting/Barraza
d) Review of the policy, legal and administrative framework
e) Prediction of any sources of conflicts and making relevant recommendations
f) Assessment of both the positive and negative impacts of all environmental and components
g) Developing mitigation measures for the negative impacts identified
h) Designing of an Environmental Management Plan for the project
i) Designing a monitoring and evaluation plan
j) Examining the projects phases, stages and activities to be undertaken and integrating them with environmental characteristics
k) The monitoring programmes, parameters and procedures to be put in place for control and corrective actions in case of emergencies shall also be examined.

1.5 Methodology

The methodology used for preparation of this EIA report is stated in the steps below;

a) Screening of the project, a process that identified the project as being among those requiring EIA under schedule 2 of the EMCA CAP 387.
b) A scoping exercise that identified the key issues to be addressed in the assessment.

c) Documentary review on the nature of the proposed activities, policy and legal framework, environmental setting of the area and other available relevant data/information.
d) Public participation and discussions with the local community, proponent and the project team.
e) Physical investigation of the site and the surrounding areas using a pre-prepared checklist identifying possible environmental and human safety issues that are likely to be affected,
f) Reviewing the proposed project designs and implementation plan/schedules with a view to suggesting suitable alternatives,
g) Developing an EMP outline with responsibilities, schedules, monitorable indicators and time frames among other aspects,
h) A comprehensive report including issues as listed in the Environmental (Impact Assessment) Regulations 2003.

The data used for developing the ESIA can be categorized into two, primary and secondary data, as tabulated below;

Type of Data	**Source of Data**
Secondary data	Published books, official government documents and statutes, plans, reports and documentation from members of the project team.
Primary Data	Formal/informal interviews, field observations, pictures, questionnaires, views from resident attendees during the public baraza and input from the project team

Table 2: Data collection methods

1.6 EIA Organization and Structure

The EIA was carried out to full completion within a period of three weeks from the date of undertaking. The Consultant (Lead Expert) coordinated the day-to-day functions and any related institutional support matters.

1.7 Reporting and Documentation

The Environmental and Social Impact Assessment Study Report drafted from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared and submitted by the proponent for review. The Consultant ensured constant briefing of the client during the exercise. Description plans and sketches showing various activities are part of the Appendices.

1.8 Responsibilities and Undertaking

The Consultant undertook to meet all logistical costs relating to the assignment, including those of production of the report and any other relevant material. The consultant arranged for own transport and travels during the exercise. On the site of the proposed development project, the proponent provided a contact person(s) to provide information required by the Consultant. The proponent also provided site plan(s) showing roads, and the actual sizes of the sites, details of raw materials, proposed process outline and anticipated by-products. The output from the consultant includes the following:

- An Environmental Impact Assessment report comprising of an executive summary, assessment approach, baseline conditions, anticipated impacts and proposed mitigation measures,

- An Environmental Management Plan outline, which also forms part of the report recommendations.

1.9 Methodology Outline

Since the intended development and use of the facility will be in line with what exists in the surrounding areas, an Environmental and Social Impact Assessment Study report would be seen to be adequate to draw attention to the potential positive and negative environmental impacts; provide mitigation measures for negative ones and enhance the positive impacts. The general steps followed during the assessment were as follows:

1. Environment screening, in which the project was identified as among those requiring environmental impact assessment under schedule 2 of EMCA, CAP 387.
2. Environmental scoping that identified the pertinent environmental issues
3. Desk Stop studies and interviews
4. Physical inspection of the site and surrounding areas

5. Reporting.

- **Environmental Screening**

This step was applied to determine whether an environmental impact assessment was required and what level of assessment was necessary. This was done in reference to requirements of the EMCA, CAP 387, and specifically the second schedule. Issues considered included the physical location, sensitive receptors in close proximity to the site and the nature of anticipated impacts. It was concluded that the proposed project falls within the category of projects under the second schedule of EMCA that requires an EIA to be done before implementation.

- **Environmental Scoping**

The Scoping process helped narrow down onto the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, natural/ecological and social, economic and cultural aspects. The site history and the facilities in close proximity to the site were considered during this stage.

- **Desktop Study**

This included documentary review on the nature of the proposed activities, project documents, designs policy and legislative framework as well as the environmental setting of the area among others. It also included discussions with managers and design engineers as well as interviews with staff and neighbors.

- **Site Assessment**

Field visits meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts were conducted. It also included further interviews with staff, neighbors and key stakeholders.

- **Reporting**

In addition to constant briefing on the environmental aspects and impacts pertinent to the project, this Environmental and Social Impact Assessment Study Report was prepared and shared with the client. The contents were presented for submission to NEMA as required by law.

CHAPTER TWO: DESCRIPTION OF THE PROPOSED PROJECT

2.1 Project background

The project is under the Department of agriculture and animal resources, County Government of Busia under the programme of Climate Smart Agriculture programme funded by the World Bank. The project entails the construction of water pan for both domestic use, watering of animals, irrigation purposes and flood control.

2.2 Project Location

The proposed site for the project is located in Akobwait Location, Changara sub-Location, Angurai East ward, Angurai Division in Teso North Sub-County, Busia County.

2.3 Project Description

The proposed development will comprise of water pan that will be used for the provision of domestic water for a population of 6,000 people in the community, watering of animals, irrigation purposes to increase food security and improve local community livelihood and flood control downstream.

A reservoir of capacity 100,288m3 is required to satisfy the all the needs of the people of Changara. For a depth of 3.5m the required area is 169m * 169m. From the topographic survey undertaken a pan area of 12,000m^3 is available to store 56,000m^3 of water. This means that water pan to be constructed will accommodate 44,288m3 of water.

2.3.1 Pan Design

Pan axis

From the map of the area, we can able to see the highest and the lowest points of the site. The contours show the constriction where the embankment wall would require the least fill material.

Embankment

From the dam axis, it can be depicted that the pan will be on the lower point of the area, hence the embankment is in the straight line. This shows the location of the pan axis which was selected in a way to minimize the fill material. The best location is shown on the map.

Embankment height

The height was obtained from the elevation difference of the area.

Highest point=1376m

Lowest point=1372m

Height (Z) =4m (<5m, Ok.)

Crest width

Crest width was calculated from the embankment height as shown below.

W= (Z/5) +3

= (4/5) +3

= 3.8m

4m used because machinery is used in the construction of the pan.

Crest length

The alignment was selected basing on the contour layout to give the shortest crest length and allow for the economical location of the spillway route. The crest length taken to be 180m from the dimension of the pan.

Pan freeboard

It was determined by calculating the following parameters; wind set up, significant wave height and wave run up.

Assuming a maximum wind speed of 130km/day for Changara

Wind set up

The fetch and depth found from the pan size, shown above thus wind set up calculated using the formula:

Zs= (Vw2*F)/(63,200*d) meters

Pan fetch (F) = 180m

Mean wind speed (Vw) = 130km/day=5.41km/hr

Reservoir depth (d) = 4m

Zs= (4.752*180)/ (63,200*4)

= 0.0033m

Significant wave height

Using the wind speed and the fetch, significant wave height (Zw) can be found as; Zw = 0.005Vw1.06*F0.47 (m)

= 0.005*5.411.06*1800.47

= 0.34m

Wave run up

To calculate the wave run up, wave period calculated as;

tw= 0.32Vw0.44*F0.28 (min)

= 0.32*5.410.44*1800.28

= 2.88min

Using wave period, wavelength calculated as shown;

$\lambda = 1.56tw^{2}$

= 1.56*2.882

= 9.59min

Assuming a maximum wind speed of 130km/day for Changara

Wind set up

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Using wave period, wavelength calculated as shown;

$\lambda = 1.56tw^2$

= 1.56*2.882

= 9.59min

The ratio of significant wave height to wavelength (Zw/λ) should not exceed 0.7, hence wave run up is finally calculated as;

Zr= 0.7*(Zw/λ)

= 0.7*(0.34/9.59)

= 0.025 m/min

Required minimum pan freeboard

Freeboard calculated by summing up wind set up, significant wave height and wave run up

Freeboard = Zs + Zw + Zr

= 0.0033 + 0.34 + 0.025

= 0.37m

Note- A freeboard of 1m allowed. The value of the freeboard calculated above shows that, the wave action on the pan has negligible effects.

Embankment slope

From the soil map, the soil has granular distribution. Given embankment height being equal to 4m, hence slope selected from the table below;

Upstream slope= 2.5,

Downstream slope= 2

Embankment Slopes

Embankment height	**Fill material**	**Slope**	
		Upstream	Downstream
≤5m	Good granular	1/2.5	½
5m to 10m	Good granular	1/2.5	½
	Clay	1/2.5	1/2.5

Table 3: Guidelines for the Design, Construction and Rehabilitation of small dams and pans in Kenya (Kenya- Belgium water development programme Nairobi, June 1992).

Embankment protection

To protect the embankment against wave action and erosion, grassing of both downstream and upstream slope is required.

Fencing also of the pan helps to prevent the animals getting in to the pan, this is accomplished by building water troughs outside the pan and fed using delivery pipes of 5cm in diameter. Also protected by planting stabilizers.

Again latrines and bathrooms will be built around the place so that as people bring their livestock, they can take a bath also.

Spillway design

For the case of design, its proposed to have a pan height of 4m.It is a medium risk pan. For this reason, a return period of 10 years was adopted. A cut spillway with a general trapezoidal section was designed. The spillway is located on the entrance of the pan, two spillways on opposite sides are designed.

Earthwork volume

The volume of earth to be excavated and compacted was calculated from the drawings attached. Excavation Volume = 26,000m3.

Storage capacity of the pan = 56,000m3.

- More fine details of the specifications and features of the proposed project can be obtained from the drawings (*attached in the appendix section).*

2.4 Construction Inputs

The project inputs include the following:

i. Construction raw materials i.e. sand, cement, stones, clay materials among others. All these should be obtained from within.
ii. Construction machines including machinery such as trucks, concrete mixers, and tools and other relevant construction equipment. These will be used for the transportation of materials, clearing of the site and construction debris. Most of the machinery will use petroleum products to provide energy.
iii. A construction labour force of both skilled and non-skilled workers.

2.5 Construction Activities

2.5.1 Description of the Project's Construction Activities

2.5.1.1 Pre-construction Investigations

The implementation of the project's design and construction phase will start with thorough investigation of the site's biological and physical resources in order to minimize any unforeseen adverse impacts during the project cycle.

2.5.1.2 Clearance of Vegetation.

The site has some vegetation cover including grass and few trees. The proponent shall ensure as many indigenous trees as possible are used for re-vegetation as well as conserving the trees along the pan boundary.

Plate 2: Available trees next to the proposed pan construction site

2.5.1.3 Excavation and Embankment Works

Excavation will be carried out to prepare the site for construction of the pan. This will involve the use of heavy earthmoving machinery such as tractors and bulldozers.

2.5.1.4 Landscaping

To improve the aesthetic value or visual quality of the site once pan construction ceases, the Proponent will carry out landscaping. This will include leveling the site and planting tress. It is noteworthy that the proponent will use plant species that are available locally preferably indigenous ones for landscaping.

2.6. Description of the Project's Operational Activities

2.6.1 Toilets and wash rooms

The toilets to be constructed as described in this report will be used by the community during the operation of the pan

2.6.2 Solid Waste

The proponent takes cognizance of waste that will be generated during the construction, and operation of the project. An integrated solid waste management system will be applied at all phases of the project. First, the proponent will give priority to Reduction at Source of the waste materials. Under this option, the proponent will implement a solid waste management awareness programme for the community.

Secondly, Recycling and Reuse of the waste will be the second alternative in priority. Under these options the proponent plans to a management system of separating waste at the source. The recyclables will be sold to waste buyers.

2.7 Description of the Project's Decommissioning Activities

Decommissioning is an important phase in the project cycle and comes last to wind up the operational activities of a particular project. It refers to the final disposal of the project and associated materials at the expiry of the project lifespan. If such a stage is reached, the proponent needs to remove all materials resulting from the decommissioning from the site. The following should be undertaken to restore the environment:

a) The site should be well landscaped by flattening the mounds of soil
b) Planting indigenous trees
c) All the equipment should be removed from the site
d) Fence and signpost unsafe areas until natural stabilization occurs
e) Backfill surface openings if present

2.8 Products

2.7.1.1 By-Products

The by-products will be disposed-off as follows:

a) **Soil:** The soil generated during excavation will be reused within the project.
b) **Excess sand and ballast piles:** These can be used for future construction activities e.g. renovations. Upon completion of the project, these will be moved by the contractor to a suitable yard.

2.8 Project Budget and Duration

The proposed project is estimated to cost Kenya shillings, **Twenty Four Million, Eight Hundred and Twenty Four Thousand, Four Hundred and Seventy Six Only (24,824,476).**

3.1 Project Location

The proposed project is located in Akobwait Sub – location, Changara Location, Angurai Division, Teso North Sub-county, Busia County. The proposed site is (Twenty two) kilometers from the Teso North headquarters through Angurai market, Chamasiri and Angurai center.

3.2 Climate

Busia County fall within the Lake Victoria Basin and it has a bi-modal rainfall pattern. The long rains season falls between March and May while the short rains season falls between September and November with the rainfall amount ranges between 750mm and 1,800mm per annum. The average temperature is 22°C. The altitude is undulating and rises from about 1,130m above sea level at the shores of Lake Victoria to a maximum of about 1,500m in the Samia and North Teso Hills. Teso North Sub-County is relatively wet and experiences mean annual rainfall of approximately 700mm.

3.3 Infrastructure

Due to rapid population growth, provision of basic infrastructure for all has become an important concern of development planners in Busia County. The area is experiencing high population growth and is served by the all-weather road that connects Malakisi centres and Lwandayi center in Bungoma County. Changara Market serves the entire population of Changara Location and population from neighboring Bungoma County taking into consideration that it is located at the boundary between the two counties of Bungoma and Busia. The nearby feeder roads are all in good condition.

The project area has access to essential utility services including; electricity, roads and telecommunication. Thus, such infrastructural background assures the area of the potential to expand and diversify.

3.4 Geology

The geology of the area comprises mainly of rocks of the Archaean greenstone belt of western Kenya, especially the metavolcanics of the kakapel origin. The soils in the project location are generally good and this is good for farming activities. The catchment area for the pan is approximate by 50 ha.

3.4.1 Hydrogeology

The hydrology of an area is determined by the nature of the parent rock, structural features, weathering processes and precipitation patters. Ground water occurrence in Busia County is essentially determined by the geology of the area, including the tectonic features and permeability of the rocks.

The aquifer in this area is expected within the weathered and fractured portions of the granites below the soil cover. More potential zones are also in the fault zones. Recharge is accomplished from natural precipitation (rain), which infiltrates into aquifers (weathered and/or fractured zones). In terms of the well inventory, there are no boreholes drilled in the vicinity of the investigated area. Some hand dug wells are reported in the area. The wells are perennial but with reduced yield during the prolonged dry spell. Therefore shallow aquifers are expected in the weathered layers of granite below the soil layer.

3.5 Biological

3.5.1 Flora and Fauna

The vegetation within the area is influenced by the relatively warm temperatures and moderate rainfall. The area has vegetation that is essentially classified as trees which are both indigenous and exotic. The moderate rainfall supports agriculture, thus during the wet season, the surrounding area is covered by crop vegetation such as maize, beans, sweet potatoes and bananas. The notable invasive species encountered in the area was lantana camara.

The animals of importance noted in the location of the project area were mainly domestic and included; indigenous livestock, goats, sheep and poultry.

3.6 Settlement

Busia County is located in western Kenya; it borders Lake Victoria to the South West, the Republic of Uganda to the West, North and North East, and the following Counties; Bungoma and Kakamega to the East, and Siaya to the South East and South. It covers an area of 1,695 square km. The projected population of the county stands at 900, 946 with a population density of 439 people per km^2 as per the 2009 Census report. The settlement pattern is clustered in Changara center and evenly settlement is experienced in the entire location.

3.7. Socio- Economic and Related Activities

Economic activities in the area include subsistence farming mainly maize, beans and Bananas. Apart from crop farming, animal rearing is also an activity in the area and these include cows, sheep, goats and poultry.

3.8 Social amenities

The project area has access to basic social amenities like hospitals, churches, markets and other educational facilities.

3.9 Character of surrounding developments

Right from inception, concerted efforts have been put in place that a blend of both business premises, administrative offices, private farms and private residential homes is realized in the proposed project. The proposed development will thus blend with the existing neighborhood without causing any conflicts in Changara location.

4.1 Introduction

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

According to Sections 58 and 138 of the Environmental Management and Coordination Act (EMCA) CAP 387 of the laws of Kenya and Section 3 of the Environmental (Impact Assessment and Audit) Regulations 2003 (Legal No. 101), requires an Environmental Impact Assessment project/study report prepared and submitted to the National Environment Management Authority (NEMA) for review and eventual Licensing before the development commences. This was necessary as many forms of developmental activities cause damage to the environment and hence the greatest challenge today is to maintain sustainable development through sustainable use of natural resources without interfering with the environment.

4.2 Relevant Policies

There are a number of policies that are pertinent to this project, chief of which is the constitution of Kenya. A brief description of the policies is given bellow.

4.2.1 The Constitution of Kenya 2010

The Constitution of Kenya, promulgated into law on 27 September 2010 is the supreme law of the Republic of Kenya and binds all persons and all State organs at all levels of government. It provides the broad framework regulating all existence and development aspects of interest to the people of Kenya, and along which all national and sectoral legislative documents are drawn.

In relation to environment, Article 42 of Chapter 4, the Bill of Rights, confers to every person the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative measures, particularly those contemplated in Article 69, and to have obligations relating to the environment fulfilled under Article 70.

Chapter 5 of the new constitution provides the main pillars on which the 77 environmental statutes are hinged and covers "Land and Environment" and includes the aforementioned articles 69 and 70. Part 1 of the Chapter dwells on land, outlining the principles informing land policy, land classification as well as land use and property. Part 2 of the Chapter directs focus on the environment and natural resources. It provides for a clear outline of the state's obligation with respect to the environment. The Chapter seeks to eliminate processes & activities likely to endanger the environment. Article 69 states that

1) The State shall:

- Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
- Work to achieve and maintain a tree cover of at least ten percent of the land area of Kenya;
- Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
- Encourage public participation in the management, protection and conservation of the environment;
- Protect genetic resources and biological diversity;
- Establish systems on environmental impact assessment, environmental audit and monitoring of the environment;
- Eliminate processes and activities that are likely to endanger the environment;

In conformity with the Constitution of Kenya 2010, every activity or project undertaken within the Republic of Kenya must be in tandem with the state's vision for the national environment as well as adherence to the right of every individual to a clean and healthy environment. The proposed development project is a development activity that will utilize sensitive components of the physical and natural resources hence need for a clearly spelt out environmental management plan to curb probable adverse effects to the environment. The proponent will therefore adhere to the provisions of the Environmental management plan provided in this report to ensure the publics' and employee's right to a clean and safe environment is not infringed.

4.2.2 Kenya Vision 2030

Kenya Vision 2030 is the country's development blueprint covering the period 2008 to 2030. It aims at making Kenya a newly industrializing 'middle income country providing high quality life for all its citizens by the year 2030. The vision has been developed through an all-inclusive stakeholder

consultative process, involving Kenyans from all parts of the country. The vision is based on three 'pillars' namely; the Economic Pillar, the Social Pillar and the Political Pillar. The vision 2030 comes after the successful implementation of the Economic Recovery Strategy (ERS) for Wealth and Employment Creation 2003-2007.

The proposed project is in line with the economic and social pillars of Kenya vision 2030 and therefore its implementation will contribute to Kenya's realization of the objectives set in the Kenya Vision 2030.

4.2.3 Sessional paper No. 10 of 2014 on the National Environment Policy (Gok, 2014)

The policy's major objective is to harmonize environmental and developmental concerns to ensure sustainability. Furthermore, this policy ensures that environmental issues are taken into consideration before the commencement of development policies, programmes, plans and projects. The proposed project is therefore consistent with the Sessional Paper No. 10 of 2014.

4.2.4 Physical Planning Policy

The current policy governs the development and approval all building plans as provided for in the Physical Planning Act (Cap 286). The proposed project will be subjected to the provisions of this policy and legislation.

4.2.5 Public Health Policy

The prevailing public health policy calls upon the project proponent to ensure that buildings are adequately provided with utilities so that they are fit for human habitation. The proposed development has been designed by professional engineers and architects and as such will have all amenities/utilities that are essential for safeguarding public health for all people using the facilities during the construction, operational and decommissioning phases of the project. The proponent will adhere to the provisions of the relevant Act of parliament; Public Health Act (CAP 242).

4.2.6: The National Wildlife Conservation and Management Policy, 2018

The policy takes cognizance of the value of wildlife in Kenya and appreciates the need to sustainably manage wildlife for the benefit of both present and future generations. This Policy proposes a broad range of measures and actions responding to the wildlife conservation challenges and seeks to balance the needs of the people of Kenya with opportunities for sustainable wildlife conservation and management countrywide

4.2.7: Forest Conservation and Management Policy, 2016

The policy underscores the need to sustainably manage forest resources within Kenya. The policy acknowledges that forest conservation and management has faced a number of challenges in Kenya; the increasing demand for land and forest resources, inadequate funding that constrains the provision of public services among others. This Policy proposes a broad range of measures and actions responding to the challenges faced by the forest sector. The proponent will adhere to the tenets of this policy at all phases of the project.

4.2.8: Wetlands Policy

The policy acknowledges that wetlands highly productive ecosystems and that they perform many functions that maintain the ecological integrity of the systems and also provide many goods and services. The policy also underscores the functions and benefits provided by wetlands and their significance for the general public as they support agriculture, tourism, industry, and biodiversity conservation, social economic and cultural activities. The policy decries the deterioration of wetland quality and quantity due to mismanagement.

The Policy seeks to ensure that the plans and activities of the government, private developers and wetland stakeholders promote conservation and sustainable/ wise use of wetlands. It provides a framework for actions to improve institutional and organizational arrangements, address legislation and government policies, increase knowledge and awareness of wetlands and their values, review the status of and identify priorities for wetlands in a national context, and address problems at particular wetland sites.

4.2.9 National Policy for Disaster Management, 2009 (GoK, 2009e)

- The policy aims at Promoting the mainstreaming of disaster management and climate change into development planning and management for sustainability
- Providing for well-structured participation of society in disaster management by integrating traditional coping strategies into the DM systems
- Supporting climate change disaster risk reduction initiatives

2.2.10 National Policy on Occupational Safety and Health, 2012

The policy aim is;

- Affirmative action for addressing workplace gender biases in occupational safety and health
- Develop and implement workplace code of practice on HIV and AIDS at work

- Develop guidelines for provision of facilities for persons with disabilities and other special needs in workplaces
- Prevention of environmental pollution

4.3 Institutional Framework

There are 21 institutions, which deal with environmental issues in Kenya. Some of the key institutions include National Environmental Management Authority (NEMA), the Department of Resource Surveys and Remote sensing (DRSRS), the Water Department, The Kenya Forest Service (KFS), the Kenya Wildlife Service (KWS), the Kenya Forestry Research Institute (KEFRI), the National Museums of Kenya (NMK), the Kenya Marine and Fisheries Research Institute (KMFRI), the Kenya Agricultural Research Institute (KARI) among others. There are also local and international NGOs.

While implementing the project, both the proponent and the contractor will have to work in liaison with a number of these institutions when dealing with issues within the jurisdiction of the institutions.

4.3.1 National Environmental Council (NEC)

EMCA 1999 No. 8 part iii section 4 outlines the establishment of the National Environment Council (NEC). NEC is responsible for policy formulation and directions for purposes of EMCA; set national goals and objectives and determines policies and priorities for the protection of the environment and promote co-operation among public departments, local authorities, private sector, non-governmental organizations and such other organizations engaged in environmental protection programmes. It also performs such other functions as assigned under EMCA

4.3.2 National Environmental Management Authority (NEMA)

The objective and purpose for which NEMA is established is to exercise general supervision and co-ordinate over all matters relating to the environment and to be the principal instrument of the government in the implementation of all policies relating to the environment. A Director- General appointed by the president heads NEMA. The Authority shall:

- Co-ordinate the various environmental management activities being undertaken by the lead agencies and promote the integration of environmental considerations into development policies, plan, programmes and projects with a view to ensuring the proper management and rational utilization of the environmental resources on a sustainable yield basis for the improvement of the quality of human life in Kenya.

- Take stock of the natural resources in Kenya and their utilization and consultation, with the relevant lead agencies, land use guidelines.
- Examine land use patterns to determine their impact on the quality and quantity of the natural resources.
- Carry out surveys, which will assist in the proper management and conservation of the environment.
- Advise the government on legislative and other measures for the management of the environment or the implementation of relevant international conservation treaties and agreements in the field of environment as the case may be.
- Advise the government on regional and international environmental convention treaties and agreements to which Kenya should be a party and follow up the implementation of such agreements where Kenya is a party.
- Undertake and co-ordinate research, investigation and surveys in the field of environment and collect and disseminate information about the findings of such research, investigation or survey.
- Perform such other functions as government may assign to the Authority or as are incidental or conducive to the exercise by the authority of any or all of the functions provided under EMCA.

However, NEMA mandate is designated to various committees.

The contractor and the client will work in liaison with NEMA in getting various permits, licenses, approvals and generally in complying with the provisions of EMCA 1999 and any other subsidiary legislation under EMCA 1999.

4.3.3 Public Complains Committee (PCC)

The Committee performs the following functions:

- Investigate any allegations or complaints against any person or against the authority in relation to the condition of the environment in Kenya and on its own motion, any suspected case of environmental degradation and to make a report of its findings together with its recommendations thereon to the Council.
- Prepare and submit to the Council periodic reports of its activities which shall form part of the annual report on the state of the environment under section 9 (3) and
- To perform such other functions and excise such powers as may be assigned to it by the council.

4.3.4 National Environment Action Plan Committee

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

i. Contain analysis of the Natural Resources of Kenya with an indication as to any pattern of change in their distribution and quantity over time.
ii. Contain analytical profile of the various uses and value of the natural resources incorporating considerations of intergenerational and intra-generational equity.
iii. Recommend appropriate legal and fiscal incentives that may be used to encourage the business community to incorporate environmental requirements into their planning and operational processes.
iv. Recommend methods for building national awareness through environmental education on the importance of sustainable use of the environment and natural resources for national development.
v. Set out operational guidelines for the planning and management of the environment and natural resources.
vi. Identify and recommend policy and legislative approaches for preventing, controlling or mitigating specific as well as general diverse impacts on the environment.
vii. Prioritize areas of environmental research and outline methods of using such research findings.

4.3.5 Standards and Enforcement Review Committee

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

Standards and Enforcement Review Committee consists of the members set out in the third schedule to the Environmental Management and Co-ordination Act.

4.3.6 National Environmental Tribunal (NET)

This tribunal guides the handling of cases related to environmental offences in the Republic of Kenya. If disputes to the proposed project arise, they are supposed to be presented here for hearing and legal direction.

The EMCA , CAP 387, Institutional Framework

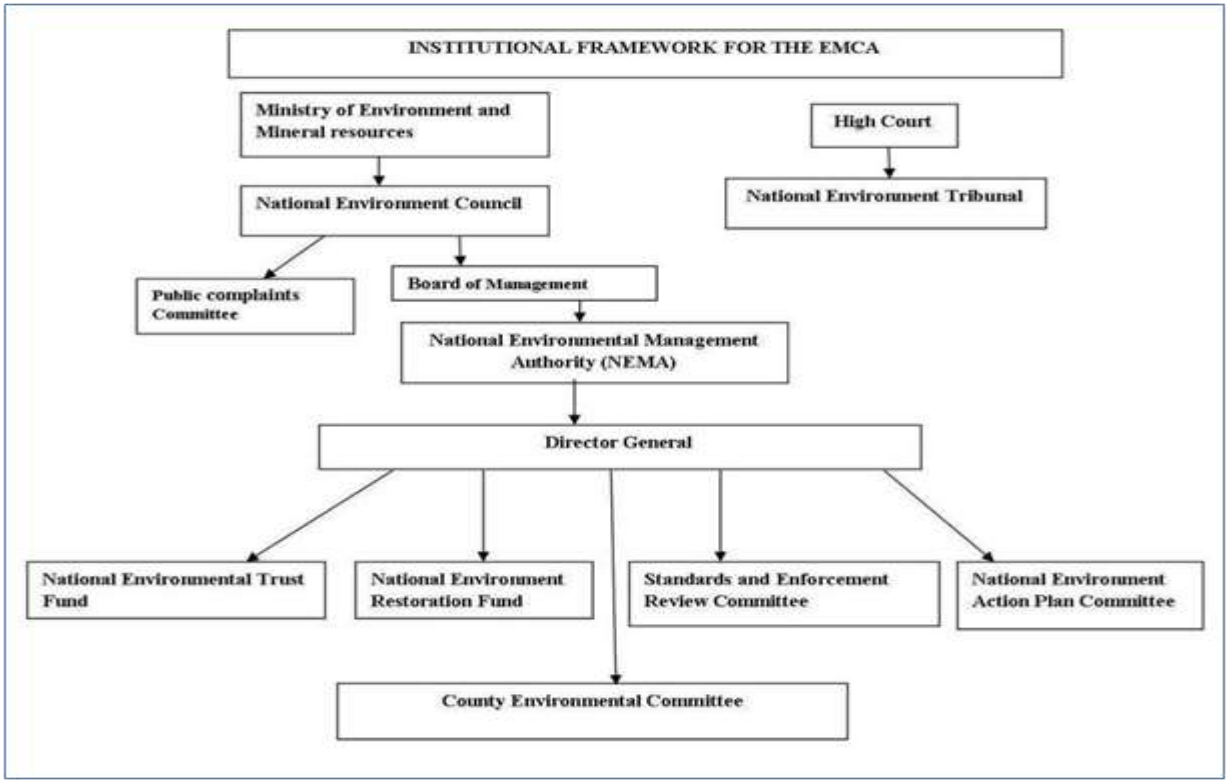

Figure 1: The EMCA , Institutional Framework

4.4 Legal Framework

Kenya has several statutes that govern environmental standards and quality. Most of these statutes are sector specific covering issues such as public health, planning, air quality, agriculture, water quality, and land use. This section seeks to bring to light statutes and legislation pertinent to the development of the proposed development in Magnet school herein referred to as the proposed project.

4.4.1 The Environmental Management and Coordination Act (EMCA), CAP 387

The Environmental Management and Coordination Act (EMCA) CAP 387, provides for the legal framework for the management of the Kenyan environment. Under the EMCA, all proposed projects that are likely to have significant impact on the environment according to the Second Schedule will undergo an Environmental Impact Assessment (EIA) while projects already in place will undertake annual Environmental Audits (EA). It aims at coordinating environmental protection activities in the country. In its preamble, the Act states that every person in Kenya has a right to a clean and healthy environment. According to section 58 of the Act (EMCA), second schedule 9 (i), and the environmental (Impact Assessment and Audit) Regulations, 2003, all new enterprises and projects must undergo Environmental Impact Assessment (EIA).

It is in line with this provision that the proponent appointed EIA experts to undertake an Environmental and Social Impact Assessment and prepare a report in respect of the proposed development. This addresses the requirement as the project activities are likely to have negative environmental impacts. This will ensure the Proponent observes continuous improvement on environmental, health and safety management and takes appropriate measures to mitigate any adverse impacts to the environment and the surrounding communities that the project may have during its implementation and operation.

Part VII, Section 68 of the same Act requires operators of projects or undertakings to carry out environmental audits in order to determine level of compliance with statements made during the EIA. The audit report should be submitted to NEMA. The proponent shall submit an Environmental Audit report in the first year of operation to confirm the efficacy and adequacy of the Environmental Management Plan.

The proponent will have to ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as solid waste management plans, water reticulation maintenance and landscaping are implemented, as per the design drawings and maintained throughout the project cycle.

EMCA CAP 387, has several subsidiary legislations that were enacted to ensure effective implementation of the Act. A few regulations that are pertinent to the proposed project are described below.

4.4.1.1 The Environmental Management and Coordinating (Water Quality) regulation 2006

The Regulations provides for sustainable management of water resources including prevention of water pollution and protection of water sources (lakes, rivers, streams,' springs, wells and other water sources).

It is an offence under Regulation No.4 (2), for any person to throw or cause to f low into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution.

Regulation No. 11 further makes it an offence for any person to discharge or apply any poison, toxic, noxious or obstructing matter, radioactive waste or other pollutants or permit the dumping or discharge of such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards for effluent discharge into the environment

Regulation No. 14 (1) requires every licensed person generating and discharging effluent into the environment to carry out daily effluent discharge quality and quantity monitoring and to submit quarterly records of such monitoring to the Authority or its designated representatives.

The proponent will have to ensure that appropriate measures to prevent pollution of underground and surface water sources are implemented throughout the project cycle.

4.4.1.2 The Environmental Management and Co-ordination (Waste Management) Regulations, 2006

The regulations provide details on management (handling, storage, transportation, treatment and disposal) of various waste streams including:

- Domestic waste,
- Industrial waste,
- Hazardous and toxic waste
- Pesticides and toxic substances
- Biomedical wastes and
- Radioactive waste

Regulation No.4 (1) makes it an offence for any person to dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle.

Regulation 5 (1) provides categories of cleaner production methods that should be adopted by waste generators in order to minimize the amount of waste generated and they include:

i. Improvement of production process through-
   - Conserving raw materials and energy
   - Eliminating the use of toxic raw materials and waste
   - Reducing toxic emissions and wastes

ii. Monitoring the product cycle from beginning to end by-
   - Identifying and eliminating potential negative impacts of the product
   - Enabling the recovery and re-use of the product where possible
   - Reclamation and recycling

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

The Proponent shall ensure that the main contractor adopts and implements all possible cleaner production methods during the construction phase of the project.

Regulation 6 requires waste generators to segregate waste by separating hazardous waste from non- hazardous waste for appropriate disposal. Regulation 14 (1) requires every trade or industrial undertaking to install at its premises anti-pollution equipment for the treatment of waste emanating from such trade or industrial undertaking. Regulation 15 prohibits any industry from discharging or disposing of any untreated waste in any state into the environment. Regulation 17 (1) makes it an offence for any person to engage in any activity likely to generate any hazardous waste without a valid Environmental Impact Assessment license issued by NEMA. Regulation 18 requires all generators of hazardous waste to ensure that every container or package for storing such waste is fixed with a label containing the following information:

a) The identity of the hazardous waste
b) The name and address of the generator of waste
c) The net contents
d) The normal storage stability and methods of storage
e) The name and percentage of weight of active ingredients and names and percentages of weights of other ingredients or half-life of radioactive material
f) Warning or caution statements which may include any of the following as appropriate--The words "WARNING" or "CAUTION"

- The word "POISON" (marked indelibly in red on a contrasting background;
-The words "DANGER! KEEP AWAY / NO ENTRY FOR UNAUTHORIZED PERSONS" and

Regulation 19 (1) requires every person who generates toxic or hazardous waste to treat or cause to be treated such hazardous waste.

During the construction phase of the project, the Proponent shall ensure that the main contractor implements the above mentioned measures as necessary to enhance sound environmental management of waste.

4.4.1.3 The Environmental Impact (Assessment and Auditing) Regulations, 2003

The Environmental Impact Assessment exercise under the Act is guided by the Environmental Impact Assessment (Assessment and Auditing) Regulations of the year 2003, which was given under legal notice no. 101. The regulations stipulate the ways in which environmental impact assessment and audits should be conducted. The project falls under the second schedule of EMCA, CAP 387 section 58 (1), (4) that require an Environmental Impact Assessment report. As stipulated by the legal notice No. 101,2003, PART V, Section 31 (3((a) (i) and (ii) it is required that an environmental

assessment be undertaken to provide baseline information upon which subsequent environmental control audit shall be based.

It is in the wake of these regulations that the proponent commissioned AWEMAC; a firm of experts to carry out an EIA exercise, write a report and submit it to NEMA with an aim of being awarded an EIA license.

4.4.1.4 Environmental Management and Coordination Controlled Substances Regulations, 2007 (Legal Notice No.73 of 2007)

The Controlled Substances Regulations defines controlled substances and provides guidance on how to handle them. This regulation mandates NEMA to monitor the activities of persons handling controlled substances, in consultation with relevant line ministries and departments, to ensure compliance with the set requirements. Under these regulations, NEMA will be publishing a list of controlled substances and the quantities of all controlled substances imported or exported within a particular. The list will also indicate all persons holding licenses to import or export controlled substances, with their annual permitted allocations.

The regulations stipulate that controlled substances must be clearly labeled with among other words, "Controlled Substance-Not ozone friendly'') to indicate that the substance or product is harmful to the ozone layer. Advertisement of such substances must carry the words, "Warning: Contains chemical materials or substances that deplete or have the potential to deplete the ozone layer."

Producers and/or importers of controlled substances are required to include a material safety data sheet. Persons are prohibited from storing, distributing, transporting or otherwise handling a controlled substance unless the controlled substance is accompanied by a material safety data sheet. Manufacturers, exporters or importers of controlled substances must be licensed by NEMA. Further, any person wishing to dispose of a controlled substance must be authorized by NEMA. The licensee should ensure that the controlled substance is disposed of in an environmentally sound manner. These regulations also apply to any person transporting such controlled substances through Kenya. Such a person is required to obtain a Prior Informed Consent (PIC) permit from NEMA. In case the contractor deals with substances defined as "controlled substances" by the regulations, he will be required to comply with the regulations.

4.4.1.5 Environmental Management and Coordination (Conservation of Biodiversity regulations 2006)

Kenya has a large diversity of ecological zones and habitats including lowland and mountain forests, wooded and open grasslands, semi-arid scrubland, dry woodlands, and inland aquatic, and coastal and marine ecosystems. In addition, a total of 467 lake and wetland habitats are estimated to cover 2.5% of the territory. In order to preserve the country's wildlife, about 8% of Kenya's land area is currently under protection.

The primary purpose of these regulations is to monitor the status and the components of biological diversity in Kenya and take necessary measures to prevent and control their depletion so as to ensure that conservation of biological diversity resources is achieved. Part II, section 4 of the regulations states that

a) A person shall not engage in any activity that may- (a) have an adverse impact on any ecosystem;
b) Lead to the introduction of any exotic species;
c) Lead to unsustainable use of natural resources, without an Environmental Impact Assessment License issued by the Authority under the Act.

The contractor will ensure that the construction activities do not negatively impact on the existing ecosystems near the construction area.

4.4.1.6 Environmental Management and Co-ordination (Noise and Excessive Vibrations Regulations 2009

The regulations define noise as any undesirable sound that is intrinsically objectionable or that may cause adverse effects on human health or the environment. The regulations prohibit any person from making or causing to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Article 13 2(d) of the regulations allows for construction work at night for public utility construction, construction of public works, projects exclusively relating to roads, bridges, airports, public schools and sidewalks, provided noise generated is not caused within a residential building or across a residential real property boundary where such noise interferes with the comfort, repose, or safety of the members of the public. The second Schedule of the Regulations provides for the maximum permissible level of noise at construction sites.

Facility	Maximum Noise level permitted (leq) in dB(A)	
	Day (6.01am-6.00pm)	Night (6.01 pm-6.00am)
Health facilities, educational institutions, homes for disabled and residential areas	60	35
Other areas	75	65

Table 4: Minimum and maximum permissible noise levels

4.4.1.7 Air Quality Regulations, 2008

This regulation is referred to as "The Environmental Management and Coordination (Air Quality) Regulations, 2008". The objective is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources, including as mobile sources (e.g. motor vehicles) and stationary sources (e.g. industries) as outlined in the Environmental Management and Coordination Act, 1999. It also covers any other air pollution source as may be determined by the Minister in consultation with the Authority. Emission limits for various areas and facilities have been set. The regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas.

4.4.2 The Occupational Safety and Health Act, 2007

This is an act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes.

The key areas addressed by the Act include;

- General duties including duties of occupiers, self-employed persons and employees.
- Enforcement of the act including powers of an occupational safety and health officer.
- Registration of workplaces.
- Health General Provisions including cleanliness, ventilation, lighting and sanitary conveniences.
- Machinery safety including safe handling of transmission machinery, hand held and portable power tools, self-acting machines, hoists and lifts, chains, ropes & lifting tackle, cranes and

other lifting machines, steam boilers, air receivers, refrigeration plants and compressed air receiver.

- Safety General Provisions including safe storage of dangerous liquids, fire safety, evacuation procedures, precautions with respect to explosives or inflammable dust or gas.

Under section 6 of this act, every occupier is obliged to ensure safety, health and welfare of all persons working in his workplace. The occupier shall achieve this objective by preparing and as often as may be appropriate, revising a written statement of his general policy with respect to the safety and health at work of his employees and the organization and arrangements for the time being in force for carrying out that policy (Section 7).

To ensure machinery safety, every hoist or lift - section 63 and/ or all chains, ropes and lifting tackles - section 64 (ld), shall be thoroughly examined at least once in every period of six months by a person approved by the Director of Occupational Health and Safety Services. Similarly, every steam boiler - section 67 (8) and/or steam receiver section 68 (4) and all their fittings and/or attachments shall be thoroughly examined by an approved person at least once in every period of twelve months whereas every air receiver shall be thoroughly cleaned and examined at least once in every period of twenty four months or after any extensive repairs - section 69 (5). According to section 71 (3), every refrigeration plant capable of being entered by an employee also needs to be examined, tested and certified at least once in every period of twelve, months by an approved person.

During project implementation and operations, a large labour force will be required. This Act makes provisions for safety, health and welfare of persons upon which provision of their protection will be based. This will protect them against hazards to health and safety arising out of or in connection with their activities at work especially during the construction phase. This Act therefore safeguards workers welfare during the project phases by ensuring capacity building on Health and safety of workers at work place. In summary, this act will be used a guideline to ensure health and safety of workers is guaranteed. The proponent will ensure that the contractor includes in the contract adequate measures to promote safety and health of workers during all phases of the proposed project

4.4.3 The Public Health. Act (Cap. 242)

Section 115 of the Act states that no person/institution shall cause nuisance or, conditions likely to be injurious or dangerous to human health. Section 116 require local Authorities (currently County governments) to take lawful, necessary and reasonably practicable measures to maintain areas

under their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health.

Such nuisance or conditions are defined under Section118 waste pipes, sewers, drains refuse pits in such a state, situated or constructed as in the opinion of the medical leer of health to be offensive or injurious to health. Any noxious matter or waste water, discharged from any premises into a public street or into the gutter or side channel or watercourse, irrigation channel or bed not approved for discharge is also termed as a nuisance. Other nuisances are accumulation of materials or refuse which in opinion of the medical officer of health is likely to harbor rats or other vermin.

Part XII Section 136 states that all collections of water, sewage, rubbish, refuse and fluids which permits or facilitate the breeding or multiplication of pests shall be termed nuisances and are liable to be dealt with in the manner provided by this Act.

4.4.4 The Physical Planning Act, 2012

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

Section 30 states that any person who carries out development without permission will be required to restore the land to its original condition. It also states that NO other licensing authority shall grant license for commercial or industrial use or occupation of any building without a development permission granted by the respective local authority.

Finally, Section 36 states that if in connection with a development application, local authority is of the opinion that the proposed development activity will have injurious impact on the environment; the applicant shall be required to submit together with the application an environmental impact assessment (EIA) report. EMCA, 1999 echoes the same by requiring that such an EIA is approved by the National Environmental management Authority (NEMA) and should be followed by annual environmental audits.

The proponent has complied with this provision by appointing EIA/Audit experts prepare and submit this Environmental Impact Assessment study report to National Environmental management Authority (NEMA). Formal approval of architectural and engineering drawings will be required prior to commencement of the project.

4.4.5 The Mining Act, 2012

There has been a clear lack of a formal mining policy in Kenya. Mineral exploitation and mining has been carried under the auspices of the Mining Act, Cap 306 (now the Mining and Minerals Act) administered by the Department of Mines and Geology in the Ministry of Mining. The Department has the responsibility of undertaking geological surveys, geo-scientific research, coordination and regulation of the activities of the mining sector. All un-extracted minerals under or upon any land, as per the Act, are vested in the Government, subject to any rights, which under the Act, have been granted to any other person. The reviewed Mining and minerals Act law provides for lesser discretionary powers to the licensing authorities and hence provide for greater security of tenure. Similarly, there is now a planned mining policy, which will cover environmental protection, local processing, technology transfer and royalties and taxes. Kenyan laws now require that the resulting open pits be rehabilitated appropriately, so that the natural environment is protected.

The Mining and Minerals Act is the main legislative tool that governs the prospecting and extraction of all minerals including quarrying activities in the country. The Act vests all un-extracted minerals under or upon the land in the hand the government. Under the Act, it is an offence for any person to mine without authority. The Act lists areas or land where no person should mine unless with respective authority (Section 7).The proposed site is not near such areas. The Act provides for compensation by the miner for disturbance, nuisance or damage to lawful occupiers of the lands.

The proponent will ensure the stakeholders in the mineral sector are consulted before quarries are opened. EIAs will be carried for all quarries and borrow pits.

4.4.6 County Government Act, 2012

The main purpose of the enactment of this Act was to give effect to Chapter Eleven of the Constitution; to provide for county governments' powers, functions and responsibilities to deliver services and for connected purposes. Functions which were carried out by local governments were effectively transferred to the county governments.

The Act gives county the responsibility of planning and co-coordinating all developments within their areas of jurisdiction. Part XI (sections 102-115) of the Act provides for planning principles and

responsibilities of the county governments. The land use and building plans provided for in the Act are binding on all public entities and private citizens operating within the particular county.

The proposed project is within the County of Busia and thus there will be need of working in liaison with the county government of Busia. The plans for the proposed project must be approved by the county government of Busia and the County government may also issue directives and authorizations on various aspects e.g. waste management and fire emergency preparedness among others.

Therefore, the proponent should work in liaison with County Government of Busia and in particular the department of Environment and Natural Resources.

4.4.7 Penal Code Act (Cap.63)

Section 191 of the penal code states that if any person or institution that voluntarily corrupts or foils water for public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same Act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution, dwelling or business premises in the neighborhood or those passing along public way, commit an offence.

The Proponent will be required to ensure strict adherence to the Environmental Management Plan throughout the project cycle in order to mitigate against any possible negative impacts

4.4.8 The Land Registration Act, 2012

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

- Registration of interests in all public land as declared by Article 62 of the Constitution;
- Registration of interests in all private land as declared by Article 64 of the Constitution;
- Registration and recording of community interests in land.

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

4.4.9 The Environment and Land Court Act, 2011

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

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

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

a) To manage public land on behalf of the national and county governments;
b) To recommend a national land policy to the national government;
c) To advise the national government on a comprehensive programme for the registration of title in land throughout Kenya;
d) To conduct research related to land and the use of natural resources, and make recommendations to appropriate authorities;

4.4.11 The Wildlife Conservation and Management Act, 2013

This Act may be cited as the Wildlife Conservation and Management Act, 2013. This Act shall apply to all wildlife resources on public, community and private land, and Kenya territorial waters. The primary purpose of this Act is to provide for the protection, conservation, sustainable use and management of wildlife in Kenya and for connected purposes ENACTED by the Parliament of Kenya, as follows—

- Part VI of the act section 1 clarifies the provisions of this Act with respect to conservation, protection and management of the environment shall be in conformity with the provisions of the Environmental Management and Coordination Act.
- Section 27 part (1) No user rights or other license or permit granted under this Act shall exempt a person from complying with any other written law concerning the conservation and protection of the environment.

4.4.12 The Energy Act of 2006

The Energy Act 2006 was enacted on 2nd January 2007. The Act establishes an Energy Regulatory Commission mandated to perform all function that pertains to energy production, transmission, setting and enforcing of energy policies, Public education and enforcing energy conservation strategies, prescribing the energy licensing process and issuing of licenses that pertain to energy sector in Kenya. Section 30 of the Act provides the factors that shall be taken into consideration

prior to issuance of license. It states the need and expression of an entity to conserve and protect the environment and natural resources in accordance to the Environmental and Coordination Act of 1999 (No. 8 of 1999), moreover, the Act gives provisions for the need to protect health and safety of users of energy by providing an enabling environment of operation that protects the health and safety of users of the service for which the license or permit is required and other members of the public affected by the undertaking.

4.5 Relevant International Conventions and Treaties

Kenya is signatory to several international conventions and treaties that would need to be adhered to in implementing this project and are geared towards environmental protection and conservation. Some of these include;

a) ILO Conventions ratified by Government of Kenya
b) Safety and Health in Construction Recommendation, 1988
c) Recruiting of Indigenous Workers Convention, 1936 (No.50)
d) Convention on Wetlands or the Ramsar Convention
e) The Convention on International Trade in Endangered Species (CITES)
f) Convention on the Conservation of Migratory Species
g) United Nations Framework Convention on Climate Change
h) United Nations Convention to Combat Desertification
i) United Nations Convention on Biological Diversity (UNCBD)

4.5.1 The Convention on Biological Diversity (1992)

The convention promotes the protection of ecosystems and natural habitats, respects the traditional lifestyles of indigenous communities, and promotes the sustainable use of resources. The project activities especially during construction will impact negatively to the flora and fauna of the respective construction areas. As such both the proponent and the contractor must ensure that the activities of the proposed project do not affect the immediate ecosystems negatively and that the livelihoods of the local people are not negatively affected but rather enhanced.

4.5.2 Stockholm convention on Persistent Organic Pollutants (POPs)

POPs have a long time effect on the food chain and can persist in the environment for a very long time. Due to global warming, most of these pollutants end up in the Nordic countries and hence the convention was signed in Stockholm, Sweden. All states are to abide by requirements in the treaty

as it is designed to protect human health and the environment from PoPs- which are chemical substances that are persistent and toxic, that bio-accumulate in fatty tissue (achieving higher concentrations as they move up a particular food chain) and that are prone to long range environmental transport. This convention is most pertinent during the construction phase of the project. The contractor and the proponent must ensure that the materials and processes employed do not lead to the emission of Persistent Organic Pollutants.

4.5.3 Vienna Convention for the Protection of Ozone Layer

Inter-governmental negotiations for an international agreement to phase out ozone depleting substances concluded in March 1985 with the adoption of this convention to encourage inter-governmental co-operation on research, systematic observation of the ozone layer, monitoring of CFC production and the exchange of information. Therefore both the proponent and the contractor are obliged to minimize or phase out the generation of CFCs into the atmosphere during both phases of project implementation.

5.1 Introduction

This chapter describes the process of the public consultation that was followed to identify the key issues and impacts of the proposed development. Views from the general public and neighbors, who in one way or the other would be affected by the proposed project, were sought through oral interviews and administering of questionnaires as stipulated in the Environment Management and Coordination Act, CAP 387. A number of site visits has been made to the site to interview the residents.

One of the key information sources used during the Environmental and social Impact Assessment exercise was public participation exercise. The exercise was conducted by a team of experienced registered environmental experts via administration of pre- designed questionnaires and by interviewing neighbors surrounding the proposed project site.

The purpose for such interviews was to identify the positive and negative impacts and subsequently promote and mitigate them respectively. It also helped in identifying any other issues which may bring conflicts incase project implementation proceeds as planned.

5.2 Objectives of the Consultation and Public Participation (CPP)

The objective of the consultation and public participation was to;

a) Disseminate and inform the stakeholders about the project with special reference to its key components and location.
b) Gather comments, suggestions and concerns of the interested and affected parties
c) Incorporate the information collected in the ESIA study.
d) Increasing public confidence
e) Improving transparency and accountability in decision making
f) Reducing conflict that may arise

In addition, the process enabled,

1) The establishment of a communication channel between the general public, the team of consultants and the project proponent
2) The concerns of the stakeholders to be known to the decision-making bodies at an early phase of project development.

5.3 Methodology used in the CPP

The Consultation and Public Participation (CPP) Process is a policy requirement by the Government of Kenya and a mandatory procedure as stipulated by EMCA CAP 387, section 58, on Environmental Impact Assessment for the purpose of achieving the fundamental principles of sustainable development.

In general, the following Steps were followed in carrying out the entire CPP process:-

a) Identification of individuals interested in the process- database of the interested and affected parties
b) Administration of questionnaires to the different target groups and local community members along the proposed project Site

Administration of Public Participation Questionnaires

During the third and fourth week of the month of May, 2019, a site visit was made to the site and a number of questionnaires were administered to the public and the residents. The copies of the questionnaires were attached to the proposed report and submitted to NEMA for approval.

In the fourth week of May, a total of eighty (80) questionnaires were administered at the proposed site and its environs. The questionnaires were administered to an area of a radius of about 1km from the site. The target group for this area were the residents in close proximity to the proposed project.

Plate 3: 1st Public participation meeting held in Changara Village

Plate 4: 2nd public participation meeting held over the Pan and installation of the irrigation system.

5.4 Issues Raised during Public Consultations

5.4.1 Positive Issues

- The project will enhance efficiency in water supply
- The project will enhance economic activities mainly farming and thus improving livelihood
- The project will create employment opportunities
- There will be time saving since residents will not have to keep walking for long distances in search of water
- The project will ensure supply of water throughout the year regardless of the season
- Availability of water will enhance agriculture especially in livestock development
- Construction will bring other infrastructural development in the area among them the road leading to the dam site and water related facilities.
- The dam can be used in fish farming hence improving the community livelihood
- Increased Aesthetic Value of the area
- Reduction in poverty levels of many households. This will be as a result of the availability of more farm outputs that can be sold in the available markets.

- Diversification of farming enterprise leading to improved nutrition as a result of availability of water
- Lower food prices making food affordable in most homesteads as a result of irrigation in most of the households
- There is the likelihood of improved agricultural extension services within the project area.

5.4.2 Negative Issues

- May lead to environmental degradation and destruction of farm structures and crops in case of pan burst and leakages/ Any overflow of the pan may affect the downstream communities and lead to destruction of property
- If the pan is not well secured it can be a source of safety risk for the community and animals
- Noise during construction
- Removal of vegetation cover/ Destruction of vegetation cover
- Aquatic life may be affected downstream
- During operation phase, degradation of soil quality would result mainly from improper use of fertilizers and pesticides in scenario that farmers have not been educated well on the use of farm inputs in irrigation agriculture/ project.

6.1 Introduction

This section identifies the potential social and environmental impacts of the proposed project in terms of the nature, magnitude, extent and location, timing and duration of the anticipated impacts. These impacts may relate to the project design stage, construction stage or the project operation and decommissioning stage. Based on impact prediction methods, site visits and observations and the results of public consultations, both beneficial and adverse environmental impacts have been identified. Suitable mitigation measures to the negative impacts are discussed in chapter 7. These are then costed and responsibilities for their implementation assigned as appropriate within the Environmental and Social Management Plan (ESMP). Both potential negative and positive impacts have been considered during the siting and Construction phase, Operational Phase and Decommissioning phase.

6.2 Siting and Construction Phase

During the sitting, construction of the pan and the irrigation component, there is a likelihood of having the following impacts.

6.2.1 Positive Impacts

6.2.1.1 Employment opportunities

There will be job opportunities especially to casual workers. Employment opportunities are a benefit both in economic and social sense. In the economic sense it means abundant unskilled labour will be used in economic production. In the social sense these young and energetic otherwise poor people will be engaged in productive employment other than remaining idle. Remaining idle may attract them into social ills like drug abuse and other criminal activities like robberies. Several workers including casual laborers, masons, carpenters and joiners are expected to work on the site for a period that the project will start to the end. Apart from casual labour, semi-skilled and unskilled labour and formal employees are also expected to obtain gainful employment during the construction period.

The proposed project, during construction phase will directly employ as a minimum the following groups:

- Supervising engineering team;
- Contractor’s staff (managerial, skilled and unskilled labour force);

- Suppliers of plant, machinery, materials and essential services;
- Construction monitoring personnel from the county Government and other lead agencies such as NEMA.

6.2.1.2 Provision of Market for Supply of Building Materials

The project will require supply of project materials some, of which will be sourced locally in the surrounding areas. The project will also provide ready market for construction/ installation material suppliers such as hardware shops and individuals with such materials.

6.2.1.3 Increased Business Opportunities

The number of project staff required will provide ready market for various goods and services, leading to business opportunities for small-scale traders such as food vendors around the project site.

6.2.1.4 Increased revenue to suppliers of construction materials and utilities

This will be an opportunity for the suppliers of construction/ installation materials and other utility suppliers to create market and sell their goods. In turn this will boost their profit margin which is an advantage to their businesses.

6.2.2.5 Economic growth

Through the use of locally available materials during the construction phase/ installation e.g. cement, steel metals, irrigation pipes and others; the project will contribute towards growth of the country's economy by contributing to the gross domestic product. The consumption of these materials, irrigation pipes, oil, fuel and others will attract taxes including VAT which will be payable to the government hence increasing government revenue while the cost of these raw materials will be payable directly to the producers.

6.2.2 Potential Negative Impacts

The key negative impacts identified during the construction phase of the project include;

6.2.2.1 Soil Erosion

Stripping of the vegetation will expose the top soil to agents of erosion and the movement of vehicles and machinery in the area may aggravate the problem. Soil erosion is an important problem both at its source and downstream of the development site. Lost soil will be deposited somewhere, and the location of the deposition could alter downstream hydrology and increase

flooding. It may also pose a water quality issue directly as a result of siltation and indirectly from contaminants carried with or attached to soil particles and it may also negatively affect the soil fertility of the affected land.

6.2.2.2 Waste generation (solid wastes)

Sources of this waste will be rejected materials, surplus materials, surplus spoil and excavated materials. Poor waste management may lead to health effects, unaesthetic appearance of the place and even increase project cost. Generated waste should be appropriately managed through: identification of the waste types; segregation into the various categories; and the establishment of suitable mechanisms for collection, storage, transfer, and final disposal.

6.2.2.4 Impacts on Vegetation (Vegetation Clearing)

During the survey period, there were no floral species of conservation concern reported at the proposed site. The construction of the proposed development should observe minimal and selective removal of the existing vegetation covers. Selective habitat clearing reduces the risk for loss of key habitat species and nesting sites for local bird species. It also allows for regeneration. In the long run, this will ensure minimal disturbance on wildlife, territorial occupation and other ecological process.

Construction earthworks for access roads (to project site) might release dust particles into the ambient air during the dry period. When a lot of dust settles on the leaves, it is bound to have negative effects on flora as it covers leaf stomata thus reducing their photosynthetic activity. In addition, dust coated leaves are less attractive and preferred by respective fauna consumers. Limited vegetation removal and clearing will compliment the efforts on screen planting and landscaping through re-vegetation, which will lead to improved visual quality of the area.

Plate 5: Vegetation likely to be affected by the project

6.2.2.5 Air Quality

Emissions in forms of dust, particulate matter, fugitive emission and, exhaustion from project machines and equipment are anticipated during the project construction phases. These emissions emanating from trucks and construction equipment are known to have adverse impact on the environment, plant and human health including effect on the upper to lower respiratory infections and silicosis condition.

- ✓ Activities likely to generate dust include speeding of vehicles on earth surface not palliated with water, excavation of earth materials in dry sections;
- ✓ Activities likely to generate particulate matter include loose material transportation, vehicle and machines exhaust emissions
- ✓ Some of the particulate matter to be generated include sand, soot, cement, gravel and murram, among others; and
- ✓ Exhaust emissions likely to be generated include smoke, hydrocarbons and nitrogenous gases among others pollutants from vehicles, machinery and equipment's exhausts.

6.2.2.6 Occupational Health and Safety Issues

Potential impacts during construction include: exposure to physical hazards from the use of equipment's; trips and fall hazards; rock falls/slides at high elevations and exposure to dust and noise. Other injuries or fatalities may result from workers operating equipment without adequate

training or with lack of PPE or extended exposure to outdoor weather resulting in heat related lethargy.

6.2.2.7 Excessive Noise and Vibration

Levels of noise and vibrations typical of construction works will be generated at the project site during the construction phase. This noise impact is expected to be negative in the long and short-term. The major sources of noises and vibration will be construction equipment's, vehicles and workers.

Elevated noise and vibration levels within the site are adverse to the health and safety of the project workers, the residents, passers-by and, other persons and animal within the vicinity of the project site. The major receptors exposed to the noise are expected to be at a minimum and will include mainly the construction workers.

6.2.2.8 HIV/AIDS

The project will attract new people to the project area and increase the amount of disposable cash of the construction workers. This may lead to several repercussions leading to the spread of HIV/AIDS and/or other sexually transmitted diseases (STDs). Influx of new people to the project area especially construction workers can affect the number of new cases of HIV, because they often interfere with an otherwise stable situation but the contrary can also happen where the newcomers find themselves at higher risk.

6.2.2.9 Surface and ground water hydrology and water quality degradation

Changes in surface hydrology alter the flow of water through the landscape. Project related excavation could lead to surface and ground water quality degradation. Contaminated soil or ground water in the path of the project could be disturbed by excavation resulting in a potential transfer of the contamination to surface waters. The excavated area, if linear could act as a conduit to extend groundwater contamination to new areas. Spills of hazardous materials in excavated areas could introduce contaminants to ground water.

6.2.3.0 Increased storm water Volume

There is a likelihood of interference with the percolation and flow of storm water from the excavations.

6.3 Operational phase

Some of the impacts both positive and negative that may be as a result of the proposed project during the operation stage will include;

6.3.1 Positive Impacts

It is anticipated that the operations phase of this project will result in the following positive impacts;

- Optimal use of land especially for irrigation
- Increased food production as a result of irrigation
- Improved livelihood of the community
- Increased business opportunities for agricultural goods

6.3.2 Negative Impacts

The potential impacts likely to occur during the operations and maintenance phase of the project include;

6.3.2.1 Occupational Health and Safety Issues

Occupation health and safety hazards during the operation and maintenance phases shall result from various sources and have adverse effects if not controlled within recommended limits. Some of the risk sources are use of water that has been contaminated.

6.3.2.1 Salinization of the farms

If the irrigation component is not well managed, it might lead to Salinization of the farms and this has negative impacts on the biodiversity and general crop production.

6.4 Decommissioning Phase

Some of the anticipated impacts during the decommissioning phase of the proposed projects include;

6.4.1 Positive Impacts

In the event that the project will be decommissioned, the primary activity is expected to be rehabilitation of the site.

The potential positive impacts during the decommissioning phase include;

- Rehabilitation and restoration of the site to its original status
- Employment opportunities

6.4.2 Negative Impacts

The following are the potential negative impacts;

6.4.2.1 Noise Pollution

Activities likely to produce noise during decommissioning include cutting and demolition of structures, machine operations.

6.4.2.2 Air/dust Pollution

This is expected to result from demolishing of structures at the site and the transport of demolition debris to the disposal site.

7.1 Introduction

The proponent of the proposed project acknowledges the fact that the proposed project activities will have some impacts on the biophysical environment, health and safety of its employees and members of the public, and socio economic wellbeing of the local residents. Thus, the main focus will be on reducing the negative impacts and maximizing the positive impacts associated with the project activities through a programme of continuous improvement.

An environmental management/monitoring plan will be developed to assist the proponent in mitigating and managing environmental impacts associated with the life cycle of the project

7.2 Proposed mitigation measures

7.2.1 Construction and Operational Phase

7.2.1.1 Soil Erosion

Site clearing or disturbance of the natural vegetation will be planned and approved as part of project management process.

Areas cleared, excavated, or/and exposed during construction will be re-vegetated using native vegetation species, preferably of species growing in the immediate pristine environment to allow harmony with the surrounding and minimize duration for watering and care. The restoration period will require monitoring of the re- vegetated sites to assess impacts of heavy foraging, patch growth as well as gulley formation. Presence of well rooted vegetation will act as soil stabilization for the areas.

7.2.1.2 Waste generation (Solid and liquid)

1) **Mitigation Measures for Solid Waste Management**

A site waste management plan should be prepared by the contractor prior to commencement of construction/ installation activities. This should include designation of appropriate waste storage areas, collection and removal schedule, identification of approved disposal site, and a system for supervision and monitoring.

- Special attention should be given to minimizing and reducing the quantities of solid waste produced during site preparation and construction.
- Any vegetation and combustible waste should not be burned on the site.

- Reusable inorganic waste (e.g. excavated sand/soils) should be stockpiled away from drainage features and used for in filling where necessary and/or possible.
- Unusable construction/ installation waste, such as damaged pipes, formwork and other construction material, must be disposed of at an approved dumpsite.
- Provide solid waste receptacles and storage containers, particularly for the disposal of plastic bags, boxes, so as not to block drainage system and to prevent littering of the site.
- Make arrangements for the daily collection of litter from the site and appoint a licensed solid waste transporter to collect and transport it for dumping at approved site.

2) **Mitigation Measures for Liquid Waste management:**

- Provide workers with appropriate sanitary facility which can be in the form of exhaustible mobile toilets
- Alternatively effluent from mobile toilets should be disposed by a registered NEMA wastewater handler
- A specific area for washing of cement trucks and equipment's should be identified and should not be near in water bodies
- All equipment must be fuelled at properly designed fuelling stations.

7.2.1.3 Impact on Vegetation (Vegetation Clearing)

- Map out ecologically sensitive areas at the site and make them known to the engineers and contractor
- Ensure there is selective clearing of the vegetation this allows future re- growth and regeneration. This will ensure minimal disruption of wild fauna's natural movement, territoriality, and other ecological processes;
- It is desirable to re-vegetate disturbed areas along roads, and pavements and other construction sites.

7.2.1.4 Air quality

The following mitigation measures are recommended to control effects of project on air quality and human health:

- Provide personnel with Personal Protective Equipment & Clothing (PPE&C) such as dust masks, boots among others. Mechanism should be put in place to ensure PPE&C are specific for the activities at hand and are always worn within the project sites

- The stockpiles of earth generated during construction works, unpaved access roads and areas used for handling fine construction materials should be palliated with water regularly in order to suppressed evolution of particles
- All machinery and equipment should be maintained in good working condition in order to minimize emissions to acceptable standards
- Train construction and delivery trucks drivers on pre-cautionary measures that enable curb emissions for example advise on techniques to reduce dust evolution especially when nearing the project site to avoid creating dusty conditions; techniques to conserve fuel and reduce emission by switching off the engines when vehicles are idling
- Construction trucks delivering materials to site should be covered in order to minimize spread of fugitive emissions to the surrounding areas
- No burning of materials should be permitted at the project site
- Use clean energy to fuel project vehicles, equipment's and machines in order to reduce air pollutants

7.2.1.6 Risk of Leaks and Spills

The following mitigation measures are recommended to control effects of project on risk of leaks and spills:

- Conduct regular maintenance of site equipment and machinery to ensure leakages are controlled or detected early;
- Project vehicles and equipment should be serviced according to manufacturer's requirements to limit release of exhaust emissions
- Investigate the possibility of fitting catalytic converters in machines with engines so as to convert harmful substance in the exhaust fumes to less harmful substances
- Safety procedures for fuel storage and re-fuelling should be well understood and implemented by site staff; and oil residuals including waste oil, lubricants, used filters, should be carefully collected and stored for safe disposal, in order to prevent spillover effects of contaminant hydrocarbons into storm water or groundwater resources
- Protect project area from fire by posting warning signs in area where hydrocarbon fuels are used
- Observe the requirements of the emission control regulations.

7.2.1.7 Occupational Health and Safety Issues

- Ensure all equipment's are inspected before use for appropriate safe guards and that the machine operators are trained on machine safety
- Caution will have to be kept at high and strict consideration during any excavation works and work at height
- Ensure the working hours are controlled and that employees are not allowed to extend the working hours beyond an acceptable limit for purposes of gaining extra pay
- Ensure appropriate road safety signage's are strategically placed and drivers adhere to the requirements of such signage
- Comply with the provisions of the OSHA 2007 and its subsidiary legislation.

7.2.1.8 Excessive Noise and Vibrations

The following mitigation measures are recommended to control effects of noise and vibrations during construction phase:

- Conduct periodic noise measuring and monitoring to determine levels and extent of harmful noise
- Clearly label the high noise areas
- Provide PPE (hearing protection) to persons operating within or visit identified high noise areas
- In order to meet noise level requirements, the works equipment's should be equipped with standard noise attenuation features. Machines that exceed acceptable noise limits should be equipped with silencers or lagging materials or specially designed acoustic enclosures
- Inform local residents when construction activities are likely to generate excessive noise in order to minimize disruption to local residents
- Sensitize truck drivers to switch off engines while offloading materials; to avoid gunning vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals.

7.2.1.9 HIV/AIDS

Measures recommended for implementation to enable reduce the spread of the virus include the following;

a) Review the construction activities to integrate with the HIV/AIDS campaigns
b) Develop appropriate training and awareness materials for Information, Education and Communication (IEC) on HIV/AIDS
c) Identify other players (local CBOs, NGOs, and government organizations) on HIV/AIDS for enhanced collaboration
d) Develop an intervention strategy compatible with the construction programme to address success of the HIV/AIDS prevention and provide peer educators for sustainability in collaboration with other stakeholders
e) Integrate monitoring of HIV/AIDS preventive activities as part of the construction supervision. Basic knowledge, attitude and practices are among the parameters to be monitored, and particularly on provision of condoms, status testing and use of ARVs.

7.2.1.10 Hydrology and Water Quality Degradation

Several measures shall be put in place to mitigate the impacts that are likely to lead to hydrology and water quality degradation. The proponent will prepare a hazardous substance control and emergency response plan that will include preparations for quick and safe cleanup of accidental

spills. It will prescribe hazardous-materials handling procedures to reduce the potential for a spill during project operation, and will include an emergency response programme to ensure quick and safe cleanup of accidental spills. The plan will identify areas where refueling and vehicle maintenance activities and storage of hazardous materials, if any, will be permitted.

Soil sampling and trial holes digging will be conducted before excavation for foundations begins and soil information will be provided to excavation crews to inform them about soil conditions and potential hazards. If suspected contaminated groundwater is encountered in the depths of the proposed development, samples will be collected and submitted for laboratory analysis for petroleum hydrocarbons, metals, volatile organic compounds and semi-volatile organic compounds.

7.2.2 Decommissioning Phase

7.2.2.1 Noise Pollution

Mitigation measures include:

1. Schedule noisy activities during the day time period
2. Use silencers on machines where possible
3. Ensure machinery is well maintained to reduce noise emitted.

7.2.2.2 Air/dust Pollution

Mitigation measures include;

- Practice dust management techniques, including watering down dust
- Set up dust barriers/ screens at strategic locations
- Provide and enforce the appropriate use of Personal Protective Equipment (PPE) against dust.

7.2.2.3 Solid waste

Mitigation measures include:

- Disposal of solid waste in compliance with EMCA 2006 waste management regulations
- Segregation of waste to encourage reuse and recycling;

7.2.2.4 Liquid waste

These are likely to arise from cleaning activities and sanitary facilities.

Mitigation measures include:

- Prudent use of water to reduce liquid waste volumes

- Adhere to EMCA 2006 water quality regulations
- Adhere to WRMA 2007 guidelines for effluent discharge into surface water resources

7.2.2.5 Occupational Health and Safety Hazards

Mitigation measures include:

- The Contractor should ensure registration of all workplaces by the Director, Directorate of Occupational Health and Safety (DOHSS) forming the basis of work statistics
- The Contractor should ensure provision of appropriate Personal Protective Equipment (PPE) for staff such as:
  - ✓ Earmuffs for ear protection
  - ✓ Helmets for head protection
  - ✓ Dust masks for dust protection for all project works
  - ✓ Goggles with good visibility for eye protection
  - ✓ Overalls and dust coats to protect the skin
  - ✓ High-visibility retro-reflective fluorescent yellow-green, fluorescent orange/fluorescent red jackets with 360o visibility
  - ✓ Safety Shoes for protection of the feet
  - ✓ Gloves of different types according to specific works
- The Project Manager should ensure that the contractor complies with all standard and legally required health and safety regulations as set out by the Occupational Safety and Health Act (Part XI: Section 96) as pertains to construction activities
- The Contractor should provide a standard First Aid Kit on site.

DECOMMISSIONING EMP

Note: A due diligence environmental audit will be undertaken and submitted to NEMA at least three months prior to decommissioning and in line with the Environmental Management and Coordination Act CAP 387 Laws of kenya.

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Monitoring Means	Time Frame
Demolition waste	Use of an integrated waste management system for solid wastes through: Reduction; Reuse and Recycling. The other way is by sanitary land filling.	Project Manager and Contractor	Inspection and Observation	One-off
	All structures that will not be used for other purposes must be removed and recycled/reused as far as possible.	Project Manager and Contractor	Inspection and Observation	One-off
	Where recycling or reuse is not possible, the materials should be taken to a licensed waste disposal site.	Project Manager and Contractor	Inspection and Observation	One-off
Vegetation disturbance	Implement appropriate revegetation program to restore the site to its original status.	Project Manager and Contractor	Observation	One-off
	Consider use of indigenous plant species in re-vegetation.	Project Manager and	Observation	One-off
Increased occupational health and safety risks	Adherence to the Occupational Health and Safety Rules and Regulations stipulated in the Occupational Safety and Health Act, 2007.	Health and Safety Manager	Inspection, meeting and observation	Throughout decommissioning period
	Provision of appropriate personal protective Equipment as well as ensuring a safe and healthy environment for demolition workers.	Proponent	Inspection and Observation	Throughout decommissioning period
	Mitigate demolition workers accidents by enforcing adherence to safety procedures and preparing contingency plan for accident response	Health and Safety Manager	Meeting and Observation	Throughout decommissioning period
Noise and vibration .	Sensitize demolition vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Project Manager and Contractor	Meeting	Throughout demolition period
	Sensitize demolition drivers to avoid hooting especially when passing through sensitive areas such as hospital and schools.	Project Manager and Contractor	Meeting	Throughout demolition period

	Ensure that demolition machinery is kept in good condition to reduce noise and vibration generation.	Project Manager and Contractor	Inspection	Throughout demolition period
	Ensure that all equipment used are insulated or placed in enclosures.	Project Manager and Contractor	Inspection	Throughout demolition period
	The noisy demolition works will be planned to be done during the day only.	Project Manager and the site	Observation	Throughout demolition period

Table 5: EMP for the Decommissioning Phase

This section analyses the project alternatives in terms of site, materials and technology scale, solid waste, wastewater management and irrigation Technology options and shall involve studying design alternatives and analyzing them based on the environmental costs and benefits.

8.1 Relocation Option

Relocation option to a different site is an option available for the project implementation. At present the developer does not have an alternative site.

8.2 No Project Alternative

The No Project option in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. This option will however, involve several losses both to the proponent and the community as a whole. The land will continue to remain idle and underutilized.

8.3 The proposed development alternative

Under the proposed development alternative, the developer of the proposed project would be issued with an EIA License. In issuing the license, NEMA would approve the proposed project, provided all environmental measures are complied with during the construction period and occupation phases.

8.4 Drilling a Borehole

Drilling of a borehole could be an alternative to the proposed pan project. But, as it is widely known, it is very hard to drill a borehole that can yield water adequate enough for a population of about 6,000 people. It is also known that boreholes dry up after sometime and that their water is not assured to be soft. Drilling of boreholes is also associated with drying of lands due to their effect on underground water levels; unlike surface water resources such as the proposed water pan that lead to high levels of underground water as well as leading to creation of conducive micro-climates around them. Hence, drilling of a borehole is a not viable alternative to the proposed water pan.

8.5 Analysis of Alternative Construction Materials and Technology

The proposed project will be constructed using modern, locally and internationally accepted materials to achieve public health, safety, security and environmental aesthetic requirements. Equipment that saves energy and water will be given first priority without compromising on cost or

availability factors. The pan banks will be constructed using stones, granular soils, clay sand, cement while the irrigation component will utilize the plastic pipes for the distribution of water and other metallic pipes for efficient water distribution and pressure control.

8.6 Domestic Waste Water Management Alternatives

The following locally available technologies are discussed below:-

8.6.1 Alternative 1 - Use of stabilization Ponds/Lagoons

This refers to the use of a series of ponds/lagoons which allow several biological processes to take place, before the water is released to the outside environment. The lagoons can be used for aquaculture purposes and irrigation. However, they occupy a lot of space but are less costly. No chemicals are used/heavy metals sink and decomposition processes take place. They are usually a nuisance to the public because of smell from the lagoons/ponds. This option is not preferable in the area because the required space is not available and the area is a cosmopolitan area.

8.6.2 Alternative 2 - Use of Constructed/Artificial Wetland

This is one of the powerful tools/methods used in raising the quality of life and health standards of local communities in developing countries. Constructed wetland plants act as filters for toxins. The advantages of the system are the simple technology, low capital and maintenance costs required. However, they require space and a longer time to function. Long term studies on plant species on the site will also be required to avoid weed biological behavioral problems. Hence it is not the best alternative for this kind of project.

8.6.3 Alternative 4- Waste Water Treatment Plant

This involves the construction of a plant and use of chemicals to treat the effluents to locally/internationally accepted environmental standards before it is discharged into the river nearby. It is usually expensive to construct and maintain, but it is the most reliable, efficient and cost-effective in the long term.

8.6.4 Alternative 5- Use of Bio-digester

Bio digester is an on-site sanitation unit that utilizes anaerobic technology for the disposal of toilet (black) wastewater as well as bathroom (grey) water, in a closed system. This is an incredibly ethical sanitation technology which treats wastewater in an environmentally friendly manner, facilitating its use for irrigation or its return to water bodies without polluting them. The process also generates organic fertilizer and biogas (a form of fuel) by allowing naturally occurring bacteria to break down

solid waste. From the analysis and economics as well as environmental; considerations use of bio digester system is a viable option for the proponent to adopt.

8.7 Solid waste management alternatives

A lot of solid wastes will be generated from the proposed development. An integrated solid waste management system is recommendable. First, the proponent will give priority to Reduction at Source of the waste materials. This option will demand a solid waste management awareness programme in the management and the workers. Notices for proper waste management/handling may be posted at strategic places for the sake of visitors.

8.8 No irrigation option

The No irrigation project alternative option as far as the proposed irrigation project is concerned implies that the status quo is maintained. This alternative model helps the proponent and various decision making levels to approximate the impacts of project implementation against the non-implementation thereby making the right decision regarding project implementation.

This option is the most suitable alternative from a conservative environmental perspective as it ensures non-interference with the existing environmental conditions. Under the no project alternative, the proposal to install irrigation system would therefore not receive the necessary approval from NEMA. As a result, the proposed installation of irrigation system would not be constructed and no increase of acreage under irrigated agriculture.

This option will however, involve several losses both to the proponent and the farming community as a whole. Food insecurity will persist and continue being a major challenge and the water and land resource would remain underutilized.

The No of project option is the least preferred option socio-economically because:

- Land would remain underutilized
- Loss in productivity of the land
- Increased economic activities that are detrimental to the environment
- Reduced capital gains from the land
- No employment opportunities will be created
- Reduced economic growth
- Increased poverty levels resulting to crimes

Therefore, from this analysis it is apparent that the No project alternative is no alternative to the people of Changara, County Government of Busia, and the government of Kenya.

8.9 Irrigation Technology options

Irrigation methods are the systems how to obtain water for irrigation purposes from its sources. The choice of irrigation methods depend on several factors such as topography, water resources, the crops cultivated, the land tenure systems, the growing seasons and the rain and water regimes. There are several irrigation methods that can be used in the project area. There is an apparent need to choose the most appropriate method that will promote the effectiveness in the water conservation measures.

There was a consideration of various methods that would be used in the areas so as to ensure water Conservation measures are promoted. Some of the methods include:

8.9.1. Sprinkler irrigation

Sprinkler or overhead irrigation is an irrigation system in which water is distributed throughout the field by the aid of high-pressure sprinklers. The idea is to simulate rainfall during dry weather. The advantages of sprinkler irrigation systems include their more even distribution of water when different soil types are found within one irrigation scheme. Sprinkler irrigation systems are not affected by uneven land distribution. The disadvantage of sprinkler systems is that they are affected by windy conditions which disturb the even distribution of water from the sprinklers.

The benefits of Sprinkler irrigation include: System losses (runoff, seepage) substantially reduced, over irrigation is completely eliminated and uniformity of application is high, irrigation water requirement reduced as compared to other methods, no land leveling required in the field and land use for productive purposes can be maximized, fertilizer can be injected in the irrigation water to reach the root zone directly and finally the system allows better weed control.

This option is not considered for Changara area because:

- Sprinkler system has a high initial capital cost and high operational costs due to high energy requirements
- Crops will be more prone to diseases due to moist environment.
- Water with impurities and sediments may damage the system.

Therefore in conclusion, the sprinkler irrigation technology therefore not recommended as an option for Changara since the project is expected to optimize and conserve water among other benefits.

8.9.2 Drip Irrigation

Drip irrigation is an irrigation system in which water is delivered at the root of the plant, drop by drop. It is also known as trickle irrigation. The main advantage of drip irrigation is that it is the most water efficient method of irrigation, leveling off of the field not necessary, ability to irrigate irregular shaped fields, allows safe use of recycled water, moisture within the root zone can be maintained at field capacity, minimized soil erosion, minimized weed growth, uniform distribution of water minimal waste of fertilizers, foliage remains dry thus reducing the risk of disease.

The disadvantages are that it is the most expensive and least aesthetically pleasing method because of all the plastic lines which have to be installed close to each other on the ground. This kind of method is largely sustainable though prohibitive in terms of initial capital investments. Therefore, this option will be considered for Changara community since it is efficient in water conservation.

9.0 Introduction

The proponent of the proposed project acknowledges the fact that the proposed project activities will have some impacts on the biophysical environment, health and safety of its employees and members of the public and socio-economic wellbeing of the local residents. Thus, the main focus will be on reducing the negative impacts and maximizing the positive impacts associated with the project activities through a programme of continuous improvement. An Environmental Management/Monitoring Plan has been developed to assist the proponent in mitigating and managing environmental impacts associated with the life cycle of the project. The EMP has been developed to provide a basis for an Environmental Management System (EMS; ISO 14001 principles) for the project. It is noteworthy that key factors and processes may change through the life of the project and considerable provisions have been made for dynamism and flexibility of the EMP. As such, the EMP will be subject to a regular regime of periodic review.

Table 6: Environmental Management plan

Expected Negative Effects	Recommended Mitigation measures	Responsible Party	Time frame	Cost(Kshs)
1. Curb project associated conflicts and Lost Time Injuries (LTI)e.g. Disputes with neighborhood				
Project Implementation Disputes	Community agreements and negotiations should be formalized before the project start as per the laws of the land	Proponent/Government of Kenya	Project Planning Phase	
	Sufficient planning for adequate resources required i.e. financial, personnel and equipment	Proponent &Contractor	Project Planning Phase	
2. Minimize extraction site impacts and ensure efficient use of raw materials in construction				
High Demand of construction raw materials	Source building materials from local suppliers who use environmentally friendly processes in their operations	Project Manager &Contractor	Throughout construction period	
	Ensure accurate budgeting and estimation of actual construction material requirements to ensure that the least amount of material necessary is ordered	Project Manager &Contractor	Throughout construction period	40,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost(Kshs)
	Ensure that damage or loss of materials at the construction site is kept minimal through proper storage.	Project Manager &Contractor	Throughout construction period	15,000
	Use at least5%-10% recycled, refurbished or salvaged materials to reduce the use of raw materials	Project Manager &Contractor	Throughout construction period	0
3. Minimize vegetation disturbance at and or around construction site				
Vegetation/biodiversity disturbance	Ensure proper demarcation and delineation of the project area to be affected by construction works.	Contractor, Civil engineer &Project Manager	1month	100,000
	Specify locations for trucks and equipment, and areas of the site which should be kept free of traffic, equipment, and storage	Civil Engineer, Architect and Project Manager	1month	20,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost(Kshs)
	Designate access routes and parking within the site	Civil Engineer, Architect and Project Manager	1month	10,000
	Introduction of vegetation(trees, and grass) on open spaces and their maintenance	Architect &Landscape specialist	Monthly to Annually	20,000
	Design and implement an appropriate land scaping programme to help in re-vegetation of part of the project area after construction	Architect &Landscape specialist	2months	15,000
4. Reduce storm-water, runoff and soil erosion				
Increased storm water, runoff and soil erosion	A storm water management plan that minimizes impervious area infiltration by use of recharge areas and use of detention and/or retention with graduated outlet control structure will be designed	The Civil Engineer, Mechanical Engineer and Project Manager	1month	10,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost(Kshs)
	Apply soil erosion control measures such as leveling of the project site to reduce run-off velocity and increase infiltration of storm water into the soil.	The Civil Engineer, Mechanical Engineer and Project Manager	1months	
	Ensure that construction vehicles are restricted to existing graded roads to avoid soil compaction within the project site	The Civil Engineer, Mechanical Engineer and Project Manager	Throughout construction period	
	Ensure that any compacted areas are ripped to reduce run-off.	The Civil Engineer, Mechanical Engineer and Project Manager	2months	
	Open drains all interconnected will be provided on site	Civil Engineer	Throughout construction period	7,000 per unit
5. Minimize solid waste generation and ensure efficient solid waste management during construction				

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost(Kshs)**
Increased solid waste generation	Use of an integrated solid waste management system i.e. Through hierarchy of options: 1. Source reduction2. Recycling3.Composting and reuse	Project Manager &Contractor	Throughout construction period	5,000
	Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed rather than cutting them to size, or having large quantities of residual materials	Project Manager &Contractor	One-off	0
	Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed off.	Project Manager &Contractor	One-off	0

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost(Kshs)
	Donate recyclable/reusable or residual materials to local community groups, and individual local residents or homeowners.	Project Manager &Contractor	One-off	0
	Use of durable ,long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated overtime	Project Manager &Contractor	Throughout construction period	–
	Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements	Project Manager &Contractor	One-off	10,000

Expected Negative Impacts	Recommended Mitigation Measures	Responsible Party	Time Frame	Cost(Kshs)

	Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste	Project Manager &Contractor	Throughout construction period	0
	Use construction materials containing recycled content when possible and in accordance with accepted standards.	Project Manager &Contractor	Throughout construction period	0
	Reuse packaging materials such as cartons, cement bags, empty metal and plastic containers to reduce waste at the site	Project Manager, Mechanical Engineer &Contractor	Throughout construction period	0
	Dispose waste more responsibly by dumping at designated dumping sites.	Project Manager, Mechanical Engineer &Contractor	Throughout construction period	2,000/ month

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost(Kshs)**
	Waste collection bins to be provided at designated points on site	Project Manager, Mechanical Engineer &Contractor	Throughout construction period	

	Running an educational campaigns amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste	Project Manager, Mechanical Engineer &Contractor	Throughout construction period	10,000
6. Reduce Dust emissions				
Dust emission	Ensure strict enforcement of on-site speed limit regulations	Project Manager &Contractor	Throughout construction period	8,000
	Avoid excavation works in extremely dry weathers	Project Manager &Contractor	Throughout construction period	
	Sprinkle water on graded access routes when necessary to reduce dust generation by construction vehicles	Project Manager &Contractor	Throughout construction period	
	Personal Protective equipment to be worn	Project Manager	Throughout construction period	
7. Minimization of exhaust emissions and Traffic congestion				

Exhaust emission	Vehicle idling time shall be minimized	Project Manager &Contractor	Throughout construction period	0
	Alternatively fuelled construction equipment shall be used where feasible equipment shall be properly tuned and maintained	Project Manager &Contractor	Throughout construction period	0

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost(Kshs)**
	Proper planning during construction period	Project Manager &Contractor	Throughout construction period	0
8. Minimization of noise and vibration				
Noise and vibration	Sensitize construction vehicle drivers and machinery operators to switch off engines of vehicles or machinery not being used.	Project Manager &Contractor	Throughout construction period	5,000

	Sensitize construction drivers to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as churches, residential areas and hospitals	Project Manager &Contractor	Throughout construction period	7,000
	Ensure that construction machinery are kept in good condition to reduce noise generation	Project Manager &Contractor	Throughout construction period	9,000
	Comply with the provisions of Environmental Management and Coordination(Noise and Excessive Vibration Pollution)(Control)Regulations, 2009 regarding noise limits at the workplace	Project Manager &all site foremen	Throughout construction period	0
9. Minimization of energy Consumption				
Increased energy consumption	Ensure planning of transportation of materials to ensure that fossil fuels (diesel, petrol)are not consumed in excessive amounts	Project Manager &Contractor	Throughout construction period	10,000

	Monitor energy use during construction and set targets for reduction of energy use.	Project Manager &Contractor	Throughout construction period	3,000
11.Minimize release of liquid effluent				
Generation of wastewater	Provide means for handling sewage generated by construction workers	Mechanical Engineer &Project Manager	One-off	5,000 per Month

Expected Negative Impacts	**Recommended Mitigation Measures**	**Responsible Party**	**Time Frame**	**Cost(Kshs)**
	Conduct regular checks for pipe blockages or damages since such vices can lead to release of the effluent into the land and water bodies	Mechanical Engineer &Project Manager	Throughout construction period	4,000/month
12.Minimize occupational health and safety risks				

General register	A general register should be kept within the facilityasstipulatedinSec122&123of the Occupational Safety and Health Act, 2007.	Project Manager &Contractor	One-off	1,500
Posting of abstract of OSHA 2007Act,	There shall be displayed at prominent places within the site the prescribed abstract of the OSHA and the relevant notices asstipulatedinsection121ofthe OSHA, 2007.	Project Manager &Contractor	One-off	5,000
Incidents, accidents and dangerous occurrences**.**	Ensure that provisions for reporting incidents, accidents and dangerous occurrences during construction using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO) are in place.	Project Manager, Developer &Contractor	Continuous	3000/month
	Enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.	The Contractor, Project Manager &Site Safety Officer	Continuous	15,000
Insurance	Ensure that the premises are insured as per statutory requirements (third party and workman's compensation)	Developer	Annually	_

Safety, health and environment(SHE) policy	Develop, document and display prominently an appropriate SHE policy for construction works	Project Manager, Developer &Contractor	One-off	3,500
Health and safety committee	Provisions must be put in place for the formation of a Health and Safety Committee, in which the employer and the workers are represented. Statutory training to be offered.	Project Manager	Annually	100,000
Sanitary conveniences	Suitable, efficient, clean, well-lit and adequate sanitary conveniences should be provided for construction workers	Project Manager	One-off	50,000
Medical examination	Arrangements must be in place for the medical examination of all construction employees before ,during and after termination of employment	Project Manager, Developer& Contractor	Continuous	2000 per examination
Machinery/equipment safety	Ensure that machinery, equipment, personal protective equipment, appliances and hand tools used in construction do comply with the prescribed safety and health standards and be appropriately installed maintained and safeguarded	Project Manager, Developer &Contractor	One-off	–

	Ensure that equipment and work tasks are adapted to fit workers and their ability including protection against mental strain	Project Manager, Developer &Contractor	Continuous	_

	All machines and other moving parts of equipment must been closed or guarded to protect all workers from injury	Project Manager	One-off	_
	Arrangements must be in place to train and supervise inexperienced workers regarding construction machinery use and other procedures/operations	Project Manager	Continuous	100,000 per training
	Equipment such as fire extinguishers must be examined by a government authorized person. The equipment may only be used if a certificate of examination has been issued	Project Manager	Continuous	
	Reports of such examinations must be presented in prescribed forms, signed by the examiner and attached to the general register	Project Manager	Continuous	20,000 per examination
	All floors ,steps, stairs and passages of the premises must be of sound construction and properly maintained	Project Manager &Contractor	Continuous	_

Safe means of access and safe place of employment	Securely fence or cover all openings in floors	Project Manager &Contractor	One-off	_
	Ensure that construction workers are not locked up such that they would not escape in case of an emergency	Project Manager &Contractor	Continuous	_
	All ladders used in construction works must be of good construction and sound material of adequate strength hand be properly maintained	Project Manager &Contractor	One-off	_
Emergency preparedness and evacuation procedures	Design suitable documented emergency preparedness and evacuation procedures to be used during any emergency	Project Manager &Contractor	One-off	5,000
	Such procedures must be tested at regular intervals	Project Manager &Contractor	Every4months	5,000
	Ensure that adequate provisions are in place to immediately stop any operations where there in an imminent and serious danger to health and safety and to evacuate workers	Project Manager &Contractor	One-off	8,000

	Ensure that the most current emergency telephone numbers posters are prominently and strategically displayed within the construction site	Project Manager &Contractor	One-off	3,000
	Provide measures to deal with emergencies and accidents including adequate first aid arrangements	Project Manager &Contractor	Continuous	
First Aid	Well stocked first aid box which is easily available and accessible should be provided within the premises	Project Manager &Contractor	Annually	50,000
	Provision must be made for persons to be trained in first aid, with a certificate issued by a recognized body.	Project Manager &Contractor	Annually	50,000

13.Ensure the general safety and security of the site and surrounding areas				
Increased Pressure on	Coordinate with other planning goals and objectives for the region	Architect, Project Manager, Contact or and the Developer	Continuous	

Infrastructure	Upgrade existing infrastructure and services, if and where feasible.	Architect, Project Manager, Contactor and the Developer	Continuous	5,000
Insecurity	Ensure the general safety and security at all times by providing day and night security guard sand adequate lighting within and around the construction site.	Security Officer, Project Manager& Police	Continuous	100,000 monthly
	Body-search the workers on entry, to avoid getting weapons onsite, and leaving site to ensure nothing is stolen.	Security Officer	Continuous	
	Ensure only authorized personnel get to the site	Security Officer	Continuous	
	Security alarms will be installed	Security Officer	Continuous	

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