



**ENVIRONMENTAL IMPACT
ASSESSMENT STUDY REPORT FOR
THE PROPOSED DAYSTAR DAM
PROJECT ON PLOT: L. R. 19031,
MAVOKO SUB-COUNTY,
MACHAKOS COUNTY**



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DOCUMENT AUTHENTICATION

A. ENVIRONMENTAL CONSULTANTS

This Environmental Impact Assessment (EIA) for the Proposed dam Project was compiled in accordance to the legal requirements provided for and to guide the practices, activities and conduct of EIA, as contained in the Environmental Management and Coordination Act (EMCA 1999), the compliance to Environmental (Impact Assessment and/Audit) Regulations, 2003 and other subsequent legislations relating to the environment. The following Environmental Experts were involved in the actual EIA:

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- **Mike Nderitu (Lead Expert-NEMA Reg. No. 2646)**
- **Timothy Maina (Associate Expert, Reporting-NEMA Reg. No. 2343)**
- **Sila Mati (Data Collection and Public Consultation)**

The EIA was done during the month of September 2016.

Signed----- Date -----

For EIA Experts

B. PROPONENT PRELIMINARY DETAILS

Location of the Project: Mavoko Sub-County neighbouring Lukenya Boys
GPS Coordinates: 1° 26'35" E, 37° 02'54" N (WGS84)
Neighbours: Mixed Land Uses (Schools and Residential Properties)
Nature of Activity: Water Resource Project
Name of Project: Daystar Dam Project
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Terms of Reference: As stated
Date of EIA: September 2016

Signature..... Date:

For the Project Proponent

EXECUTIVE SUMMARY

Daystar University Management is proposing to construct a concrete gravity Dam at Athi River Campus. The proposed project is informed by the need to address perennial challenges the university has been undergoing with regard to clean water supply. Currently the university relies on water supplied by local government owned company that is inadequate and unreliable. To supplement the water supply, the university has been hiring the services of water bowsers and this is very expensive and unsustainable in the face of projected population growth and infrastructure development in the university.

The proposed project will occupy approximately 5ha when the reservoir is full. The proposed dam will be for domestic purposes only and is expected to supply water to a population of 8000 students up to the ultimate year 2036. The dam has been designed to have full reservoir storage of 160,000m³ and a live storage of 155,000m³. The dam wall will be 10m high and it is expected to cost approximately Ksh.100million. The proposed dam will entail all the necessary civil works; excavation, compaction and embankment. The designs have provided for a spillway in form of an ogee overflow section at the middle of the dam wall which shall ensure that excess water is returned to the river valley.

In conformity with the Environmental Management and Coordination Act (EMCA) of 1999, such a project should be subjected to EIA before commencement. The purpose of this EIA was to investigate potential impacts of the proposed project on the bio-physical, social and natural environment in Project influence area. The EIA has proposed mitigation measures, including an Environmental Management Plan (EMP). The EIA employed several methods and techniques in data collections including:

- i. Literature review;
- ii. Discussions with project proponent staff;
- iii. Consultations and public Participation (CPP);
- iv. Observations and
- v. Photography

Data collection instruments used in the EIA included a checklist (for preliminary survey); Observations guide for site inspection; and Interview guides. Topics covered during the EIA of the proposed project focused on but not limited to the following:

- i. Public safety
- ii. Waste management
- iii. Project characteristics
- iv. Physical landscape
- v. Soil-water run-off characteristics
- vi. Land use activities in the location
- vii. Biodiversity and environmental issues
- viii. Social and cultural issues
- ix. Conservation and
- x. Analysis of the discussions

a) While Meeting with the neighbouring community and consulting other stakeholders, the discussions on the proposed project focused on but not limited to the following:

- i. Potential social impacts of the project;
- ii. Economic aspects of the project;
- iii. Potential impacts of construction on biodiversity, especially culturally important site(s)/ plants and the indigenous knowledge of conservation;
- iv. Potential conflicts due to project suitability vis a vis neighbouring land use practices;
- v. Discussion on potential impacts on animal and human health;
- vi. Employment consideration to the local residents;
- vii. The stakeholders support to the proposed project; and
- viii. Cross cutting issues (gender, marginalized groups, HIV/Aids).

b) Major Observations

- i. The proposed project will be undertaken in a privately owned land.
- ii. The project proponent is expected to apply sustainable resources use;
- iii. There project site will be properly secured;
- iv. The proposed project is compatible with the current land use in the locality. There exist other dams in the university and no major negative impacts have been reported.

c) Anticipated Positive impacts

- ✓ The university will have adequate water supply;
- ✓ Will lead to averting of property damages and losses associated with poor flood management
- ✓ Job creation-long-term and short-term
- ✓ Proper water usage (cleaning and landscaping purposes)
- ✓ Economical whereby water costs will be reduced and the savings diverted to other priority areas.

d) Anticipated Negative impacts

- ✓ If waste generated will not be properly disposed there is risk of diseases to both humans living within the project influence area and animals scavenging the poorly disposed wastes;
- ✓ Aesthetic beauty will also be lowered by littering of wastes;
- ✓ Soil erosion during the construction works;
- ✓ Noise from construction machines and vehicles; and
- ✓ Injuries/ casualties if proper occupation health measures will not be observed among other negative impacts.

e) Proposed Mitigation Measures:

- ✓ Soil erosion control measures should be undertaken;
- ✓ Compensation for those who will suffer injuries; and
- ✓ The project should be reviewed from time to time identify any unforeseen impact.

f) Recommendations from the key stakeholders

- ✓ The project should go on;
- ✓ All relevant stakeholders should be involved all through and where the skills needed are locally available, locals should be accorded first priority.

Having considered the data collected, analyzed and collated information available, it is the experts considered opinion that:

- ✓ The project **DOES NOT** pose any serious environmental concern, other than those of minor scale that accompany most development activities.
- ✓ The positive impacts of the project far **OUTWEIGH** the negative ones, which will be adequately contained by following the prescribed EMP.

As such the project could be allowed to commence, and activities be managed within the provided EMP and sound environmental management practices that are internationally recognized.

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ACRONYMS

AIDS	Acquired Immuno-Deficiency Syndrome
ASL	Africa Spirits Limited
CAP	Crisis Action Plan
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPP	Consultation and Public Participation
CSDS	Chemical Safety Data Sheets
EA	Environment Audit
EAP	Environment Action Plan
EIA	Environment Impact Assessment
EMCA	Environment Management Coordination Act
EMMP	Environment Management and Monitoring Plan
EMP	Environment Management Plan
GoK	Government of Kenya
IAEA	International Atomic Energy Agency
IOMAC	Regional Convention/Agreement on the Organization for Indian Ocean Marine Affairs
JKIA	Jomo Kenyatta International Airport
KBS	Kenya Bureau of Standards
KWS	Kenya Wildlife Service
NCA	National Construction Authority
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NPEP	National Poverty Eradication Plan
NWL	Normal Water Level
OSH	Safety and Health
PCC	Plain Cement Concrete
PIA	Project Influence Area
PMF	Probable Maximum Flood
PPEs	Personal Protective Equipment
SHE	Safety Health and Environmental
STD	Sexually Transmitted Diseases
UNFCCC	United Nations Framework Convention on Climate Change
WRMA	Water Resources Management Authority

1. INTRODUCTION

1.1. Introduction the Project

Daystar University, a privately owned institution of higher learning was established in the early 80s. Its Athi River campus, which is located at the foot of Lukenya hills, occupies an average of 300 acres of land in a semi-arid region located at Mavoko Sub-County, Machakos County. The university would like to construct a concrete gravity dam to enhance water supply to the growing university population (projected to grow to 8000) while at the same time supporting proposed infrastructural development. The capacity of the dam will be 160,000m³ and will occupy approximately 5ha of land at full capacity.

1.2. Project Objective

To construct a concrete gravity dam with the following parameters:

- ✓ Full reservoir area: 5.0ha
- ✓ Full reservoir storage: 160,000m³
- ✓ Live storage: 155,000m³
- ✓ Dam height: 10m
- ✓ Estimated cost: Approximately KShs.100million
- ✓ Purpose: Domestic water use only

1.3. Project Justification

The proposed dam is informed by the need to address perennial water supply challenges the university has been going through. Currently the university is supplied with water by a local authority owned company that is inadequate and unreliable. The university has been contracting private water vendors to truck to the university with water bowsers. This has been expensive to the university and unsustainable. The university has also constructed two small dams that have not been sustainable too. In addressing this challenge the university has contracted the services of water resources experts (engineers, hydrologists) to undertake studies on the most viable source of adequate, affordable and sustainable source of water, hence the proposed project. Ground water is also not sustainable and it is also not environmental friendly because it dries the underground (aquifer) thereby destabilizing the recharge and discharge capacity of the area. Growth and development in the university has been limited by lack of reliable source of water. This has limited population increase in the university despite availability of land and the proximity of the university to Machakos and Nairobi towns. The university cannot undertake further infrastructural development and this limits its capacity too. It is against this background that the university is proposing to put up the proposed dam project.

1.4. Terms of Reference

The list below highlights the terms of reference for this study. The terms of reference define the objectives and scope of the EIA as follows:

- i. Assess the baseline environmental conditions in the project area, such as biological, physical and socio-economic environment;
- ii. Study the potential positive and negative impacts of implementing the proposed project in the society living within the influence of the project including, but not limited to, sustainable water supply to the institution, job creation, improvement in the livelihood and improvement of land use in the locality.
- iii. Assess the potential environmental and social impacts of the project and suggest suitable mitigation measures for the adverse impacts;

- iv. Study the project conditions and requirements in terms of location, construction and operation requirements;
- v. Study issues arising from the proposed project for example livelihood disruption, public safety and rehabilitation of the affected environment.
- vi. Prepare an EMP for implementation and monitoring of mitigation measures along with budgetary estimates, institutional and reporting requirements.

1.5. EIA Methodology

The EIA is based on site visits, literature review, discussions with the project proponent, engineers and consultation with the public (public participation). The project proponent provided the proposed project design report. While preparing the EIA project report, care has been taken to identify the potential negative impacts and their mitigation measures in terms of:

- i. Impacts due to project location;
- ii. Impacts from project design and during construction; and
- iii. Impacts during the operation of the project.

For the purpose of the assessment and preparation of the project report, the following approaches and methodologies were employed:

- i. Desktop studies which involved review and analysis of literature for acquisition of secondary data;
- ii. Environmental screening, in which the project was identified as among those requiring EIA under schedule two (2) of EMCA, 1999;
- iii. Environmental scoping that provided the key environmental issues to be investigated in relation to implementation of the proposed project;
- iv. Physical inspection of the site and surrounding areas;
- v. Conducted interviews involving all necessary stakeholders for collection of primary data (Consultation and Public Participation-CPP);
- vi. Identification of potential impacts and preparing;
- vii. Confirmation and sharing of findings with the project proponent; and Reporting

1.6. Consultation and Public Participation (CPP)

Consultation and Public Participation was done within the Project Influence Area (PIA). This promotes open governance whereby everybody is granted equal opportunity to voice their opinion/ views with regard to the proposed project: the opinions/ views given assist in planning of the proposed project. This promotes awareness and provides an opportunity for better planning of the proposed project whereby opinions from various stakeholders are considered.

Kenya has developed EIA Regulations, which must be adhered to by proponents of all development projects. These regulations have been clearly spelt out in the Environmental Management and Coordination Act (EMCA, 1999) and the EIA and Environmental Audit (EA) Regulations of 2003. These documents provide guidance on environmental and social issues/factors that must be considered during an EIA and preparation of the project report. The study found out the proposed project lies within the institution and further from other communities and therefore consultation was done with various stakeholders within the institution and consultants namely: the projects department, the administration department, the student body and the consulting engineers.

2. PROJECT DESCRIPTION

2.1. Introduction

This section highlights details pertaining the proposed project; the projects specs and baseline information of the project location and the project influence area. The section also examines the compatibility of the proposed project with the local land uses.

2.2. Project Location

The proposed project will be located at Daystar University, Athi River Campus. The university is located on the lower side of Lukenya hills overlooking Mombasa Road in Mavoko Sub-County, Machakos County.



Figure 1: Proposed Project Location (Daystar University Compound)

2.3. Project Details

The proposed project will entail construction of a concrete gravity dam. The proposed dam will be for domestic purposes only and is expected to supply water to a population of 8000 students up to the ultimate year 2036. The dam has been designed to have full reservoir storage of 160,000m³ and a live storage of 155,000m³. The dam will be 10m high and it is expected to cost approximately Ksh.100million. A full reservoir area of 5ha will be flooded at full storage. A two-metre-wide walkway has been provided at the crest as an alternative path. The catchment area was determined to be 2.2km² while the river valley was found to be 2.3km long. These data have been used to determine the catchment yield and develop the expected floods.

The main construction materials will be Concrete and this was informed by the following reasons:

- i. In order to minimise the area occupied by the dam wall and maximize on storage area;
 - ii. The foundation is rocky hence attracting better bond with concrete than earth embankments;
- and

- iii. For safety reasons concrete would allow for a wide spillway without incurring huge costs and additional area.

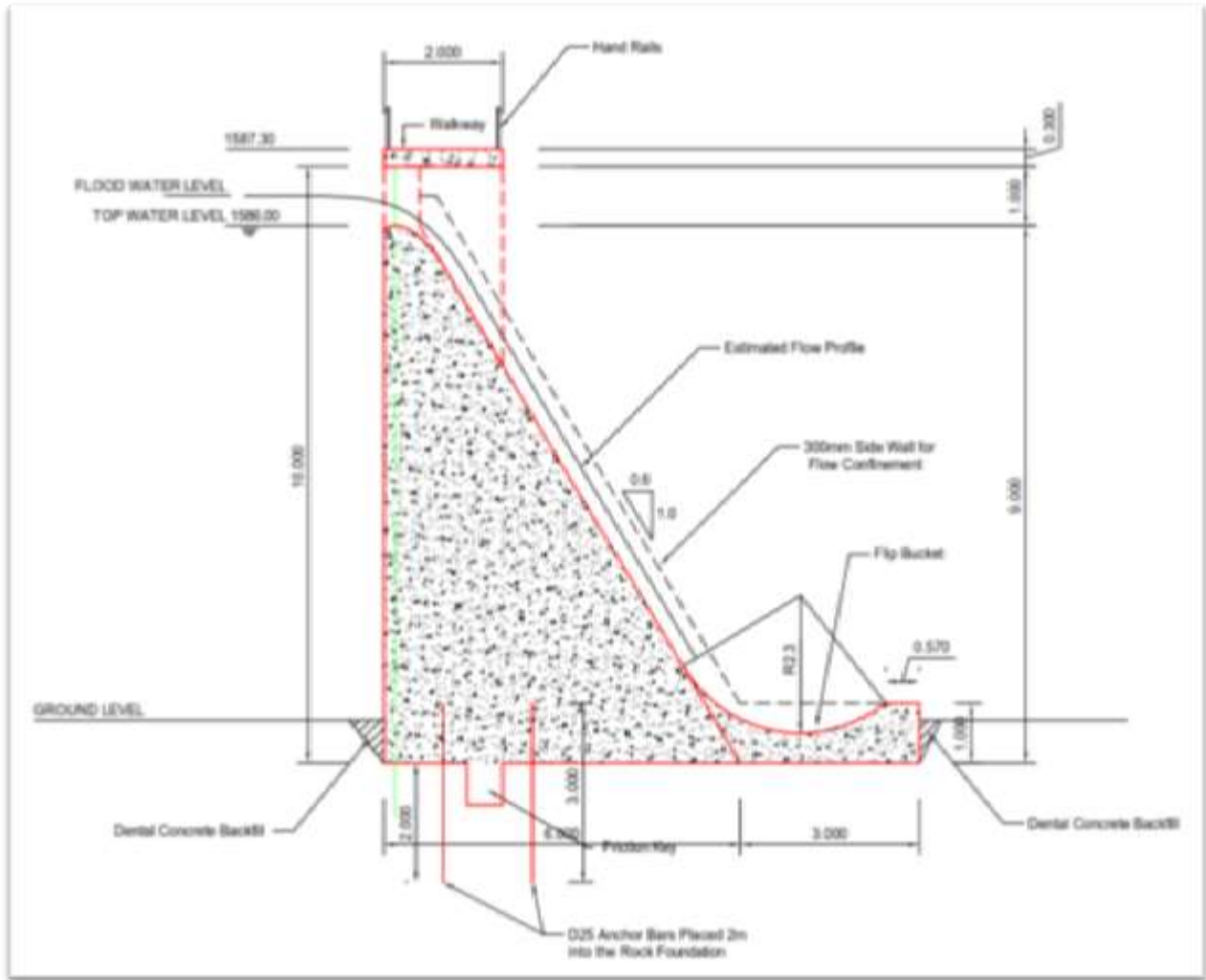


Figure 2: Typical Section for the spillway Overflow Section (showing the walkway at the top)
 Source: Dam Design Report, 2016

2.4. Project Summary Sheet

The table below summarizes the proposed project design details/ parameters

Table 1: Project Summary Sheet

Item	Particulars
Name of the proponent	Daystar University
Name of Project	Proposed Daystar Dam
Specific location	Daystar University-Athi River Campus , Machakos County, Mavoko Sub-County
Site Coordinates	1° 26'35" E, 37° 02'54" N (WGS84)
Project Objective	To construct concrete gravity dam
Project Scope	To construct concrete gravity dam with the capacity of 160,000m ³ . The dam will occupy 5.0ha at full storage up to the ultimate year 2036. The dam is designed to serve a population of 8,000 students.
Land/ Plot Details	L. R. No. 19031, Mavoko Sub-County, Machakos County
Reservoir Area:	50,675 m ² (5ha)
Dam Volume Capacity	160,000 m ³
Dam Type:	Concrete Gravity Dam
Dam Crest Length:	320m
Dam Height:	10m
Dam Crest Level:	1587.00masl

Construction Joints:	10 m Centre to centre	
Dam Concrete Panels:	32 Number	
Dam Upstream Slope:	1:0 (Vertical)	
Dam Downstream Slope	1:0.6	
Sediment scour outlet:	700x700mm Penstock gate	
Intake pipe:	DN 200 mm Steel Pipe (gate regulated)	
Spillway Type:	Ogee overflow	
Spillway Width:	40m	
Energy Dissipater:	Flip Bucket	
Spillway design Capacity:	67 m ³ /Sec	
Spillway design Flood:	1:10,000 Return (high Risk)	
Water Demand:	750m ³ /day ultimate (2036)	
Supply Population:	8,000 students	
Dam Safe yield:	750 m ³ /day (6 months Dry Period)	
Catchment safe yield:	347,600 m ³ /year -80% Recurrence level	
Catchment mean Rainfall	722 mm/year (JKIA met station Data)	
Project Budget	a) Civil and other works	
	b) Overheads including design, supervision and administration	(30% material costs)
Approximate Total cost of Construction:	KShs.100 million	

2.5. Project Input

The material input for construction of the proposed concrete gravity water dam is as indicated on the table below.

Table 2: Project Input

Component	Activities	Materials	Equipment
Site Preparation	Site clearing (removing of vegetation)	none	Tractors, loaders, Shovels,
Excavation Works	Excavation works to desired depth	none	Excavator, shovels, tippers
	Levelling and compaction	none	Soil Compactor
	Embankment (optional)	Soils and other materials to engineer's specification	Excavator, tippers
Weir (Dam wall)	Erecting concrete wall fitted with necessary water infrastructure (spillway and intake pipes)	-Reinforced Concrete to engineer's specification -Steel bars, Sand, cement, ballast	Manual Equipment
Walkway	Constructing 2 meter walkway at the (Crest/Topside of the weir)	Guard rails	Manual equipment and tools & Welding machines
Pipe Network	Installing pipes	Intake pipe- DN200 steel pipe	Manual equipment, lifting crane/ tractor
Perimeter fence	Erecting a fence securing the dam site	Poles, Barbed wires, nails	Manual equipment
Landscaping	Rehabilitating the project site, levelling, planting of vegetation (trees, flowers)	Jembes, pangas, tree and flower seedlings, pavements blocks-cabro	Manual equipment

2.6. Project Output

The following will be the main outputs resulting from implementation of the proposed project:

a) Waste Output

- i. Site clearance wastes;
- ii. Domestic waste/ Waste associated with workers;
- iii. Metallic wastes;

- iv. Containers (plastic/papers);
- v. Wooden pallets;
- vi. Broken culverts; and Concrete wastes mortar among others

b) Other Outputs Include

- i. Noise emissions from construction machinery, motor vehicles, among others; and
- ii. Air emissions from machinery (Carbon Dioxide (CO₂), Carbon Monoxide (CO), Nitrogen Oxide (NO_x), Nitrogen Dioxide (NO₂), PPM etc.)

2.7. Project Site and Land Ownership

The project land is owned by Daystar University; the proponent is in possession of legal documents to attest to the ownership of the land.

2.8. Cultural and Historic Sites

There are no cultural or historically important sites within the project influence area and therefore the proposed dam is bound to have no adverse impacts on the cultural aspects of the neighbouring community.

2.9. Local Land Uses

Daystar University lies on a 300-acre piece of land located at the foot of Lukenya hills, which is a semi-arid region. Currently a small portion of the land is occupied by structures that entail: Administration block, tuition halls/ theatres, hostels, water tanks, Central stores among other requisite structures for learning institutions. The proposed dam will be located in the middle of other existing dams and along a water path/ course that passes through the university. The proposed project is compatible with the local land uses because there are other existing dams and there have not been recorded any negative impact from the prevailing dams (*refer to figure 1*). Secondly, it is important to note the water path is a dry valley that drains water during the rainy season from the Lukenya hills. There are no major water bodies downstream and the water course remains dry during the dry months (9 months in a year). Adequate safety measures have been proposed to secure the dam and walkway that will be at the crest/ atop the weir. The foundation area is by a big percentage rocky. The concrete wall would also bond well with the rock as well as provide an overflow spillway without incurring huge costs and this was attested by design engineers.

2.10. Baseline Information

Baseline information is very important because it establishes the current biophysical conditions and it against these conditions that performance of environmental strategies will be evaluated. Baseline information is intended to establish the present state of the environment, taking into account changes resulting from natural events and from other human activities (Glasson, 1994; Canning et al., 2003). The expected social and economic gains from the proposed project must be weighed in light of possible negative impacts on the environment and tenable measures that have been proposed to mitigate against such impacts. The baseline information for this project was gathered from both secondary sources and the field visits described earlier in this report.

2.10.1. Soils

Different types of soils were identified within the project influence area but sandy soils were predominant. Other soils noticed included Black clay soils near the lower dam; and Patches of red volcanic soils.

2.10.2. Flora

The institution is inhabited by different types of vegetation. The dominant vegetation identified included grass and shrubs. Herbaceous plants were also identified. Aquatic plants were also noticed on the existing water dams (upper and lower dam). Plant species identified in the area included Trees (different acacia species with yellow back acacia being predominant); Shrubs (acacia species); Grass; Papyrus; Epiphytes (climbers); Aloe Vera and Sisal species.



Figure 3: Shrubs and trees



Figure 4: Grass and runners

2.10.3. Fauna

The study identified animal life in the project influence area. There were insects, signs of grazers (antelopes), rodents, birds and the area is good habitat for snakes and other invertebrates.

2.10.4. Water Resources

Currently the institution has two water dams and underground water tank for water storage. The institution has also laid pipe network for the whole institution.



Figure 5: The Upper Dam



Figure 6: The Lower Dam

2.10.5. Drainage

The institution is well drained with dry river valleys evident in the institution. Storm water drains were also visible throughout the institution.

3. REVIEW OF POLICY AND LEGAL FRAMEWORK

3.1. General Overview

Kenya has a policy, legal and administrative framework for guiding it in environmental management. Under the framework, the National Environment Management Authority (NEMA) is responsible for ensuring that EIAs are carried out for new projects and EAs on existing facilities as per the provisions of EMCA, 1999. EAs are carried out in order to identify positive and negative impacts associated with ongoing projects with a view to taking advantage of the positive impacts and developing mitigation measures for the negative ones. The guidelines on EAs are contained in Sections 58 to 67 of EMCA of 1999.

EIA is a tool for environmental conservation and has been identified as a key requirement for new projects to ensure sustainable operations with respect to environmental resources and socio-economic activities in the neighbourhood of the facilities. The government has established regulations to facilitate the process on EIAs and EAs. The regulations are contained in the Kenya Gazette Supplement No. 56, legislative supplement No. 31, Legal Notice No. 101 of 13th June 2003.

In order to ensure that the activities undertaken during implementation of the project conform to existing policies and laws, a number of key statutes and principles geared towards ensuring proper environmental and natural resources management were examined. This enabled the identification of specific provisions of various relevant laws that need to be adhered to. These included the following:

- Environmental Management Principles and Guidelines
 - ✓ Sustainability
 - ✓ Principle of Intergenerational Equity
 - ✓ Principle of Prevention
 - ✓ Precautionary Principle
 - ✓ Polluter Pays Principle
 - ✓ Principle of Public Participation
 - ✓ The Cultural and Social Principle
 - ✓ Principle of International Co-Operation

- The Kenya National Environmental Action Plan (NEAP, 1994)
- Policy Framework
 - ✓ Environmental Policy Framework
 - ✓ National Water Policy, 2000
 - ✓ Water Catchment Management Policies
 - ✓ The National Poverty Eradication Plan (NPEP), 1999
 - ✓ And others

- Legal Framework
 - ✓ Environmental Management and Coordination Act No. 8 of 1999.
 - ✓ Physical Planning Act, 1999.
 - ✓ Environmental Impact Assessment and Audit Regulations of 2003.
 - ✓ Local Authority Act (Cap 265), 1998.
 - ✓ EMCA (Waste Management) Regulations, 2006 Legal Notice No.12.
 - ✓ The Public Health Act, Cap 242.
 - ✓ Occupational Safety and Health Act (OSHA) 2007.
 - ✓ Noise and Excessive Vibrations Pollution Control Regulations 2009.
 - ✓ Way leave Act, 2010.

- ✓ Water Act of 2002
- ✓ And others

- The Constitution of Kenya

3.2. Environmental Management Principles and Guidelines

The project proponent and management is expected under law and best practice to consider and exercise all the principles and tenets of environmental management. These principles are as discussed below:

3.2.1. Sustainability

The principle of sustainability requires that natural resources should be utilized in a way and at a rate that does not lead to the long-term decline of natural resources, thereby maintaining its potential to meet the needs and aspirations of present and future generations. It strives for equity in the allocation of the benefits of development and decries short-term resource exploitation which does not consider the long-term costs of such exploitation. In the course of implementing the proposed project, the project proponent/manager is strongly advised to use resources sustainably and source materials from suppliers that have been identified as employing/ practicing sustainable resources use.

3.2.2. Principle of Intergenerational Equity

The principle of sustainability should be examined together with that of intergenerational equity, which focuses on future generations as a rightful beneficiary of environmental protection. Essentially, the principle of intergenerational equity advocates fairness, so that present generations do not leave future generations worse off by the choices they make today regarding development. Operations and activities undertaken at all the stages of the proposed project ought to be designed to embrace the rationale of intergeneration equity in resources use both natural and man-made resources. Besides, intra-generation equity should be observed whereby various resources users in the current generation should not have their resources use ability compromised by the proposed project.

3.2.3. Principle of Prevention

The principle of prevention states that protection of the environment is best achieved by preventing environmental harm in the first place rather than relying on remedies or compensation for such harm after it has occurred. The reasoning behind this principle is that prevention is less costly than allowing environmental damage to occur and then taking mitigation measures. The project proponent is duty bound under EMCA 99 to undertake all the preventive and viable measures to protect the environment in the course of implementing the project, upon commissioning the project through to decommissioning of the project.

3.2.4. Precautionary Principle

The precautionary principle recognizes the limitations of science, as it is not always able to accurately predict the likely environmental impacts of resource utilization. It calls for precaution in the making of environmental decisions where there is scientific uncertainty. Accordingly, it is closely related to the principle of prevention and can be viewed as the application of the principle of prevention where the scientific understanding of a specific environmental threat is not complete. The precautionary principle thus requires that all reasonable measures must be taken to prevent the possible deleterious environmental consequences of development activities. Further, it demands that scientific uncertainty should not be used as a reason for not taking cost effective measures to prevent

environmental harm. The project proponent should undertake all the necessary precautionary measures in the course of implementing the proposed project.

3.2.5. Polluter Pays Principle

The polluter pays principle requires that polluters of natural resources should bear the full environmental and social costs of their activities. It seeks to internalize environmental externalities by ensuring that the full environmental and social costs of resource utilization are reflected in the ultimate market price for the products of such utilization. Since environmentally harmful products will tend to cost more, this principle promotes efficient and sustainable resource allocation as consumers are likely to prefer the cheaper less polluting substitutes of such products. This principle dictates that when undertaking a project or running institution, if damage is caused to private properties or even public utilities such as roads or public goods such as water bodies, measures to compensate the affected should be instituted immediately.

3.2.6. Principle of Public Participation

The principle of public participation seeks to ensure environmental democracy and requires that the public, especially local communities should participate in the environment and development decisions that affect their lives. It requires that the public should have appropriate access to information concerning the environment that is held by public authorities and should be given an opportunity to participate in decision-making processes. This principle calls for public participation in the development of policies, plans and processes for the management of the environment. Public participation ensures that:

- ✓ The process is open and transparent
- ✓ Provides valuable sources of information on key impacts, potential mitigation measures and possible alternatives
- ✓ Ensures that a project meets the community's needs
- ✓ Ensures that a project is legitimate and it is a way of ensuring that conflicts can be addressed before NEMA makes a decision.
- ✓ Assists in informed decision making
- ✓ Promotes better implementation of projects once NEMA has made a decision
- ✓ Enlightens the community on the opportunities and benefits that could arise from a project

3.2.7. The Cultural and Social Principle

The Cultural and Social Principle is traditionally applied by many communities in Kenya for the management of the environment or natural resources in so far as the same are relevant and are not repugnant to justice and morality or inconsistent with any written law. Since time immemorial many communities have lived sustainably in various ecosystems in Kenya. It against this setup that existed where resources utilization though devoid of sophisticated/ complicated technologies guaranteed health environment that the current development should borrow leave from. It is therefore important for the proponent to factor in local/ traditional environment management systems in the course of implementing the project especially in storm water/ flashfloods control.

3.2.8. Principle of International Co-Operation

The Principle of International Co-operation applies in the management of environmental resources shared by two or more states. Environmental impacts do not respect national or international boundaries and as such are trans-boundary. This principle ensures that international relations and understanding are upheld and therefore management of environmental concerns arising from a

project/ action across two jurisdictions can be managed. However, the proposed project does not have far reaching cross boundary impacts.

3.3. National Environment Action Plan

According to NEAP 1994, the Government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programmes that disregarded environmental sustainability. Established in 1990, the plan's effort was to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources are an integral part of societal decision-making. Under the NEAP process, EIA was introduced and among the key participants identified were the industrialists, business community and local authorities.

3.4. Policy Framework

3.4.1. Environmental Policy Framework (2013)

The Kenya Government's Environmental Policy of 2013 is geared towards sound environmental management for sustainable development. This is envisaged in the principle of prudent use, which requires that the present day usage should not "compromise the needs of the future generations". This is applicable in the proposed project because resources will be drawn for use in the proposed project. The policy emphasis is on environmental protection in order to ensure sufficient supplies for the present and future generations. The policy envisages the use of the "polluter pays principle", where one is expected to make good any damage made to the environment. The Kenya Government's Environmental Policy aims at integrating environmental aspects into national development plans. The broad objectives of the National Environmental Policy include:

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

EIA critically examines the effects of proposed project on the environment and identifies potential negative and positive impacts of any development activity or project, how it affects people, their property and the environment. EIA also identifies measures to mitigate the negative impacts, while maximizing on the positive ones. It seeks to minimize adverse impacts on the environment and reduces risks. If a proper EIA is carried out, then the safety of the environment can be properly managed at all stages of a project-operation, monitoring and evaluation as well as decommissioning. Impact assessment is required at the planning stage of a project or development activity. This helps the decision makers to factor in environment safeguards in project designs thereby avoiding possible negative impacts of the proposed project. EAs are undertaken annually after the commissioning of the project. EAs are to be undertaken regularly on projects including this one, to ensure that they operate within the set environmental principles.

The Environmental (Impact Assessment/Audit) Regulations, 2003 were issued in accordance with the provisions of EMCA of 1999. The Regulations must be administered, taking into cognizance provisions of EMCA, 1999 and other relevant national laws. The project proponent will need to observe the provisions of the various statutes that are aimed at maintaining a clean and healthy environment.

3.4.2. National Water Policy, 2000

The National Policy of Water which was promulgated in April 1999 as Sessional Paper No. 1 of 1999 calls for decentralization of operational activities from the central government to other sectors, including local authorities, the private sector and increased involvement of communities in order to improve efficiency in service delivery. It also tackles issues pertaining to water supply and sanitation facilities development, institutional framework and financing of the sector. According to the policy, in order to enable sustainable water supply and sanitation services, there is need to apply alternative management options that are participatory through enhanced involvement of others in the provision of these services but particularly the private sector. It is therefore important for the proposed project management to factor in sanitation facilities in the proposed project to avoid contamination of water resources.

The overall objective of the National Water Policy is to lay the foundation for the rational and efficient framework for meeting the water needs for national economic development, poverty alleviation, environmental protection and social well-being of the people through sustainable water resource development and management.

3.4.3. Land Policy of 2009

The Sessional Paper No. 3 of 2009 on National Land Policy was formulated to address the critical issues of land administration, access to land, land use planning and environmental degradation. It also addresses restitution of historical injustices, conflicts, unplanned proliferation of informal urban settlements and information management. It recognizes the need for security of tenure for all Kenyans. The overall objective of the National Land Policy is to secure rights over land and provide for sustainable growth, investment and the reduction of poverty in line with the Government's overall development objectives. Among others, the Policy provides the framework for the maintenance of a system of land administration and management that will provide efficient and effective utilization of land and land based resources.

The Policy designates all land in Kenya as public, community and private land. Most significantly, the Policy establishes a mechanism for securing the tenure of public land by placing all public land under the National Land Commission to hold and manage the land in trust for the people of Kenya. The Policy has provisions aimed at protecting forest reserves and water catchment areas through establishment of mechanisms for repossession of any public land acquired illegally or irregularly and establishment of an appropriate system for registering public institutional land. Through the Policy, the Government will ensure that all land is put into productive use on a sustainable basis by facilitating the implementation of key principles on land use, productivity targets and guidelines as well as conservation.

3.4.4. The National Poverty Eradication Plan, 1999

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

to earn income. The proposed project will provide employment opportunities during implementation to casual workers and thereafter will offer employment to various service providers like property managers/ agents, water suppliers and eventually a reward to the proponent. This will go a long way in poverty alleviation.

3.5. Legal Framework

3.5.1. Environment Management and Coordination Act (1999)

EMCA is an Act of parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for related matters. NEMA is a body established under the Act, and has the legal authority to exercise general supervision and co-ordination over all matters relating to the environment, and is the principal arm of the Government charged with the implementation of all policies relating to the environment.

Part II of EMCA (1999) states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. It is worth noting that the entitlement to a clean and healthy environment carries a collective duty. Hence, there is not only the entitlement to a clean and healthy environment, but also the duty to ensure that the environment is not degraded in order to facilitate one's own as well as other persons' enjoyment of the environment. All EIAs reports are submitted to NEMA for review and necessary advice thereafter. The law is based upon the principle that everybody is entitled to a healthy and clean environment.

Discretionary approvals required: The Act requires that projects acquire approval before their commencement. NEMA approves and issues an environmental license after an Environmental Impact Assessment or a Project report depending on whether the project assessment and report satisfies it. This is also in compliance with the requirements of EMCA Part VI section 58 (1) and (2) which states that:

“Notwithstanding any approval, permit or license granted under this Act or any other law in force in Kenya, any person, being a proponent of a project, shall, before financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeded with, carried out, executed or conducted by another person any undertaking specified in the Second Schedule to this Act, submit a project report to the authority in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fee” The proponent of the project shall undertake or cause to be undertaken at his own expense an EIA study and prepare a report thereof where the Authority, being satisfied, after studying the report submitted under Subsection (1), that the intended project may or is likely to or will have a significant impact on the environment, so directs”.

3.5.2. EIA and EA Guidelines (2003)

The EIA and EA guidelines require that EIAs and EAs be conducted in accordance with the issues and general guidelines spelt out in the second and third schedules of the regulations. These include coverage of the issues on schedule 2 (ecological, social, landscape, land use and water considerations) and general guidelines on schedule 3 (impacts and their sources, project details, national legislation, mitigation measures, a management plan and environmental auditing schedules and procedures.

3.5.3. The Water Act Cap 372 (2002)

The water Act aims to “make better provision for the conservation, apportionment and use of water resources of Kenya.” It prohibits persons from diverting, abstracting, obstructing or using water from a body of water except as provided for in the Act (Section.5). The Act stipulates that a

permit is required in all cases of proposed diversion, abstraction, obstruction, storage or use of water, with minor exceptions relating to use for domestic purposes (Section.36). Under the *Water Act (General) Rules*, it is stated that any rights acquired under the permit are subject to the **Public Health Act** and the *Malaria Prevention Act*, in addition to the Water Act itself. The Public Health Act has wide-ranging provisions on pollutant discharges, which are set out below. The Water Act (General) Rules make provision for discharges in a number of respects, as follows:

- ✓ Effluent shall not be returned to any body of water unless it has been purified. Further, it must not contain poisonous or injurious matter or excess silt, gravel or boulders.
- ✓ Water used for pulping, mulling or washing of coffee shall be efficiently screened.
- ✓ The regulating authority may determine the potential prejudicial effects of the pollutant discharges and order the removal already made.
- ✓ It is an offence to allow effluent discharges, either domestic or industrial, if this would harm fish, and a fish warden may order its removal. Plans for rendering such effluent innocuous shall be submitted to and approved by the enforcing authority.

Part ii section 3 clearly states that “every water resource is vested in the State, subject to any rights of user granted by or under this Act or any other written law”. The Water Act clearly defines a reserve and it states that a reserve refers to “quantity and quality of water in relation to a water resource required To satisfy basic human needs for all people who are or may be supplied from the water resource; and To protect aquatic ecosystems in order to secure ecologically sustainable development and use of the water resource. In determining the reserve of a water source (section 13 part 1 through 3) the act stipulates that:

1. The Minister shall, by notice in the Gazette, determine the reserve for the whole or part of each water resource which has been classified under this Part.
2. A determination of the reserve shall ensure that adequate allowance is made for each aspect of the reserve.
3. The Minister, the Authority and all public bodies shall, when exercising any statutory power or performing any statutory function in relation to the water resource concerned, take into account and give effect to the requirements of the reserve.

In utilizing water resources, a permit is sought from WRMA. Section 25 stipulates the water uses that would require a permit from WRMA. The following uses would like user permit from WRMA:

- a) any use of water from a water resource, except as provided by section 26;
- b) the drainage of any swamp or other land;
- c) the discharge of a pollutant into any water resource;
- d) Any purpose, to be carried out in or in relation to a water resource, which is prescribed by rules made under this Act to be a purpose for which a permit is required.

A user permit is however, not required for the following reasons as stipulated in section 26; 1(a-c) that states that:

- 1) Except as provided by subsection (2), a permit is not required:
 - a) for the abstraction or use of water, without the employment of works, from or in any water resource for domestic purposes by any person having lawful access thereto;
 - b) for any development of ground water, where none of the works
 - c) necessary for the development are situated i) within one hundred metres of any body of surface water (other than enclosed spring water, as defined in subsection (3); ii) or within a ground water conservation area; or
 - d) for the storage of water in, or the abstraction of water from, a dam

- e) Constructed in any channel or depression which the Authority has declared, by notice published in the Gazette, not to constitute a watercourse for the purposes of this Act.

The project proponent should comply with all the legal requirement necessary for implementing the proposed project, these are requirements related to permits, water charges among others as stipulated in water act, 2002. Section 31 focus on water charges for water use. Subsection 1 states that “The conditions of a permit may require that, on issue of the permit and at prescribed intervals thereafter, the permit holder shall pay charges to Authority for use of water in accordance with the permit”. Further to this section 2 states that “The charges shall be determined by reference to a schedule of charges published in the Gazette from time to time by the Authority, with the approval of the Minister and following public consultation “.

Section 32 outlines conditions to be observed for the issuance of user permit. Subsection 1 states that “In issuing a permit, and in fixing any conditions to be imposed on a permit, the Authority shall take into account such factors as it considers relevant, including:

- a) existing lawful uses of the water;
- b) efficient and beneficial use of water in the public interest;
- c) any catchment management strategy applicable to the relevant water resource;
- d) the likely effect of the proposed water use on the water resource and on other water users;
- e) the class and the resource quality objectives of the water resource;
- f) the investments already made and to be made by the water user in respect of the water use in question;
- g) the strategic importance of the proposed water use;
- h) the quality of water in the water resource which may be required for the reserve; and
- i) The probable duration of the activity or undertaking for which a water use is to be authorised.

Section 39 through 42 stipulates reasons behind variation of a permit, abandonment of permitted activities and surrender of permits.

3.5.4. Water Resource Management Rules (2007)

In addition to the Water Act 2002, the main document outlining the regulations is the Water Resource Management Rules (2007). The rules set out the procedures for obtaining water use permits and conditions placed on permit holders.

3.5.5. Water Quality Regulations (2006)

The Water Quality Regulations (2006) are contained in the Kenya Gazette Supplement No. 68, Legal Notice No. 120. Of relevance to the proposed project and for the purpose of this Study Report is Part II Sections 4-5 as well as Part V Section 24. Part II Section IV states that “Every person shall refrain from any act which directly or indirectly causes, or may cause immediate or subsequent water pollution”. Part IV Section 24 states that “No person shall discharge or apply any poison, toxic, noxious or obstructing matter, radioactive wastes, or other pollutants or permit any person to dump any such matter into water meant for fisheries, wildlife, recreational purposes or any other uses”.

3.5.6. Public Health Act Cap 242 (2012)

This Act provides the impetus for a healthy environment and gives regulations to waste management, pollution and human health. Public Health Act protects human health, prevent and guard against

introduction of infectious diseases into Kenya from outside, to promote public health and the prevention, limitation or suppression of infectious, communicable or preventable diseases within Kenya, to advice and direct local authorities in regard to matters affecting the public health to promote or carry out researches and investigations in connection with the prevention or treatment of human diseases. This Act provides the impetus for a healthy environment and gives regulations to waste management, pollution and human health.

3.5.7. The Land Planning Act Cap 303 (1968)

The Land Planning Act Cap 303 of 1968 of the Laws of Kenya makes provision for planning the use and development of land. Sec 6 (1) of the subsidiary legislation provides that "a local authority may, after consultation with, and with the agreement of the Minister, prepare and submit to the Minister for his approval an area plan, as the case may be, for that part of the area under its jurisdiction to which these regulations apply."

3.5.8. Physical Planning Act Cap 286 (2010)

This Act provides for the preparation and implementation of physical development plans for connected purposes. It establishes the responsibility for the physical planning at various levels of Government in order to remove uncertainty regarding the responsibility for regional planning. It provides for a hierarchy of plans in which guidelines are laid down for the future physical development of areas referred to in a specific plan. The ostensible intention is that the three-tier order plans, the national development plan, regional development plan, and the local physical development plan should concentrate on broad policy issues.

The Act also promotes public participation in the preparation of plans and requires that in preparation of plans, proper consideration be given to the potential for economic development, socio-economic development needs of the population, the existing planning and future transport needs, the physical factors which may influence orderly development in general and urbanization in particular, and the possible influence of future development upon natural environment. The innovation in the Act is the requirement for EIA and EA. Any change of use of the actual development without authority constitutes an offence.

3.5.9. Land Control Act Cap 406 (2010)

This law provides for the control of transactions in agricultural land, especially the machinery of the Land Control Boards/Land Commission. However, it is of environmental interest that one of the points to consider in granting or refusal of consent by the Board is what impact the transaction is likely to have on the maintenance or improvement of standards of good husbandry within the specific agricultural area. Trust land is land held and administered by various local government authorities as trustees under the constitution of Kenya and the Trust Land Act (Cap. 288). National reserves and local sanctuaries as well as county council forest reserves, fall on trust land. Individuals may acquire leasehold interest for a specific number of years in trust land can (in theory) be posed by the local authorities should the need arise. Local authorities should retain regulatory powers over trust land. Private land is land owned by private individuals under the Registered Land Act (Cap .300). On registration as the landowner, an individual acquires absolute ownership on a freehold basis. The use of private land may, however, be limited by provisions made in other legislation, such an Agriculture Act (Cap. 318).

3.5.10. The Local Government Act Cap 265 (1998)

This law empowers a local authority to apply through the minister for land to meet its different development purposes. Such requests and purposes are deemed to be public purposes within the meaning of the Land Acquisition Act (Cap 295). Such a local authority may, within such land, establish and maintain a conservation area.

3.6. Laws Governing Environmental Health

The health of the environment is a broad issue that should apply to any activity occasioning environmental degradation. However, what we have in Kenya is construed rather narrowly to apply only to environmental problems, which affect the human body, but not including diseases. For brief analytical purposes, it is handled in the following subsections:

- ✓ Public Health
- ✓ The Working Environment
- ✓ Radiation Control
- ✓ The Management of Hazardous Wastes
- ✓ General Waste Management Regulations
- ✓ Liquid Waste Management
- ✓ Noise Pollution

3.6.1. Public Health

Under this section the review is confined to the provision of the Public Health Act (Cap 242 of 2012), the Traffic Act (Cap 403 of 2013), the Local Government Act (Cap 265 of 1998), the Penal Code (Cap 63 of 1948) and the Factories Act (Cap. 514 of 1977). Within the Public Health Act, the sections on housing and prevention of mosquitoes are directly pertinent. On sanitation, the Act borrows from the common law doctrine of nuisance, which makes it an offence for any landowner or occupier to allow nuisance or any other condition liable to be injurious or dangerous to health to prevail on his land. A medical health officer, once satisfied of the danger, may issue an order requiring the owner or occupier of the land to remove the nuisance. Fighting malaria is also a critical environmental task dealt under the Act. Part XII makes it an offence to leave on one's land or premises, any collection of water, sewage, rubbish, well, pool, gutter, channel cesspit, latrine, urinal or dump pit where mosquitoes may breed. Such a situation constitutes a nuisance. Any person who fails to clear such a nuisance is guilty of an offence under the Act.

Environmental health requirements are also provided for under the general powers and duties of the local authorities in the Local Government Act (Cap 265 of 1998). Municipal Councils are required to provide and maintain sanitary services, sewage and drainage facilities, take measures for the control, destruction of rats, vermin, insects and pests, control or prohibit industries, factories and businesses which emit smoke, fumes, chemicals, gases, dust, smell, noise vibrations, discomfort or annoyance to the neighborhood, and to prohibit or control work or trade of disinfection or fumigation by cyanide or other means. The Penal Code (Cap 65 of 1948) carries the offence of common nuisance identical to that in the Public Health Act. The offence under the Penal Code is a misdemeanor punishable by imprisonment for one year. This however is distinct from that in the Public Health Act which may require the offender to abate the offence.

Air pollution is dealt with by the Traffic Act (Cap 403 of 2013) and the Factories (Amendment) Act of 1990. The Factories Act specifically prohibits factories from emitting any dust, fumes or impurities into the atmosphere without undergoing appropriate treatment to prevent air pollution or

other ill effects to life and property. The amendment further prohibits the use of any stationary internal combustion engine, discharging exhaust gas into the atmosphere without treatment. The Traffic Act prohibits air pollution through Section 51 which requires that motor vehicle use proper fuels. The Rules promulgated under the Act provide that every vehicle be so constructed, painted and used so as not to emit any smoke, or visible vapor. Air pollution as a manifestation of nuisance is also prohibited under the Mining Act (Cap 306 of 2012). Section 26 requires that a holder of prospecting or mining license who causes a nuisance or damage to a landowner or lawful occupier to pay reasonable compensation for such nuisance or damage.

3.6.2. Radiation Control

Since 1982, Kenya decided to join in the global movement for the use of nuclear energy for peaceful purposes, a movement lead by the International Atomic Energy Agency (IAEA). Most of such uses are in the fields of medicine, agriculture, energy and environmental monitoring. The dangers of injury to the public prompted the adoption of the Radiation Protection Act (Cap 243 of 1984) in November 1984 to provide according to its citation, protection of the public and radiation workers from the dangers arising from the use of devices or materials capable of producing ionizing radiation and for connected purpose. The Act prohibits the unauthorized manufacture, production, possession or use, sale, disposal, lease, loan or dealership, import, export of any irradiating device or radioactive material. All authorized buyers, sellers, users, of such device must be properly licensed.

3.6.3. Management of Hazardous Waste

In the foregoing section, we saw that radiation protection focuses largely on protection of human beings against injury by such wastes or radiations. The Public Health Act is also concerned with the protection of human health. Section 75 of the Constitution whose purpose is protection from the deprivation of property, empowers the government to acquire property “in circumstances where it is necessary to do so because that property is in a dangerous state or injurious to the health of human beings or animals or plants.” This is the closest reference to the protection of the environment and its resources.

3.6.4. EMCA Waste Management Regulations (2006)

These Regulations apply to all categories of waste as is provided for. According to the regulations, no person should dispose off any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. Any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed off of such waste in the manner provided for under these Regulations. Any person whose activities generates waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose of such waste in a designated waste disposal facility. Any person, whose activities generate waste, should segregate such waste by separating hazardous waste from non-hazardous waste and shall dispose of such wastes in such facility as is provided for by the relevant Local Authority. Any person who owns or controls a facility or premises which generates waste should minimize the waste generated by adopting the following cleaner production principles, namely:

- Improvement of production process through:
 - i. Conserving raw materials and energy
 - ii. Eliminating the use of toxic raw materials within such time as may be prescribed by NEMA
 - iii. Reducing toxic emissions and wastes
 - iv. Monitoring the product cycle from beginning to end by:

- a. Identifying and eliminating potential negative impacts of the product.
- b. Enabling the recovery and re-use of the product where possible.
- c. Reclamation and recycling.
- v. Incorporating environmental concerns in the design, process and disposal of a product.

Every trade or industrial undertaking should install at its premises anti-pollution technology for the treatment of waste emanating from such trade or industrial undertaking. No owner or operator of a trade or industrial undertaking should discharge or dispose of any waste in any state into the environment, unless the waste has been treated in a treatment facility and in a manner prescribed by the Authority in consultation with the relevant lead agency. The proposed project implementers and management must observe this law strictly in the management of its solid wastes, waste water and sewage.

a. Standards for Liquid Waste

Table 3: The effluent generated from any facility should conform to the following limits

Parameters	Permissible Limits
pH	6.5-9.8.5
Suspended solids	100 mg/l
Oil and grease	Nil
BOD	30 mg/l
COD	50 mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent

3.6.5. EMCA Noise Regulations (2009)

The noise regulations in the country clearly state that any person who contravenes their provisions commits an offence. The provisions are as per the following table.

Table 4: First Schedule of the Regulation Provides for the Following Maximum Permissible Noise Levels

Zone		Sound Level Limits dB(A)		Noise Rating Level (NR)		
		(Length-14hours)		(Length-14 hours)		
		Day	Night	Day	Night	
A.	Silent Zone	40	35	30	25	
B.	Places of worship	40	35	30	25	
C.	Residential:	Indoor	45	35	35	25
			50	35	40	25
D.	Mixed residential (with commercial some and Places of entertainment)	55	35	50	25	
E.	Commercial	60	35	55	25	
Time Frame						
Day		6.01 a.m. – 8.00 p.m. (Length-14 hours)				
Night:		8.01p. m. – 6.00 a.m. (Length-10hours)				

3.6.6. EMCA Air Quality Regulations, (2009)

These regulations offer guidance on air quality management Kenya. The contractor should adhere to set standards of air quality in these regulations. Special attention is drawn to the following Schedules:

- Schedule 1: Ambient Air Quality Tolerance Limits
- Schedule 2: Priority Air Pollutants

- Schedule 4: Guideline on Air Pollution Monitoring Parameters from Stationary Sources
- Schedule 5: General Guidelines
- Schedule 7: Acceptable Emission Control Systems
- Schedule 10: Record of Pollution Exposure Results.
- Schedule 11: Methods of Test and Measurement of Air Pollutants
- Schedule 12: Acceptable Mobile Emission Control Technologies.

3.6.7. 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 Act was published in the Kenya Gazette Supplement No. 111 (Acts No.15). It received presidential assent on 22nd October, 2007 and became operational on 26th October, 2007. The key areas addressed by the Act include:

- i. General duties including duties of occupiers, self-employed persons and employees
- ii. Enforcement of the Act including powers of an occupational safety and health officer
- iii. Registration of workplaces (hence the proponent needs to register the workplace of this project)
- iv. Health General Provisions including cleanliness, ventilation, lighting and sanitary conveniences
- v. 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
- vi. Safety General Provisions including safe storage and handling of dangerous liquids, fire safety, evacuation procedures, precautions with respect to explosives or inflammable dust or gas
- vii. Chemical safety including the use of material safety data sheets, control of air pollution, noise and vibration, the handling, transportation and disposal of chemicals and other hazardous substances materials
- viii. Welfare general provisions including supply of drinking water, washing facilities, and first aid kits and Offences, penalties and legal proceedings.

Under Section 6 of this Act, every occupier is obliged to ensure safety, health and welfare of all persons 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). He is also required to establish a **safety and health committee** at the workplace in a situation where the number of employees **exceeds twenty** (section 9) and to cause a thorough safety and health audit of his workplace to be carried out at least once in every period of twelve months by a registered safety and health Advisor (Section 11). In addition, any accident, dangerous occurrence, or occupational poisoning which has occurred at the workplace needs to be reported to the occupational safety and health officer of the respective area by an employer or self-employed person (section 21). According to section 44, potential occupiers or users of any premises as work places are required to apply for registration to the Director for all premises intended for use as workplaces. Such places shall be maintained in a clean state during the operation phase (section 47).

To ensure machinery safety, every hoist or lift – section 63 and/or all chains, ropes and lifting tackles – section 64 (1d), 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.

In relation to fire safety, section 78 (3) requires spillage or leaks of any flammable liquid to be contained or immediately drained off to a suitable container or to a safe place, or otherwise treated to make it safe. Furthermore, a clear and bold notice indicating that smoking is prohibited should be conspicuously displayed in any place in which explosive, highly flammable or highly combustible substances, are manufactured, used, handled or stored-section 78 (5). In addition, necessary precautions for dealing with fire incidents should be implemented including provision of means for extinguishing fire and means for escape, in case of fire, for the persons employed in any workplace or workroom – section 81. As far as disaster preparedness and emergency response program is concerned, section 82 (1) makes it a mandatory requirement for every occupier of a workplace to design evacuation procedures to be used during any emergency situation and to have them tested at regular intervals.

To promote health and safety of employees who are at risk of being exposed to chemical substances, section 84 (3) and 85 (4) requires every employer to maintain at the workplace material safety data sheets and chemical safety data sheets respectively for all chemicals and other hazardous substances in use and ensure that they are easily available to the employees. The employers’ positive contribution towards the welfare of the employees include provision and maintenance of adequate supply of wholesome drinking water - section 91 and a first aid box or cupboard of the prescribed standard – section 95 at suitable point (s) conveniently accessible to all employees.

Other precautionary measures include: issuance of a permit to work to any employee, likely to be exposed to hazardous work processes or hazardous working environment, including such work processes as the maintenance and repair of boilers, dock work, confined spaces, and the maintenance of machinery and equipment, electrical energy installations, indicating the necessary precautions to be taken – section 96 (1); provision and maintenance for the use of employees, adequate, effective and suitable protective clothing including suitable gloves, footwear, goggle and head coverings in any workplace where employees are likely to be exposed to wet, injurious or offensive substance – section 101 (1).

Table 5: Provisions under the Occupational Safety and Health Act, 2007

Section	Provisions
Section 55	All plant, machinery and equipment whether fixed or mobile for use either at the workplace or as a workplace, shall only be used for work which they are designed for and be operated by a competent person.
Section 56	<ul style="list-style-type: none"> ■ Every flywheel directly connected to any prime mover and every moving part of any prime mover, except prime mover referred to in subsection (3), ■ shall be securely fenced, whether the flywheel or prime mover is situated in an engine-house or not. ■ Every part of an electric generator, motor and rotary converter, and every flywheel directly connected thereto shall be securely fenced.

Section 63	<ul style="list-style-type: none"> ■ Every hoist or lift shall be of good mechanical construction, sound material and adequate strength, free from patent defect and be properly maintained. ■ Every hoist or lift shall be thoroughly examined at least once in every period of six months or after any modifications or extensive repairs or within a shorter period, by a person approved for the purposes of this section by the Director by certificate in writing, and a report of the result of every such examinations, in the prescribed form and containing the prescribed particulars, shall be signed by the person carrying out examination and shall be entered in or attached to the general register within fourteen days of the examination. ■ There shall be marked conspicuously on every hoist or lift the maximum working load which it can safely carry and no load greater than load shall be carried on any hoist or lift.
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a) Safety –General Provisions

Part VIII of the Occupational Safety and Health Act, 2007 describes safety general provisions. Section 74 (1) provides for storage. It states that “all goods, articles and substances stored in a workplace shall be stored or stacked:

- ✓ In such a manner as will ensure their stability and prevent any fall or collapse of the stack;
- ✓ In such manner as not to interfere with the adequate distribution of the natural or artificial light, the natural ventilation systems, the proper operation of machines or other equipment, the unobstructed use of passageways, gangways or traffic lanes, and the efficient functioning of sprinkler systems, the unobstructed access to other fire extinguishing equipments within the workplace; and
- ✓ On firm foundations not liable to overload any floor.

Section 76 (2) states that “Every employer shall take necessary steps to ensure that workstations, equipment and work tasks are adapted to fit the employee and the employee’s ability including protection against mental strain”. According to Section 76 (3) ‘Every manufacturer, importer and supplier or an agent of a manufacturer, importer and supplier of the machinery and equipment referred to in paragraph (1) shall ensure that the equipment complies with the safety and health standards prescribed under this Act and shall provide adequate and appropriate information including hazard warning signs”. Section 76 (4) further states that “An employer shall not require or permit any of his employees to engage in the manual handling or transportation of a load which by reason of its weight is likely to cause the employee to suffer bodily injury”. Other provisions covered under this Safety – general provisions include:

- ✓ Section 77: Safe means of access and safe place of employment;
- ✓ Section 78: Fire Prevention;
- ✓ Section 79: Precautions in places where dangerous fumes are likely to be present;
- ✓ Section 81: Safety provisions in case of fire; and
- ✓ Section 82: Evacuation procedures.

Part IX of the Occupational Safety and Health Act, 2007 also provides for Chemical Safety, Part X provides for Welfare – General Provisions, Part XI Health, Safety and Welfare Special Provisions and Part XII special applications.

3.6.8. Employment Act (2007)

a) General Principal

The Act constitutes minimum terms and conditions of employment of an employee and any agreement to relinquish vary or amend the terms set shall be null and void. The Act stipulates that no person shall use or assist any other person, in using forced labour. Clause 5 of the Act states that its shall be the duty of the Minister, Labour officer, the National Labour Court and the subordinate

labour courts to; Promote equality of opportunity in employment in order to eliminate discrimination in employment Promote and guarantee equality of opportunity for a person who, is a migrant worker or a member of the family of the migrant worker lawfully within Kenya. No employer shall discriminate directly or indirectly, against an employee or prospective employee or harass an employee or prospective employee on the following grounds; race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability, pregnancy, mental status or HIV status. An employer shall pay his employees equal remuneration for work of equal value.

b) Part IV Rights and Duties of Employment

The provisions of this part and part VI constitute basic minimum and conditions of contract of service. The employer shall regulate the hours of work of each employee in accordance with provisions of this Act and any other written law. Subsection (2) of section 27 states that an employee shall be entitled to at least one rest day in every period of seven days. An employee shall be entitled to not less than twenty-one working days of leave after every twelve consecutive months.

c) Maternity Leave

Section 29 of the Act stipulates that a female employee shall be entitled to two-month maternity leave with full pay and an employer who has paid a female employee wages for two months during her maternity leave shall be reimbursed by the National Social Security Fund, the equivalent of wages paid by the employer during maternity leave or a lesser amount as may be determined by the minister in rules made by the minister for that purpose. Subsection 8 of section 29 further states that no female employee shall forfeit her annual leave entitlement on account of having taken her maternity leave.

d) Section 37 (Conversion of Casual Employment to Term Contract)

Where a casual employee works for a period or a number of continuous working days which amount in the aggregate to the equivalent of not less than one month; or performs work which cannot reasonably be expected to be completed within a period, or a number of working days amounting in the aggregate to the equivalent of three months or more. The contract of service of the casual employee shall be deemed to be one where wages are paid monthly. In calculating wages and the continuous working days, a casual employee shall be deemed to be entitled to one paid rest day after a continuous six days working period and such rest day or public holiday which falls during the period under consideration shall be counted as part of continuous working days.

3.6.9. Work Injuries Benefits Act (2007)

a) Obligations of Employers

Section 7 of the Act stipulates that every employer shall obtain and maintain an insurance policy, with an insurer approved by the Minister in respect of any liability that the employer may incur under this Act to any of his employees.

b) Registration of Employer

Every employer carrying on business in Kenya shall within the prescribed period and in the prescribed manner register with the Director of Occupational Health and Safety Services and any other information as the Director may require. Subsection 4 of section 8 of the Act states that where an employer carries on business in more than one workplace, or carries on more than one class of business, the Director may require the employer to register separately in respect of each place or class of business.

c) Employer to Keep Record (Section 9)

Section 9 states that an employer shall keep a register or other record of the earnings and other prescribed particulars of all employees and produce the same on demand by the director for inspection. Such records shall be retained for at least six years after the date of last entry. Thus all records in relation to the operation of the facility shall be well kept and maintained.

d) Right to Compensation

An employee who is involved in an accident resulting in the employee's disablement or death is subject to the provisions of this Act, and entitled to the benefits provided for under the Act. Subsection 3 of section 10 of the Act however states that no employee shall be entitled to compensation if an accident, not resulting in serious disablement or death, is caused by the deliberate and willful misconduct of the employee. Section 12 of the act stipulates if an employee is injured in an occupational accident or contracts an occupational disease while the employee, with the consent of the employer, is engaged in any organized first aid, ambulance or rescue work, or firefighting or other emergency services, the accident or disease is for the purpose of this Act, deemed to have arisen out of an in the course of the employee's employment.

e) Reporting of Accidents

A written or verbal notice of any accident shall be given by or on behalf of the employee concerned to the employer and a copy to the Director of Occupational Health and Safety within twenty-four hours of its occurrence in case of fatal accident. In case of any accidents, the rules shall be applied to the latter.

f) Lapse of Right to Benefits

A right to benefits in accordance with this Act shall lapse if the accident is not reported to the employer within twelve months after the date of such accident. However, it shall not be barred to compensation if it is proved that the employer had knowledge of the accident from any other source. Section 30 of the Act states that compensation for permanent disablement shall be calculated on the basis of ninety-six months earnings subject to the minimum and maximum amounts determined by the minister after consultation with the board.

In case of a fatal accident compensation shall be paid to the dependants of the employee in accordance with the set provisions in the third schedule. The employer shall further be liable to pay reasonable expenses for the funeral of the deceased employee subject to the maximum amount determined by the minister, after consultation with the National council for occupational Health and Safety. The First Schedule of the Act gives the minimum degree of Disablement for various body parts while the second Schedule gives a list of work description and the associated occupational disease.

3.6.10. Labour Institutions Act (2007)

The Act establishes the National Labour Board whose functions are to advise on all matters concerning employment and labour; Legislation affecting employment and labour; Any matter relating to labour relations and trade unionism; Labour inspection service; Reported strikes and lockouts; Labour market information and indices etc.; The board shall in consultation with the minister, establish; Work permit committee; National manpower development committee; Trade dispute committee; and Productivity committee and such other committees or panel as are necessary

for the performance of board's functions.

Section 34 of the Act stipulates that an authorized officer may either alone or in the presence of another person, enter any premises or place where persons are, or may be employed for the purpose of performing his duties as specified under the Act. The labour officer may, for the purpose of monitoring or enforcing compliance with any law require the production of wages sheets or other employment records kept by an employer, enter inspect and examine all latrines and other sanitary arrangements or water supply, inspect and examine all food provided or appearing to be provided for employees, and take samples thereof in duplicate, in the presence of the employer or the employers representative which samples shall be sealed and one sample so sealed shall be left with the employer, order that all buildings and premises where employees are housed or employed be kept in a clean and sanitary condition. Section 37 of the act states that the medical officer shall exercise the powers conferred upon the labour officer and in addition:

- ✓ Order an employee who, in his opinion is sick and for whom the conditions prevailing at the place of employment are not conducive to rapid recovery of his health to proceed to hospital and in that case the employer shall at the earliest opportunity and at his own expense send the employee to the place of work or to a hospital, as the case may be.
- ✓ Condemn any food provided for employees which, in the opinion of the medical officer, is unfit for human consumption, and all food so condemned shall be destroyed forthwith in the presence of the medical officer.
- ✓ Order at the expense of the employer, such variety of food for an employee as he may deem necessary and Inspect all drugs and medicine provided for the use of employees.

3.6.11. National Construction Authority Act, 2011

Section 5 of the Act stipulates the mandate of the National Construction Authority (NCA) which is to oversee the construction industry and coordinate its development. Section 5 subsection 2 part (f) states that the authority shall provide consultancy and advisory services with respect to the construction industry; part (g) promote and ensure quality assurance in the construction industry; part (k) accredit and register contractors and regulate their professional undertakings; (l) accredit and certify skilled construction workers and construction site supervisors; (m) develop and publish a code of conduct for the construction industry; and (n) do all other things that may be necessary for the better carrying out of its functions under the Act. Hence, the management should make sure that it adheres to the provision of the Act.

3.6.12. Employment Act (2007)

a) General Principal

The Act constitutes minimum terms and conditions of employment of an employee and any agreement to relinquish vary or amend the terms set shall be null and void. The Act stipulates that no person shall use or assist any other person, in using forced labour. Clause 5 of the Act states that its shall be the duty of the Minister, Labour officer, the National Labour Court and the subordinate labour courts to; Promote equality of opportunity in employment in order to eliminate discrimination in employment Promote and guarantee equality of opportunity for a person who, is a migrant worker or a member of the family of the migrant worker lawfully within Kenya. No employer shall discriminate directly or indirectly, against an employee or prospective employee or harass an employee or prospective employee on the following grounds; race, colour, sex, language, religion, political or other opinion, nationality, ethnic or social origin, disability,

pregnancy, mental status or HIV status. An employer shall pay his employees equal remuneration for work of equal value.

b) Part IV Rights and Duties of Employment

The provisions of this part and part VI constitute basic minimum and conditions of contract of service. The employer shall regulate the hours of work of each employee in accordance with provisions of this Act and any other written law. Subsection (2) of section 27 states that an employee shall be entitled to at least one rest day in every period of seven days. An employee shall be entitled to not less than twenty-one working days of leave after every twelve consecutive months.

c) Maternity Leave

Section 29 of the Act stipulates that a female employee shall be entitled to two months maternity leave with full pay and an employer who has paid a female employee wages for two months during her maternity leave shall be reimbursed by the National Social Security Fund, the equivalent of wages paid by the employer during maternity leave or a lesser amount as may be determined by the minister in rules made by the minister for that purpose. Subsection 8 of section 29 further states that no female employee shall forfeit her annual leave entitlement on account of having taken her maternity leave.

d) Section 37 (Conversion of Casual Employment to Term Contract)

Where a casual employee works for a period or a number of continuous working days which amount in the aggregate to the equivalent of not less than one month; or performs work which cannot reasonably be expected to be completed within a period, or a number of working days amounting in the aggregate to the equivalent of three months or more. The contract of service of the casual employee shall be deemed to be one where wages are paid monthly. In calculating wages and the continuous working days, a casual employee shall be deemed to be entitled to one paid rest day after a continuous six days working period and such rest day or public holiday which falls during the period under consideration shall be counted as part of continuous working days.

3.6.13. Work Injuries Benefits Act (2007)

a) Obligations of Employers

Section 7 of the Act stipulates that every employer shall obtain and maintain an insurance policy, with an insurer approved by the Minister in respect of any liability that the employer may incur under this Act to any of his employees.

b) Registration of Employer

Every employer carrying on business in Kenya shall within the prescribed period and in the prescribed manner register with the Director of Occupational Health and Safety Services and any other information as the Director may require. Subsection 4 of section 8 of the Act states that where an employer carries on business in more than one workplace, or carries on more than one class of business, the Director may require the employer to register separately in respect of each place or class of business.

c) Employer to Keep Record (Section 9)

Section 9 states that an employer shall keep a register or other record of the earnings and other prescribed particulars of all employees and produce the same on demand by the director for

inspection. Such records shall be retained for at least six years after the date of last entry. Thus all records in relation to the operation of the facility shall be well kept and maintained.

d) Right to Compensation

An employee who is involved in an accident resulting in the employee's disablement or death is subject to the provisions of this Act, and entitled to the benefits provided for under the Act. Subsection 3 of section 10 of the Act however states that no employee shall be entitled to compensation if an accident, not resulting in serious disablement or death, is caused by the deliberate and willful misconduct of the employee. Section 12 of the act stipulates if an employee is injured in an occupational accident or contracts an occupational disease while the employee, with the consent of the employer, is engaged in any organized first aid, ambulance or rescue work, or firefighting or other emergency services, the accident or disease is for the purpose of this Act, deemed to have arisen out of an in the course of the employee's employment.

e) Reporting of Accidents

A written or verbal notice of any accident shall be given by or on behalf of the employee concerned to the employer and a copy to the Director of Occupational Health and Safety within twenty-four hours of its occurrence in case of fatal accident. In case of any accidents, the rules shall be applied to the latter.

f) Lapse of Right to Benefits

A right to benefits in accordance with this Act shall lapse if the accident is not reported to the employer within twelve months after the date of such accident. However, it shall not be barred to compensation if it is proved that the employer had knowledge of the accident from any other source. Section 30 of the Act states that compensation for permanent disablement shall be calculated on the basis of ninety six months earnings subject to the minimum and maximum amounts determined by the minister after consultation with the board.

In case of a fatal accident compensation shall be paid to the dependants of the employee in accordance with the set provisions in the third schedule. The employer shall further be liable to pay reasonable expenses for the funeral of the deceased employee subject to the maximum amount determined by the minister, after consultation with the National council for occupational Health and Safety. The First Schedule of the Act gives the minimum degree of Disablement for various body parts while the second Schedule gives a list of work description and the associated occupational disease.

3.6.14. Labour Institutions Act (2007)

The Act establishes the National Labour Board whose functions are to advice on all matters concerning employment and labour; Legislation affecting employment and labour; Any matter relating to labour relations and trade unionism; Labour inspection service; Reported strikes and lockouts; Labour market information and indices etc.; The board shall in consultation with the minister, establish; Work permit committee; National manpower development committee; Trade dispute committee; and Productivity committee and such other committees or panel as are necessary for the performance of board's functions.

Section 34 of the Act stipulates that an authorized officer may either alone or in the presence of another person, enter any premises or place where persons are, or may be employed for the purpose of performing his duties as specified under the Act. The labour officer may, for the

purpose of monitoring or enforcing compliance with any law require the production of wages sheets or other employment records kept by an employer, enter inspect and examine all latrines and other sanitary arrangements or water supply, inspect and examine all food provided or appearing to be provided for employees, and take samples thereof in duplicate, in the presence of the employer or the employers representative which samples shall be sealed and one sample so sealed shall be left with the employer, order that all buildings and premises where employees are housed or employed be kept in a clean and sanitary condition. Section 37 of the act states that the medical officer shall exercise the powers conferred upon the labour officer and in addition:

- Order an employee who, in his opinion is sick and for whom the conditions prevailing at the place of employment are not conducive to rapid recovery of his health to proceed to hospital and in that case the employer shall at the earliest opportunity and at his own expense send the employee to the place of work or to a hospital, as the case may be.
- Condemn any food provided for employees which, in the opinion of the medical officer, is unfit for human consumption, and all food so condemned shall be destroyed forthwith in the presence of the medical officer.
- Order at the expense of the employer, such variety of food for an employee as he may deem necessary and Inspect all drugs and medicine provided for the use of employees.

3.7. Legislation on Specifically Protected Areas

These are areas which through Gazettement by the government are designated as protected by law. Applicable statutes are the Forest Act, Cap 385 (2005), the Wildlife (Conservation and Management) Act, Cap 376 (1979) and the Water Act 2002. The principal legislation dealing with the management of wildlife resources is the Wildlife (Conservation and Management) Act of 2013. Wildlife in Kenya is classified as a national heritage held in trust for the benefit of the public.

The administrative agency charged with the control and management of national parks and management of wildlife in general is the Kenya Wildlife Service (KWS). This regulatory regime requires that the Minister can declare that a given area is a national park, nature reserves or a sanctuary by gazette notice. The Act also provides for various offences and penalties thereof for those who enter and reside, hunt, collect products of bees or animals or their trophy, introduction of alien species, disturbing or quarrying, animals, damaging geological, pre-historic, archeological or marine and other scientific objects or structures lawfully placed in the parks, sanctuaries or reserves. In addition, Cap 376 also provides for the regulation of the movement of tourists through the parks, as well as licenses for access thereto.

3.8. International Conventions and Treaties

A treaty is a binding agreement under International Law concluded by subjects of International Law, namely states and international organizations. Treaties can be called by many names including; International Agreements, Protocols, Covenants, Conventions, Exchanges of Letters, Exchanges of Notes, etc. However all of these are equally treaties and the rules are the same regardless of what the treaty is called.

Treaties can be loosely compared to contracts; both are means of willing parties assuming obligations among themselves, and a party to either that fails to live up to their obligations can be held legally liable for that breach. The central principle of treaty law is expressed in the maxim *pacta sunt servanda*, translated as "pacts must be respected." Kenya has ratified the following Project-relevant international conventions:

Kenya has ratified the following international conventions and protocols with direct relevance to the conservation of forests and biodiversity such as stipulated below and the tables that follows.

3.8.1 United Nations Framework Convention on Climate Change

The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 191 countries having ratified. Under the Convention, governments:

- Gather and share information on greenhouse gas emissions, national policies and best practices;
- launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries;
- Cooperate in preparing for adaptation to the impacts of climate change.

The Convention entered into force on 21 March 1994. The landmark United Nations Framework Convention on Climate Change (UNFCCC) was opened for signature at the 1992 United Nations Conference on Environment and Development (UNCED) Conference in Rio de Janeiro (known by its popular title, the Earth Summit). On June 12, 1992, 154 nations signed the UNFCCC that upon ratification committed signatories' governments to a voluntary "non-binding aim" to reduce atmospheric concentrations of greenhouse gases with the goal of "preventing dangerous anthropogenic interference with Earth's climate system." These actions were aimed primarily at industrialized countries, with the intention of stabilizing their emissions of greenhouse gases at 1990 levels by the year 2000; and other responsibilities would be incumbent upon all UNFCCC parties. The parties agreed in general that they would recognize "common but differentiated responsibilities," with greater responsibility for reducing greenhouse gas emissions in the near term on the part of developed/ industrialized countries, which were listed and identified in Annex I of the UNFCCC and thereafter referred to as "Annex I" countries. Kenya signed the UNFCCC on 12th July 1992, ratified it on 30th August 1994 and started enforcing it on 28th November 1994.

3.8.2 Kyoto Protocol

According to a press release from the United Nations Environment Programme: "The Kyoto Protocol is an agreement under which industrialized countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this target represents a 29% cut). The goal is to lower overall emissions of six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, HFCs, and PFCs - calculated as an average over the five-year period of 2008-12."http://en.wikipedia.org/wiki/kyoto_protocol

It is an agreement negotiated as an amendment to the UNFCCC, which was adopted at the Earth Summit in Rio de Janeiro in 1992. All parties to the UNFCCC can sign or ratify the Kyoto Protocol, while non-parties to the UNFCCC cannot. The Kyoto Protocol was adopted at the third session of the Conference of Parties (COP) to the UNFCCC in 1997 in Kyoto, Japan. Kenya's accession was presented on 25th February 2005 and the Protocol acceded on 26th May 2005.

Table 6: Other Treaties to Which Kenya Is a Party

Convention/ Agreement/ Treaty/ Protocol	Ratification Date
Convention on Biological Diversity (CBD)	July 26, 1994
United Nations Convention to Combat Desertification	June 24, 1997
United Nations Framework Convention on Climate Change (UNFCCC)	Aug 30, 1994
Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar)	June 5, 1990
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Dec. 13, 1978
Protocol on Bio-safety (Cartagena Protocol)	Jan. 24, 2002
Regional Convention/Agreement on the Organization for Indian Ocean Marine Affairs (IOMAC)	Sep. 7, 1999
Convention for the Establishment of the Lake Victoria Fisheries Organization	May 24, 1996
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region	May 30, 1996

3.8.3 Rationale for Environmental Provisions within the Constitution

The provision for legal and institutional mechanisms is one of the basic conceptual tools for environmental management.¹ Further, considering that the environment supports life, it requires protection that is stable and can only be changed, if necessary, by a special and substantial majority. These Constitutional provisions for environmental management are not new, and already exist in other countries.² Environmental provisions were outlined, albeit superficially, in the previous constitution of Kenya. The current constitution's innovation is the presentation, in greater detail, of obligations in respect of specific natural resources, as well as the human aspects of environmental management.

Environmental provisions are included in Chapter Four, under 'Rights and Fundamental Freedoms', Chapter Five, under 'Environment and Natural Resources', and Chapter Ten, under 'Judicial Authority and Legal System'. The Fourth Schedule also includes environmental provisions under 'Distribution of functions between National and County Governments' and the Fifth Schedule titled 'Legislation to be enacted by Parliament'.

3.9. Institutional and Administrative Framework

There are several organizations involved in water resource and environment management in the country. These organizations include the Ministry of Water and Irrigation, Ministry of Environment and Natural Resources, National Environment and Management Authority, Water Resources Management Authority and the Local Authorities etc. The overall entity involved in environmental management in Kenya is the NEMA which has been founded and mandated under EMCA.

3.9.1. National Environment Management Authority

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

a) Provincial and District Environment Committees

According to EMCA, 1999 No. 8, the Minister by notice in the gazette appoints Provincial and District Environment Committees of the Authority in respect of every province and district

¹ C. O. Okidi, *Environmental Rights and Duties in the Context of Management of Natural Resources* (Nairobi: Constitution of Kenya Review Commission, 2003).

² Ibid

respectively. The Provincial and District Environment Committees are responsible for the proper management of the environment within the Province and District in respect of which they are appointed. They are also to perform such additional functions as are prescribed by the Act or as may, from time to time be assigned by the Minister by notice in the gazette. The decisions of these committees are legal and it is an offence not to implement them.

b) Public Complaints Committee

The Committee performs functions such as 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 exercise such powers as may be assigned to it by the Council.

c) National Environment Action Plan Committee

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

- ✓ Contain an analysis of the Natural Resources of Kenya with an indication as to any pattern of change in their distribution and quantity over time; Contain an analytical profile of the various uses and value of the natural resources incorporating considerations of intergenerational and intra-generational equity;
- ✓ Recommend appropriate legal and fiscal incentives that may be used to encourage the business community to incorporate environmental requirements into their planning and operational processes; Recommend methods for building national awareness through environmental education on the importance of sustainable use of the environment and natural resources for national development;
- ✓ Set out operational guidelines for the planning and management of the environment and natural resources;
- ✓ Identify actual or likely problems as may affect the natural resources and the broader environment context in which they exist; Identify and appraise trends in the development of urban and rural settlements, their impact on the environment, and strategies for the amelioration of their negative impacts;
- ✓ Propose guidelines for the integration of standards of environmental protection into development planning and management;
- ✓ Identify and recommend policy and legislative approaches for preventing, controlling or mitigating specific as well as general diverse impacts on the environment;
- ✓ Prioritise areas of environmental research and outline methods of using such research findings; Without prejudice to the foregoing, be reviewed and modified from time to time to incorporate emerging knowledge and realities; and
- ✓ Be binding on all persons and all government departments, agencies, States Corporation or other organ of government upon adoption by the national assembly.

3.9.2. Water Resource Management Authority

WRMA which is a corporate body to function under the direction of a Governing Board is responsible for water resource management. The Authority develop principles, guidelines and procedures for the allocation of water resources, assess and re-assess water resources potential,

receive and determine applications for permits for water use, monitor and enforce conditions attached to the permits for water use.

Furthermore the Authority regulates and protects water resources quality from adverse impacts, manage and protect catchment areas, determine charges and fees to be imposed for the use of water from any water source, gather and maintain information on water resources from time to time to publish forecasts, projections and information on water resources and also liaise with other bodies for the better regulations and management of water resources. It establishes offices in the Catchment Areas called Catchment Area Advisory Committee whose membership consists of Government Officials, Stakeholders and Communities.

3.9.3. Water Services Regulatory Board

The Board regulates the provision of services by registered Water Services Providers through the Water Services Boards.

3.9.4. Water Services Boards

Section 12 (1) of the Water Act states, “The Minister shall prescribe a system for classifying water resources for the purpose of determining resource quality objectives for each class water resource. Section 12 (2) further states that “Under the prescribed classification system, water resources may be classified according to type, location or geographical or other factors.

3.10. Constitution of Kenya, 2010

Kenya has been touted as the ‘Land of Splendor’, with a rich historical background, great diversity of physical features, pleasant climate, diverse people, and magnificent wilderness areas.³ More recently, it has been praised as a model for environmental progress in the region following enactment of the new constitution which contains specific measures for environmental management.⁴ Any constitution functions to guarantee basic human rights and to provide guiding principles for the country, and by entrenching environmental rights and principles in the constitution, Kenya signals unwavering environmental commitment.

3.11. Licenses and Permits

The project proponent should demonstrate compliance to the legislations through acquisition of the appropriate licenses and permits. Furthermore, all contractors and consultants who are ever engaged in the planning, operation and maintenance of the project should demonstrate compliance to the necessary pieces of legislation. These includes: NEMA registration certificates and licenses and Registration to National Construction Authority (NCA) among others.

3.12. Compliance with Environmental Management Provisions

An analysis of the various environmental laws in Kenya shows that, at disposal to the project proponent are clear laws providing guidance on the best way to manage the environment and its resources. By not adhering to any cannot be an excuse of causing environmental degradation. Remember, ignorance is no defense in a court of law. Hence, the proponent is advised to acquaint himself with the provisions of all laws that may touch on the project’s implementation and operations.

³ Ministry of Environment and Natural Resources, *Kenya: Land of Splendour* 1 (Nairobi: Ministry of Environment and Natural Resources, 2000).
⁴ J. Walljasper, Looking South for Environmental Progress, available at <http://onthecommons.org/looking-southenvironmental-progress>

4. CONSULTATION AND PUBLIC PARTICIPATION

4.1. Introduction

This section highlights the outcome from public participation and consultation exercises undertaken within the project influence area. Public participation is geared towards informed decision making by all stakeholders involved in a project thereby promoting sustainability. The Legal Notice No. 101, the Environmental (Impact Assessment and Audit) Regulations, 2003 requires that the views of persons who may be affected by the project be sought during the process of conducting an EIA. This is achieved through a number of mechanisms, including the administering of questionnaires as well as well as holding public hearings/workshops. Public participation is a key component of an EIA and is used to integrate citizens into the environmental decision-making process. Traditional decision-making approaches such as closed-door discussions between politicians and experts are no longer appropriate (Barrington et al., 2003). Public participation, if it is to be democratic, must foster trusting relationships through open and honest negotiations between proponents and the public (Barrington et al., 2003).

4.2. Summary of Public Consultations Findings

There were various issues raised during the public consultations that directly or indirectly relate to the proposed project. The following are some of the issues raised:

4.2.1. Need for the Project

The objectives of the proposed project were highlighted. It was brought to the attention of all that the university was experiencing challenges in providing adequate water to the university population. The university was also experiencing difficulties in supporting some of the core development operations like construction works. This essentially mean that there was reduced pace of development in the university. Water supplied to the school by county government owned company was inadequate and unreliable. The university management had resulted to supplementing its water needs by trucking water to the university, a very costly undertaking.

The university management having explored all the possible ways of solving the water challenges, and with the help of water resources experts arrived at the conclusion of constructing the proposed water dam. Currently there are two other existing dams but the water engineers advised against expanding the old dams. The proposed dam will be beneficial because it will serve multiple purposes:

- i. The dam will conserve rain water;
- ii. The dam will adequately address water challenges in the university up to the year 2036;
- iii. Based on meteorological data (from nearby JKIA met station), the water stored at the proposed dam will be adequate to serve a population of 8000 students throughout the year;
- iv. The water will support other operations that the university intends to undertake i.e. construction works for hostels and other requisite infrastructure;
- v. The dam will control flooding in the institution;
- vi. The dam will support other important activities like landscaping and irrigation in the university among other notable benefits; and
- vii. The dam will offer good return on the investment made.

4.2.2. Public Safety

The university is public institution that accommodates a lot of people. It is expected as it a norm during the construction works that there will be heavy machinery, moving trucks, moving parts and other sources of risks for the public. This will certainly affect the safety of all in the institution. To

address this, the contractor in conjunction with the university management will formulate a comprehensive safety management plan that will adequately address public safety during the project and implementation period. It is also expected that there will be adequate safety awareness done to those engaged in the construction works and the university population.

The safety plan should consider providing an alternative entrance and exit for the construction vehicles and machines other than the main gate. Appropriate measures will be recommended in the management plan in this report.

4.2.3. Noise and Vibration

It is common knowledge that construction works are synonymous with noise and vibration. The proposed project will not be any different from other projects. To address this, the contractor will be guided on the acceptable/ permissible levels of noise and vibrations (see table 4). The contractor will also be guided on the timing of activities to prevent unnecessary nuisance. It is expected that the contractor will only use well maintained machines that emit minimum noise especially the electric run machines as compared to diesel run machines. Going by the nature of the project (dam), it is expected that there will be minimal if any blasting because this might interfere with the prevailing rocky ground that is suitable for the proposed dam.

4.2.4. Air Quality

It is expected that there will be dust arising from construction works. Dust is a major cause of respiratory related complications. The contractor should address this by ensuring that the air quality is maintained at the acceptable standards possible. Reference should be made to section 3.6.6 of this report.

4.2.5. Walkway

There exists a walkway at the site of the proposed dam. There are concerns that walkway will be affected by the proposed project. This has been confirmed by design report that elucidates that the current walkway will be submerged because it lies within the proposed reservoir area. To mitigate this, a temporary path/ diversion will be identified and put in place to facilitate movement of students and staff to the hostels. The students could also use the existing walkway on the lower dam that leads to the central stores. This will affect the students during the construction period only; to address this challenge, a walkway has been factored in the designs of the proposed dam (see fig 2). The walkway will be at the crest of the dam wall and will be secured with guard rails.

4.2.6. Biodiversity and Wildlife

The proposed project site is currently inhabited by different species of plants mainly: grass, shrubs, herbs and trees. It is expected that construction works will lead to clearing of plants in the construction site and eventually submerging of plants in the reservoir area. The proposed dam is expected to occupy 5ha of land; this represents a small portion of university land as far as the ecological importance of the vegetation to be cleared and submerged is concerned. The university occupies 300 acres of land and the vegetation occupying the other area is expected to mitigate the impacts of the cleared vegetation.

There was evidence of wildlife existence in the university compound. There was evidence of grazers (antelopes), birds, rodents and insects within and around the project site. Considering that the project activities will be gradual, the wildlife population is expected to adapt accordingly by migrating to neighbouring undisturbed habitat. The project site will be secured therefore ensuring that there will

be safety for the wildlife. It is expected that there will be minimal loss wildlife safe for the insects and rodents that might be caught up by moving machines and vehicles.

4.2.7. Water Treatment

In addressing the quality of water, the university management intends to put up water treatment plant, the plant will be pivotal in ensuring that quality of water availed for different uses is up to the recommended levels as stipulated in the Water Quality Regulations 2006. The university management is planning and consulting on the treatment plan.

4.2.8. University Fountain

The proposed dam will provide adequate water in the institution. Universities are unique and driven by various thematic bearings. Universities just like cities world over are identified with monuments like the one at Uhuru Park depicting Kenyan identity. It is the considered view by the Student leadership that the proposed project provides an opportunity to put up a fountain that will get its water from the dam. The student leadership should be consulted on the design of the fountain.

4.2.9. Project Support

From the consultations, it was realized that the project is fully supported by the concerned stakeholders. The project management should embrace the spirit of engagement throughout the implementation and operation periods. This will provide an opportunity for addressing arising matters/ issues while at the same time ensuring sustainability of the dam.



Figure 7: Stakeholder consultation meeting

5. ANALYSIS OF PROJECT ALTERNATIVES

5.1. Introduction

This section analysis the possible project alternatives from various facets applicable to the proposed project. The major aspects that will be considered for alternatives are; project site, technology scale and waste management strategies. Alternatives should be economically feasible with minimal adverse environmental impacts and time delays. Diverse alternatives to the proposed action must be included in the EIA. Alternatives may include both design and location options (Steinneman, 2000). In most cases, the EIA process often occurs too late in decision-making to consider a full range of alternatives. This can undermine EIA goals to encourage more environmentally sound and publicly acceptable solutions. Allowing new alternatives and objectives to evolve in relation to environmental conditions, public preferences and project sustainability may be a solution to most of the environmental and socio-economic problems associated with the implementation of new projects (Anderson et al., 2003).

5.2. The Alternatives

5.2.1. Relocation Option

Relocating the proposed project to another site in the institution was not a viable option. The proposed site was arrived at as a result of topographical survey undertaken considering the location of the existing dams (lower and upper dams) while at the same time appreciating the existing boundaries and already developed structures. According to the design report, the lower Dam site was not considered as it had already been ruled out as a result of being prone to pollution from the institutions sewer system and its proximity to the main road making it difficult to increase the embankment height. The site also lies on the lower side of the proposed water treatment works site. From the topo-survey it was established that the Upper Dam could be developed to a maximum capacity of 30,000m³ since it was limited on the upper side by the institutions land boundary. The area between the two dams was studied for maximum possible storage. The middle dam was found to have a capacity to hold 160,000m³ and hence its suitability of the proposed dam.

5.2.2. Zero or 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 lead to challenges experienced in providing water for various domestic uses in the university and will deny the proponent and the benefits associated with adequate water supply i.e. adequate water for university population, accelerated growth in the university among other tangible benefits associated with adequate water supply in a university. The **No Project Option** is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- ✓ The university will continue to incur unnecessary costs procuring water;
- ✓ The university population may suffer hygiene related challenges as result of lack of adequate clean water supply;
- ✓ The growth of the university will be limited by lack of adequate water resources;
- ✓ The university will not enjoy the benefits associated with surface water resource; and
- ✓ There are many water resource uses that the university will not exploit including floods control.

From the analysis above, it becomes apparent that the No Project alternative is no alternative to

the proponent.

5.2.3. Drilling a Borehole

Drilling of a borehole could be an alternative to the proposed dam project. But, as it is widely known, it is very hard to drill a borehole that can yield water adequate enough for a university population of around 8000 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 dam 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 viable alternative to the proposed water dam.

5.2.4. Design Considerations versus Cost Estimates

a) Sustainability and Affordability

Sustainability of the proposed dam would have a bearing the growth and development of the university. This is because water just like energy is major factor determining growth and development in an area. Sustainability would mean the ability of the dam to continuously serve the proponent without adverse impacts within the project influence area. This would call for designs that would factor in maintenance of the dam that is cost effective. This translates to affordability of the proposed project. Sustainability would also translate to the adequacy of the retained water *vis a vis* intended use(s). Affordability is greatly determined at the design stage. Dam design has employed a simple technology that lowers the cost of constructing the dam based on the prevailing geographical formation. The use of concrete to construct the dam wall is informed by the prevailing foundation area; the rock is fairly weathered and in order to ensure less area is used for the dam wall, a concrete gravity wall was selected. The concrete wall would also bond well with the rock as well as provide an overflow spillway without incurring huge costs. The technology used would ensure that the cost of maintaining the dam is affordable.

b) Analysis of Alternative Construction Materials and Technology

The proposed project will be constructed using environmentally accepted and materials compliant to engineering standards but locally available materials to achieve public health, safety, security and environmental aesthetic requirements.

c) Construction Technology

This being a gravity structure no structural steel is required, however due to the cracking nature of mass concrete, anti-cracking steel is provided based on BS 8110, where minimum steel is provided as 0.13% BH. The breath is taken as 1m width and a depth of 300mm of the wall is considered for cracking prevention. This amounted to required steel of 650mm²/m length. To provide this requirement D12 bars are considered to be placed 200mm both way for every square meter of the wall which results to 679mm²/m as indicated in the figure below.

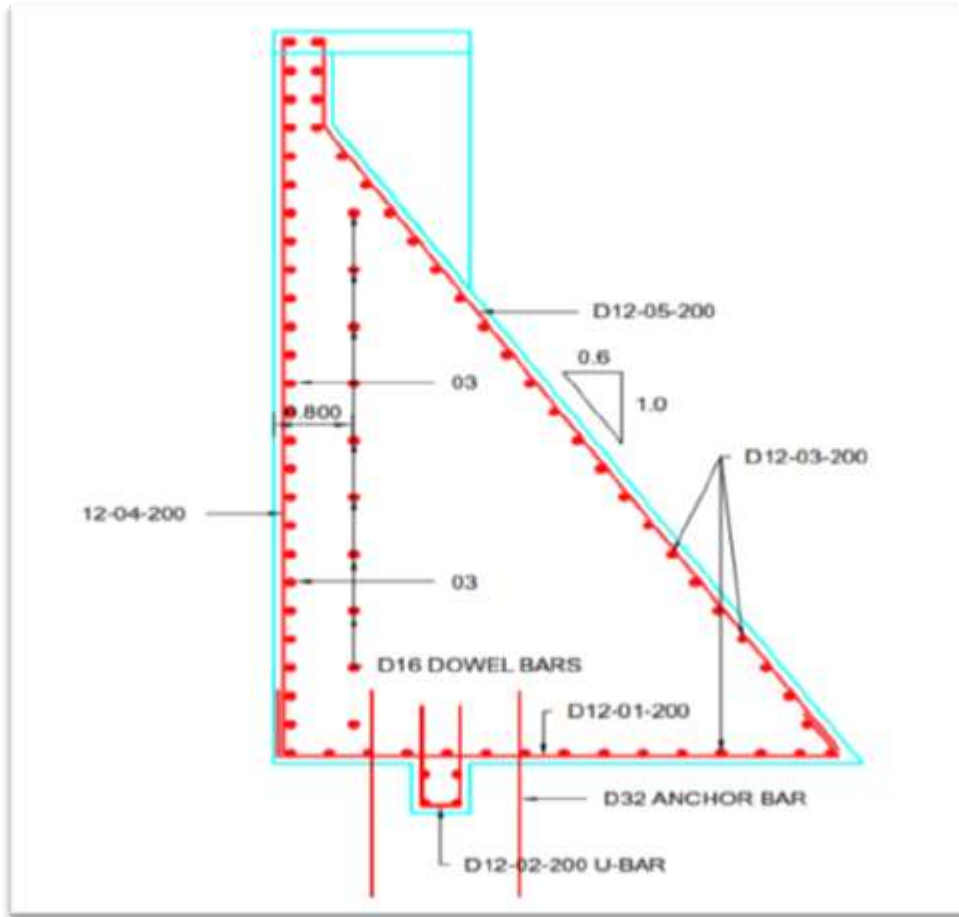


Figure 6: Typical reinforcement details for the Dam Section

Source: Dam Design Report, 2016

In order to come up with an economical design, stability of the wall has been carried out for the two key cross sections namely:

- ✓ Non overflow section;
- ✓ The spillway overflows section.

Key stability cases checked include stability against sliding and stability against overturning. Key forces considered include The dead weight of the concrete Structure; The hydrostatic pressure from the reservoir; The buoyancy forces from underground; The seismic loading; The silt load; and The force of overflowing water over the spillway section.

d) Spillway Design

The reservoir lies in an area that is close to important structures i.e. central stores. Based on dam classifications shown in Table 7 and Table 8 below, the dam is of medium risk.

Table 7: Classes of Dams

Class of dam	Maximum depth of water at NWL (M)	Impoundment at NWL (M ³)	Catchment area (Km ²)
A (low risk)	0 - 4.99	<100,000	<100
B (medium Risk)	5.00 - 14.99	100,000 - 1,000,000	100 - 1,000
C (High Risk)	>15.00	>1,000,000	>1,000

Source: Water resources management draft rules, June 2006

Table 8: Recommended return periods for design of spillways

	Minimum Return Period (Years)
A (low risk)	1 in 50
B (medium Risk)	1 in 100
C (High Risk)	1 in 500

Source: Water resources management draft rules, June 2006

Based on area, height and storage, the dam is of medium risk. However due to the huge risk of flooding neighbouring structures and the dam being within an institution, the design team has resulted to designing the overflow spillway for the 1: 10,000 flood which is for the extreme risky conditions. The spillway has also been checked to ensure that it can accommodate the Probable Maximum Flood (PMF) flow within the available 1m free board without spilling at other parts of the dam structure.

e) Construction Equipment

Equipment that saves energy and water will be given first priority without compromising on cost or availability factors. As noted on the previous section, the project will entail use of locally available materials like sand, cement and ballast or similar approved materials that would not have adverse impacts on the environment. The technology to be used is environmental friendly.

5.2.5. Solid Waste Management Alternatives

The project might not generate a lot of wastes other than excess excavated top soil that the proponent would use for landscaping purposes. An integrated solid waste management system is recommendable. First, the proponent will give priority to reduction at source of the materials. This option will demand a solid waste management awareness programme in the management and the staff involved in implementing the project. Recycling and reuse options of the waste will be the second alternative in priority. This will call for a source separation programme to be put in place. The third priority in the hierarchy of options is combustion of the waste that is not recyclable. Finally, the proponent will need to establish agreement with the local authority to ensure regular waste removal and disposal in an environmentally-friendly manner. In this regard, a NEMA registered solid waste handler would have to be engaged. This is the most practical and feasible option for solid waste management considering the delineated options.

6. POTENTIAL IMPACTS IDENTIFICATION AND MITIGATION MEASURES

6.1. Introduction

There are several potential impacts associated with activities that will be undertaken during implementation and operation of the proposed dam. The potential impacts are classified into temporary/ transient and permanent impacts depending on the influence period of the impact. The impacts are also examined under two categories i.e. negative and positive environmental impacts. The various impacts in these two categories are then examined in order of their level of importance and significance. They are also examined in categories of their time of occurrence (pre-construction/design, construction, operational or decommissioning phase).

6.2. Safety Aspects in Water Dam Construction

In all water dam construction, safety must be given priority by following guidelines such as that Water dams on catchment areas exceeding 25km² or with reservoir areas storing more than 50,000m³ may require the advice of a hydrologist to assist in the design of spillways and other outlets and for the estimation of freeboard; No spillway should be less than 2m wide and 1m deep for catchments up to 5km² and should be at least 15m wide and 1.5m deep for catchments exceeding this area and that Any water dam that involves out of the ordinary topography (i.e. steep slopes upstream, risks of landslips), hydrology (i.e. flash floods, droughts) or soils (i.e. poor quality soils, sodic soils, permeable layers in the soil, bare earth surfaces in the catchment) should only be designed and constructed under the supervision of a qualified engineer.

It is also advisable to develop a Crisis Action Plan (CAP) in relation to the management of water pans. At a minimum this should comprise of contact names and telephone numbers (owner of the water pan, authorities downstream, police and emergency services and others) to call if the water pan is damaged, develops problems or is considered unstable; A list of names, addresses and telephone numbers (keep this up to date) of inhabitants living immediately downstream of the water pan and within the estimated area of inundation; The CAP should be periodically updated to take into account changes in land use downstream and any changes to the catchment upstream.

6.3. Design Consideration for Water Dam Construction

6.3.1 Sizing of water pan

- **Water demand** - plan for water requirement for both human and livestock for 180 days at sphere standard (human 15lts/person/day, large stock 30lts/head/day, medium stock 20lts/head/day, small stock 5lts/head/day)
- **Evaporation losses** - Allow for 7mm/day for 180 days.
- **Seepage losses** - Allow for 3mm/day for 180 days (this may be left out if clay blanket is provided on water pan bed and sides)
- **Water Pan Dimensions** – To reduce the effects of evaporation, seepage and siltation, water pans should maximize on depth where possible. As a rule of thumb, in the arid and semi - arid locations, water pans with depths less than 4m is considered not viable.

6.3.2 Site Considerations

- **Soil characteristics**-The site should have soils with good water retention characteristics. Black cotton soils with fine clay have poor percolation / seepage properties therefore good sites for water pan locations.
- **Topography** - The site should have gentle slopes of 1% and a maximum 5%. Use

community knowledge and or choose natural depressions known to impound water during rainy season.

- **Size of catchment / drainage area:** should be large enough to ensure replenishment of reservoir in moderate dry years where storage required should be able to be filled by 5% of mean annual precipitation in the catchment area.
- **Pollution control** - The water pan sites should be located upstream of all pollution sources such as community sanitation, dumpsites etc.

6.3.3 Construction Considerations

- **Seepage** – If possible provide 300mm clay blanket on the bed (which may not be necessary for this particular dam because it will sit on a rock) and sides of water dam compacted in 150mm layers.
- **Sedimentation** - to reduce siltation, silt traps should be constructed to ensure deposition occurs before reaching the water dam. The silt traps will reduce velocity of surface runoff and thus minimize erosion of topsoil and consequently avert possible gully formation around the catchment.
- **Inlet** - The inlets should be well placed and linked to the catchment drainage system to be able to bring the maximum available run-off into the water dam. Inlets should be cleaned regularly, be able to direct all the water from the catchments area while silt traps facilitate deposition of silt away from the water pan during the rainy seasons which means that the silt traps can then be target for maintenance (de-silting) instead of the whole the water dam.
- **Spillway** – provide spillway channel for excess water to flow behind the silt trap and provide a masonry sill at the off-take point to prevent erosion.
- **Excavation work:** Either human labour or mechanical power can be utilized. Excavated material should be placed on leeward side such that wind does not blow cuttings back into the water dam.
- **Side slopes:** Upon excavation of the reservoir, provide side slopes of 1:2.5 to 1:3 to facilitate ease of access in to the water pan and prevent accident for people and livestock.
- **Bed slope:** the water pan bed should have a slope of 5% from inlet to the embankment to provide non eroding flow of water. The water dam bed is usually compacted upon completion to reduce seepage, if not sitting on rock as is the case for this particular dam.
- **De-silting** of water pans must ensure it is done only to original depths so as not to interfere with the water pan base which has been compacted earlier and thus increase seepage.
- **Infiltration well** – Provide infiltration well by installing horizontal collectors buried in a gravel envelope; wells be at least 2m below the water pan bed.
- **Fencing** – provide live fence using fast growing plants around the dam

6.3.4 Management

- **Protection** - Avoid cutting or interfering with shrub and trees that grow on the embankment of the dam. New water dam sites should be located where there will be little interference with vegetation. Provide mitigation for catchment protection through planting of vegetation along the water dam inlet and catchment areas to reduce soil erosion that increases sedimentation and render water dam maintenance uneconomical.
- **Operation and maintenance** - Establish a Water Environment and Sanitation (WES) committee that ensures routine operation and maintenance of the water system including fencing, hygienic handling of water, rotational guarding and implement any other agreed

arrangements. WES committees should also be trained on their roles and responsibilities, Sanitation and Acute Water Diarrhea (AWD), equitable distribution of water, gender mainstreaming, conflict management and environmental management to enhance sustainability.

For more impact identification, a checklist was employed to identify possible impacts from the project development and the matrix to determine the significance of each identified impacts.

6.4. Estimated Quantities of Generated Components

6.4.1. Design and Construction Phase

The components and wastes generated at the design phase are very negligible. During construction, it is also difficult to estimate the amount of component waste that can be generated as it will entirely depend on project management and the proponent. The services of a quantity surveyor should be acquired, to ensure that only what is needed will be purchased. Purchasing of excess materials will obviously foresee more wastes and leftovers. On the other hand, poor management and planning will also cause wastage even if the material purchased is adequate for the construction work.

6.4.2. Impact Identification Checklists

The checklists below were used to identify possible impacts from the project development and the matrix to determine the significance of each identified impacts.

Table 9: Checklist Identifying Potential Impacts from the Project

Impacts generated	Project stage			
	Design	Construction	Operation	Decommissioning
Water quality (ground and surface)		V	V	V
Hydrology/ drainage		V	V	V
Air quality		V	V	V
Noise		V		V
Climate			V	V
Topology		V	V	V
Soil and geology		V	V	V
Bio-diversity (Flora and Fauna)	V	V	V	V
Pollution		V	V	V
Social economics		V	V	V
Health and Safety	V	V	V	V
Waste Generation	V	V	V	V
Others	V	V	V	V

6.4.3. Impact Significance Matrix

The weightings of significance within the table below range from 0-3 (denoted by number of stars) whereby “0” represents no significance; “1 star” represents low significance; “2 stars” means there will be some significant effect and “3 stars” represent high environmental significance. It also conveys the negative impacts of the project activities against identified environmental attributes.

Table 10: Matrix showing significance of impact identified

Environmental Parameters	Potential Negative impacts				Cumulative Impacts			
	Design	Construction	Operation	Decommissioning	Past	Present	Future	cumulative
Flora		XXX	X	X	o	o	o	o
Fauna		XX	XX	XXX	o	o	o	o
Soil		XXX		XXXX		o		

Air		XXX	X	XX		o		
Population	X	XX	XX	X				
Micro- climate		X	X	XX	o	o	o	o
Microorganisms		XX	X	X				
Microorganisms	X	XX	X	XXXX		o	+	+
Water availability		X	X	XXXX			+	+
Humans	X	XXX	X	XXX	o	o	+	+
Economy		XXX	XXX	XX	+	+	+	+

Key: X-Not significant; XX-low significance; XXX-significant; XXXX-highly significant and +Beneficial and o- occurrence

6.4.4. Environment Impacts Magnitude

Based upon the predictions of impacts identified and assessed with the help of the checklist developed for the proposed project, environmental scenario without the project was juxtaposed with that of the project and the results were reported in table below:

Table 11: Matrix Showing Magnitude of Assessed Impacts

Environment Impact Units				
Parameter	Without project	With project	Net change	Magnitude
Crops	Nil	Nil	Nil	Zero
Natural vegetation	Nil	Negative	Small	Low
Trees/ shrubs	Nil	Negative	Small	low
Land use	Nil	Positive	high	High
Wildlife (Insects)	Nil	Negative	Small	Low
Aquatic animals	Nil	Positive	Big	High
Species diversity	Nil	Negative	Small	Low
Water pollution	Nil	Positive	Small	Low
Air pollution	Nil	Negative	Small	Low
Noise pollution	Nil	Negative	Small	Low
Solid waste	Nil	Negative	Small	Low
Land Pollution	Nil	Negative	Small	Low
Soil erosion	Nil	Negative	Small	Low
Eutrophication	Nil	Negative	Small	Zero
Health	Nil	Positive	Big	High
Benefit to Economy	Nil	Positive	Big	High
Displacement/encroachment of private land	Nil	Nil	Nil	Zero

6.5. Potential Impacts During Planning and Design Phase

6.5.1. Potential Positive Impacts During Planning and Design Phase

a) Employment opportunities

With the planning and design phase of the proposed project, there will be employment opportunities especially for professionals. Those involved in planning and design include engineers, surveyors, environmentalists and sociologists among others. Those employed will improve their living standards from the fees they will be paid for their services.

b) Creation of Awareness

During the planning and design phase of the proposed project, a lot of awareness has been done through consultations on different aspects of the project. Awareness improves civility in project planning, implementation and operations. This is a sure formula for ensuring there is sustainability of the project.

6.5.2. Potential Negative Impacts During Planning and Design Phase

The project designers and consultants mobilized a team of skilled and unskilled human resource to undertake the surveys and other studies required for the designs. These studies shall however not

allow for large scale destruction and disturbance of vegetation and soils. Mobilization of the skilled and non-skilled labour and the process of public consultations with stakeholders however lead to heightened expectations and speculations. With the foregoing, it is envisaged that there will be minimal to no negative impacts during the planning and design stage.

i. Proposed Mitigation Measures:

Impacts during this phase of the project are not significant. However, the Design Team shall take necessary measures to document any concerns and address them on as they occur. In that regard, the Design Team shall incorporate an Environmental Expert in the team and take time to sensitize and alert those within the project influence area.

6.6. Potential Impacts during Construction Phase

6.6.1. Potential Positive Impacts during Construction Phase

a) Creation of a Market for Construction materials

The Project will require materials, most of which will be sourced locally. These include sand, cement, ballast, hardcore, lining materials, steel bars/ rods. This will provide a ready market for suppliers in and outside the project area.

b) Creation of Employment Opportunities

The construction works will require several human resources from machine operators to other skilled and unskilled labourers. Machine operators will be engaged for the any excavation works, compaction works and digging of trenches where pipes will be laid.

Several workers including casual labourers, plumbers and engineers are expected to work on the site for a period of time. Semi-skilled, unskilled and formal employees are expected to obtain gainful employment during the period of construction. With labour intensive construction technologies, the project will provide employment for youths.

6.6.2. Potential Negative Impacts during Project Implementation

The following negative impacts are associated with the construction of the proposed project.

a) Interference with the Physical Setting

The proposed project could result into the following negative impacts to the physical setting:

- ✓ Changes in the local topography during excavation and embankment;
- ✓ Blockage of natural drainage for storm water;
- ✓ Excavation for creation of trenches for laying of pipes;

Proposed Mitigation Measures:

- ✓ The design shall in no way propose to implement developments that will hinder drainage, change the topography or introduce physical changes that are not in harmony with the physical setting of the project area;
- ✓ The structures to be developed should be aesthetically acceptable to blend in with the surrounding and;
- ✓ The proponent shall as much as possible complete the works in such a way that natural aesthetics shall be retained at the locations; and
- ✓ Restoration shall be undertaken to ensure that the original setting is as much as possible retained.

b) Noise Generation

Constructions of the proposed project will most likely result in noise emissions as a result of the machines that will be used e.g. excavation equipment and construction vehicles delivering materials to site. Noise will also be generated by construction workers. Significance of noise impacts depends on whether the project would increase noise levels above the existing ambient levels by introducing new sources of noise. Noise impacts would be considered significant if the project would result in the following:

- ✓ Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- ✓ Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels;
- ✓ A substantial permanent increase in ambient noise levels (more than 3dBA) in the project vicinity above levels existing before the project; and
- ✓ A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing before the project.

The project proponent through the contractor shall put in place several measures that will mitigate noise pollution during the construction phase such as the following:

- ✓ Install portable barriers to shield compressors and other small stationary equipment where necessary;
- ✓ Use of quiet equipment (i.e. equipment designed with noise control elements);
- ✓ Limit pickup trucks and other small equipment to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible;
- ✓ Provision of appropriate personnel protective equipment (PPE);
- ✓ Construct mainly during the day; and
- ✓ Consider labour based construction methodologies.
- ✓ The provisions of EMCA as stipulated in table 4 should be observed

c) Dust Emissions

Dust will be emitted during excavation and related earthworks. Air-borne particulate matter pollution is likely to occur during the excavation works. This is likely to affect site workers, in extreme situations leading to respiratory problems. To ameliorate these, the following mitigations measures are proposed:

- ✓ Minimizing the number of motorized vehicles on use;
- ✓ Rehabilitate disturbed areas;
- ✓ Provide scour checks on over-15% slopes or when working in loose soils;
- ✓ Use predetermined tracks;
- ✓ Wet all active construction areas as and when necessary to reduce dust;

d) Disposal of Spoil

Project construction will involve earthworks and excavation. This will result in the generation of some spoil materials. But there will be little carting away of excavated material. The soils may affect the surrounding environment if not adequately disposed. This can be ameliorated by observing the following measures:

- ✓ Maximizing the re-use of excavated materials in the works as far as feasible to ensure that no permanent spoil dumps are created;

- ✓ Properly disposing off the spoil in an area identified by the design team and approved by the confirmed land owners as well as by NEMA; and
- ✓ Care should be taken to avoid spoil location in land that could otherwise be used for productive purposes.

e) Solid Waste Generation

Solid wastes generated during construction include papers used for packing, plastics, cuttings and trimmings of materials among others. Dumping around the site will interfere with the aesthetic status and has a direct effect on the surrounding community. Disposal of the same solid wastes off-site could also be a social inconvenience if done in the wrong places. The off-site effects could be aesthetic, pest breeding, pollution of physical environment including water resource, invasion of scavengers and informal recycling by communities. The proposed mitigations for this impact include the following:

- ✓ Construction waste should be recycled or reused as much as possible to ensure that materials that would otherwise be disposed off as waste are diverted for productive uses;
- ✓ The Proponent shall put in place measures to ensure that construction materials requirements are carefully budgeted and to ensure that the amount of construction materials left on site after construction is kept minimal;
- ✓ Minimization of solid waste during construction of the proposed Project through use of durable, long-lasting materials that will not need to be replaced often, thereby reducing the amount of construction waste generated over time;
- ✓ Skips and bins should be strategically placed within the labour campsite, if any, and construction site, they should also be adequately designed and covered as well as emptied regularly to prevent access by vermin and minimize odour;
- ✓ Measures to ensure that waste materials from the project are disposed at suitable sites will be taken. These will include engaging only reputable truckers and conducting appropriate spot checks to verify that disposals are done in accordance with the requirements of NEMA, hence the ultimate fate of the wastes should be monitored so that they are not illegally disposed off; and
- ✓ Provide portable sanitary conveniences for the construction workers for control of sewage waste. A ratio of approximately 25 workers per chemical toilet should be used. But the construction workers can also be allowed to make use of toilets at the institution.

f) Vegetation Loss

The construction of the proposed project will involve clearing of vegetation cover at the site where the dam would be constructed. The project will lead to loss of vegetation in a relatively smaller area approximately 5ha out of the 300acres. However, the significance of the vegetation loss during the site clearance is minimal.

To contain the potential negative impacts related to vegetation loss, the following mitigation measures are recommended:

- ✓ The contractor will ensure proper demarcation of the project area to be affected by the construction works;
- ✓ Strict control of construction vehicles to ensure that they operate only within the area to be disturbed by access routes and other works;
- ✓ Retention of trees and shrubs, where possible on the potential sites for screening of the visual impact;

- ✓ Where the proposed route requires the removal of any vegetation, care will be taken to minimize the destruction or damage of trees; and
- ✓ Re-planting of destroyed trees in cleared areas where works are complete.

g) Accidental Spills and Leakages

The principal chemicals held on the site during the construction site are likely to be vehicle fuel and greases/ oils. Spillage or escape of such compounds are likely to have an immediate impact upon the local water resources and consequently on the terrestrial and aquatic flora and fauna. This can be checked by observing the following measures:

- ✓ Maintain vehicles and machineries at manufacturers specifications;
- ✓ Ensure proper storage of chemicals / materials; and
- ✓ During the course of the construction works, temporary drainage channels should be constructed to encourage dispersal of meteoric waters.

h) Workers /Public Accidents, Hazards and Safety

Construction workers are likely to have injuries and hazards as the construction works unavoidably expose workers to occupational health and safety risks. The workers are also likely to be exposed to risk of accidents and injuries resulting from accidental falls and injuries from hand tools and construction equipment.

In relation to public safety, the most serious threats will be on the areas with heavy plant and equipment moving in and out of the contractor's yard and at the construction site as well as construction materials storage areas. There will also be an increased risk of traffic accidents where delays and diversions are imposed or altered without adequate warning. This can be avoided by observing the following:

- ✓ To reduce on the workers accidents and hazards, the proponent will develop and commit the contractors to Site Occupational Health and Safety rules and regulations as stipulated in the Occupational Safety and Health Act, 2007;
- ✓ All construction workers should be advised of the dangers associated with construction work;
- ✓ Workers should be provided with suitable PPE;
- ✓ Provision of adequate sanitary facilities to workers;
- ✓ Train all workers on Safety Health and Environment (SHE) with an aim of improving awareness;
- ✓ Trenches over 1.5m deep or wherever soil conditions dictate should be secured against accidental entry by workers and the public;
- ✓ Install safety signage along the work areas;
- ✓ Where construction activities interfere with the movement of traffic, the site should be signed and controlled by trained flagmen/flag women and lit by night.

i) Extraction and Use of Construction Materials

Construction materials that will be used in the construction such as hard core, cement and rough stone will be obtained from quarries, hardware shops and sand harvesters who extract such materials from natural resource banks such as rivers and land. To check on the impacts of material extraction, the following is recommended:

- ✓ The Contractors will source construction materials such as sand and hard core from

registered and approved quarry and sand mining firms/groups whose projects have undergone satisfactory EIA/EA and received NEMA approval. Since such firms are expected to apply acceptable environmental performance standards, the negative impacts of their activities at the extraction sites are considerably well mitigated;

- ✓ The Contractor will only order for what will be required through accurate budgeting and estimation of actual construction requirements.

j) Increased Water Demand

During the construction phase of the proposed project, both the construction workers and the construction works will create demand for water in addition to the existing demand. Water will mostly be used during construction for wetting surfaces or cleaning/curing completed structures. It will also be used by the construction workers to wash and drink. To check on its sustainable use, the following mitigation measures have been proposed:

- ✓ The proponent through the contractor shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water use;
- ✓ Any water handling equipment, facility and systems shall be appropriate for the intended usage. Water used on the construction shall reflect the level of conservation achieved by the contractors. Documentation of amounts of water used will therefore be mandatory.

k) Archaeological and Other Cultural Properties

From the field studies, there are no known impacts on archaeologically protected monuments and cultural properties in the proposed project area. Should any archeological or culturally important artefact be discovered during the construction process, the contractor should develop and implement a *chance find procedure* that should be approved by National Museum of Kenya.

l) Spread of Communicable Diseases and Other Infections

During the construction phase there is a risk of spread of communicable diseases such as tuberculosis and pulmonary infections. Aspects of the physical environment that promote transmission of diseases include: disposal of wastes and ventilation which are likely to occur during the construction phase of the project. With the influx of people during construction, there will be a likelihood of increase in diseases such as typhoid, tuberculosis, diarrhoeal diseases, respiratory diseases, dysentery and cholera. Proposed mitigation measures include the following:

- ✓ Treat affected local and migrant workers which will control the movement of disease vectors (through contaminated water and between people);
- ✓ Provision of personal hygiene facilities in good condition with adequate water supply; and
- ✓ Ensure awareness raising on proper sanitation and personal hygiene to promote proper health.

m) Increase in HIV/AIDS Prevalence and other STIs

As the project is going to bring in a significant population of new people in the project area it is forecasted that rates of new infections will increase. This is due to the fact that the contractors, traders and workers will have money to attract women from the project area in a bid to solicit for sex, thereby creating avenues for spread of HIV/AIDS and other STIs. The most vulnerable members of the community are women as they don't have access to resources necessary for production and wealth creation, in this case land. This will further predispose them to sex pests and consequently HIV/AIDS.

It is recommended that the Resident Engineer should ensure that prevention and management of STIs occurrence as a result of social interaction between immigrant workers and local populations is conducted through:

- ✓ Selecting appropriate locations away from concentration of human settlements for construction camps;
- ✓ Education and sensitization of workers and the local communities on STIs including provision of condoms to the project team and the public;
- ✓ The contractor has to institute HIV/AIDS awareness and prevention campaign amongst workers for the duration of the contract e.g. erect and maintain HIV/AIDS information posters at prominent locations as specified by the Resident Engineer;
- ✓ The contractor has to ensure that staff are made aware of the risks of contracting or spreading sexually transmitted diseases;
- ✓ The contractor should ensure that the project workers are sensitized on the local culture.

6.7. Summary of the Potential Impacts Related to Dam Implementation

6.7.1. Potential Positive Impacts

- ✓ By supplying the school adequate water, the university management will make savings that will be diverted to other development projects;
- ✓ Watering landscaped areas and using retained water for cleaning purposes would reduce costs on water expenditures;
- ✓ Flood control would avert possible losses and property damage associated with uncontrolled flood water;
- ✓ Retained water would be used in further construction works therefore reducing construction costs and reducing pressure on available water resources;
- ✓ Reduced soil erosion by constructing drains; and
- ✓ Increasing the value of land near the dam, because of all the above benefits.

6.7.2. Potential Negative Impacts

- ✓ Loss of some land taken up by the water reservoir and the associated drainage channels;
- ✓ Risk of increased cases of malaria (this can be reduced by fish such as Tilapia Nilotica);
- ✓ Risk of increased cases of bilharzia, cholera, dysentery and typhoid (this can be reduced if the reservoir is fenced and the water is treated/ boiled before consumption);
- ✓ Siltation of the water reservoir will shorten the lifetime of the dam unless proper soil conservation is implemented in the catchment area;
- ✓ Risk of people and animals drowning if they try to bathe in or swim across the dam, this will occur if the dam will not be secured.

6.8. Potential Impacts to Physical Resources

6.8.1. Geology

The Proposed project would normally have a significant effect on the environment if it would:

- ✓ Expose people or structures to major geologic hazards, which is not the case as concerns the proposed project

6.8.2. Soils Resources

The Proposed development would normally have a significant effect on the environment if it would:

- ✓ Cause substantial erosion; and
- ✓ Cause substantial destruction of agricultural crops.

But during the implementation and operation of the proposed project, no soil erosion (via water or wind) will be allowed to take place neither is the project located in an agricultural land.

6.8.3. Water Resources

a) Surface Waters

The Proposed Action would have had a significant effect on the environment if it would:

- ✓ Have substantially degraded water quality;
- ✓ Contaminate a public water supply;
- ✓ Cause substantial flooding or siltation; or
- ✓ Substantially alter surface flow conditions, patterns, or rates.

b) Ground Waters

The Proposed Action would normally have a significant effect on the environment if it would:

- ✓ Substantially degrade ground water quality;
- ✓ Contaminate a public ground water supply; and
- ✓ Substantially degrade or deplete ground water resources

6.8.4. Air Resources

The Proposed Action would normally have a significant effect on the environment if it would:

- ✓ Violate any regulatory requirement of NEMA; or
- ✓ Violate any ambient air quality standard; or
- ✓ Expose sensitive receptors to substantial air pollutant concentrations.

6.8.5. Biological Resources

The Proposed Action would normally have a significant effect on the environment if it would:

- ✓ Substantially affect a rare or endangered species of animal or plant or the habitat of the species;
- ✓ Interfere substantially with the movement of any resident or migratory wildlife species;
- ✓ Substantially diminish habitat for wildlife or plants.

6.9. Possible Mitigation Measures

6.9.1. Mitigation on the Impacts on Terrestrial Resources

- ✓ Removal and establishment of trees is a lengthy and potentially expensive undertaking. Retaining as most of the vegetation is possible with proper planning care and would also significantly advance the aesthetics of the area;
- ✓ Preservation and the replanting of trees within the facility compound would mitigate against loss;
- ✓ The maintaining of any existing vegetation would be important in maintaining the integrity of these systems;
- ✓ The maintaining and replanting of vegetation should be ongoing as the development proceeds Vegetation would also serve to protect any vulnerable slopes and guard against soil erosion; and
- ✓ As far as possible, the drainage plans should follow natural regimes to prevent the die-off of tree species by flooding or drought.

6.9.2. Mitigation Measures on the Impacts of Waste Disposal

6.9.2.1. Solid Waste

- ✓ Specific attention would be given to minimizing and reducing the quantities of solid waste produced during site preparation and construction;
- ✓ A waste (debris, soil, tree cuttings) management plan would be prepared and followed;
- ✓ To avoid the harmful effects of poor solid waste disposal adequate arrangement would be to dispose of solid waste at the authorized dumpsite. Re-using as much of waste (cut trees as firewood, soil as water traps) is also encouraged;
- ✓ Strategically located and maintained temporary latrine facilities should be made available for construction workers.

6.9.2.2. Site Access-Mitigation Measures

- ✓ An appropriate schedule of activities during the construction phase will help to alleviate the impacts of increased noise, dust, etc. likely to result from construction activities;
- ✓ The activity schedule should be communicated to residents of the surrounding community; and
- ✓ Additionally, construction activities will take place during periods when disturbances to the surrounding residents are minimized, i.e. during day time only. No work should go into the night.

6.9.2.3. Construction Works-Mitigation Measures

- ✓ Good site waste management procedures should be implemented;
- ✓ Adequate drainage should be designed and engineered to prevent excessive runoff of sediments into the environment;
- ✓ Sediment traps should be installed;
- ✓ All workers should be in protective gears where possible;
- ✓ Measures to reduce the formation of fugitive dust, such as sprinkling, should be instituted where possible; and
- ✓ Warning signs and emergency telephone numbers should be well displayed.

6.10. Other Potential Impacts

6.10.1. Mitigation Measures

- ✓ Monitoring and management of the area drainage to prevent flooding;
- ✓ Solid Waste: Arrangement must be in place to ensure that solid waste and construction debris is properly disposed off;
- ✓ Other wastes such as tree cuttings would be preserved and composted or suitably secured;
- ✓ The use of adequate equipment and vehicles to reduce on dust pollution and noise would be employed;
- ✓ Frequent wetting of the site during construction will also help to alleviate the problem of fugitive dust; and
- ✓ Noise should be kept to a level which does not exceed 70dB at 50m from the site boundary at any given time.

7. ENVIRONMENTAL MANGEMENT AND MONITORING PLAN

A number of activities have to be carried out during the various phases of the project to ensure adequate environmental and social impact management. These include, but are not limited, to the following:

7.1. Project Preparation

- i. Collection of baseline data for monitoring purposes (e.g. vegetation type, ambient noise);
- ii. Training of the relevant university management staff in environmental management;
- iii. Verification of design details.
- iv. Inclusion of environmental specifications in Tender Documents, and development of Code of Conduct for the Contractor.
- v. Preparation of an occupational safety and health manual for use during project construction, operation and decommissioning.

7.2. Construction

- i. Incorporation of mitigation measures;
- ii. Enforcement of occupational safety and health requirements (conditions at the Contractor's Yard, materials storage, condition of equipment, protective clothing, etc.);
- iii. Collection of data on noise and vibration levels;
- iv. Disposal of construction solid, liquid and sanitary wastes in an acceptable manner and in conformance with regulations;
- v. Ensuring that the Contractor is following the Code of Conduct and environmental specifications in the Tender Documents;
- vi. Training the Contractor's workforce in environmental and social awareness and responsibility (including STD/HIV/AIDS awareness); and
- vii. Liaison with local administration and community leaders in matters of disturbance to the public, security issues, and other matters arising from the project.

7.3. Operation

Maintenance, calibration and checking of all equipment as specified in respective manuals or regulations;

Monitoring leakages and spills;

Collection of data on water (surface and ground), and noise and vibration levels, to be used for analysis and remediation where necessary;

Disposal of solid and sanitary wastes in an acceptable manner and in conformance with regulations;

Compliance with occupational safety and health manual to be prepared by project proponent/management during the project preparation phase; and

Environmental performance reporting (based on evaluation of data collected, investigations, etc.

The table below represents environmental management and monitoring plan. It describes how each of the main mitigation measures proposed should be implemented, how frequently, and who should be responsible during and after construction. Monitoring indicators and means of monitoring have also been included in the table. It is imperative that this Environmental Project Report is made available to the contractor at the tendering stage so that they can appreciate what is involved in implementing proposed mitigation measures and will be able to include mitigation measures in the bills of quantities.

Prior to mobilization, the Contractor should also prepare his own EMP for review by the Supervising Engineer. In his schedule of works, the Contractor must include all proposed mitigation measures, and the Supervising Engineer should ensure that the schedule and environmental management/monitoring plans are complied with. This will also lend a sense of ownership to the Contractor, in addition to instilling in him/ her, a thorough understanding of the pertinent issues.

The responsibility for supervision of the implementation of all the proposed mitigation measures during construction and the defects liability period will lie with the Supervising Engineer, while the Contractor will be responsible for day to day operational matters of construction, which will include implementation of mitigation measures that he is responsible for.

After the defects liability period, responsibility for the operation and maintenance of the facility will rest with the property owner. The table also presents an estimate of the costs of environmental management and mitigation.

Table 12: Environmental Management Plan

Impacts	Proposed Mitigation	Monitoring Indicators	Responsibility	Costs(Ksh)
Soil				
Soil erosion	Re-vegetation	Vegetation cover	Project Manager	200,000.00
Soil compaction	Compaction to Engineers specification	Type of machinery and equipment	Project manager	
Paving	Reduction of paved/compacted areas	Percentage of compacted area	Project manager	
Water				
Surface run off and waste water.	Embankment, re-vegetation, Proper drainage systems	Amounts of storm and wastewater; Size and type of drainage system	The project manager	200,000.00
Pollution/contamination	Proper waste management	Incidences of spillage; Poor disposal of wastes; Composition of run off	Project manager and facility users	
Air				
Dust	Watering of uncovered area/watering area; Construction of a dust screen around the site, Dust masks for the workers,	Amounts of dust raised Dam area paved	The project manager	100,000.00
Emissions	Use of low emission machinery; use of scrubbers;	Type of machinery Amounts of emission	Contractor/ project manager	
Noise	Construction during day time; Using silencers in heavy machines, use of PPE such as ear muffs	Decibels	The project manager	20,000.00
Micro-climate modification	Reduction of bare areas and re-vegetation	Bare Area, especially around the facility; Number of trees and amount of vegetation cover	Project manager The proponent	20,000.00
Biodiversity				
Degradation of vegetation	Planting more trees	Number of trees; State of landscaped vegetation	Project manager and proponent	30,000.00
Social concerns and General Safety				
Insecurity / public safety	Contracting a security firm and fencing the dam	Presence of a security Personnel; fence around the dam site	The proponent Project manager	30,000.00 month
Protective Gear	Use of protective clothing, where necessary.	Provision of safety gear and equipment	Proponent; Project manager	50,000.00

Accidents and falling objects	Erecting hazards warning signs. Using smaller trucks that make narrow turnings	Signboards and size of trucks	Proponent/ manager/ contractor	
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Table 13: Environmental Monitoring Plan for each Phase

Ref. No	Affected Environment	Objective to Address Impact	Mitigation Measures	Responsible party	Due Date / Frequency	Monitoring Activity	Estimate cost (Ksh)
Construction Phase							
C1	Air Quality	To minimize exhaust pollution and nuisance	The use of well-maintained construction plant and equipment	Project Manager	continuous	Routine inspection / maintenance records	20, 000.00 month
C2	Occupational Health and Safety (OHS)	To ensure Health and Safety on and around the construction site	All construction activities will be conducted in accordance with applicable Kenyan Construction OSH Stds.	Project Manager	continuous	Joint site inspection by relevant authorities	50, 000.00 to purchase PPE and put in place proper signage
C3	Occupational Health and safety	To ensure Health and Safety on the construction site	The Contractor will comply with OHS regulations agreed with the proponent.	Project Manager	continuous Daily / As required	Routine inspection of worksites / Obtaining necessary permits	
C4	Occupational Health and safety	To prevent injury to the public	Barrier tape and warning signs will be put in place in relevant strategic places	Project Manager	Twice daily/ As required	Visual inspection	5, 000.00 per month
Operational Phase							
O1	Water quality	To prevent pollution of water	Control soil erosion	Project Manager	As required	Monitoring water quality records	20, 000.00 per month
O2	Water erosion	Prevent localized erosion	Proper maintenance of storm drains	Project Manager	Continuous	Visual inspection	30, 000.00 per three months
O3	Public health	Prevent disease outbreaks	Proper Hygiene within and around the construction site	Project Manager	As required	Visual inspection of number of dust bins and other public health measures.	30, 000.00 per month
O4	Land use	Prevent de-vegetation	Plant more trees	Project manager/ proponent	As required	Visual inspection	5, 000.00 per month
O4	Conflicts	To Make sure all stakeholders are comfortable with project implementation.	Creating a conflict management plan	Proponent, community, students leaders and government officials	Continued Interaction and engagement	No of meeting/ consultations held	

7.4. Repair and Maintenance

7.4.1. Leaking of the Reservoir

Newly built dams do not usually hold water for as long a period as expected during the first couple of years, due to leakages. The reasons and recommendations for curing leakages may be summarized as follows:

Table 14: Leakage problems in reservoirs and recommended solutions

Problem	Reason	Solution
Water disappears through the floor of the dam	The floor was not made water-tight, and holes made by rodents, rotten tree roots, old ant-hills, forgotten pits and trial pits, all drain water into the ground below.	The holes must be sealed with clayey soil and compacted. Stones and boulders must be removed from the floor, as water can seep along them into the ground below. If some boulders are too large to remove, these should be covered with a thick layer of clayey soil to prevent seepage. Should the dam still leak after the floor has been prepared as described above, the floor should be compacted by driving a tractor repeatedly over the floor of the reservoir until the soil has been compacted firmly. Should the floor of a reservoir still leak after compaction, it can be sealed (puddled) with a layer of water-resistant materials, such as clay, powdered ant-hills or lime, which are compacted onto the floor
Water seeps through a newly-built dam wall	-poor constructed dam wall	-Repairing the dam wall

7.4.2. Washed-Out Spillways

Spillways can be washed-out to such depths that they drain all floodwater out of their water reservoirs either due to erosion caused by excessive floodwater, or because the floor of a spillway was not made to withstand erosion, as recommended below. Recommendations to prevent washed-out spillways:

- ✓ A huge volume of rainwater runs off a large catchment during heavy rains. If a smaller dam is built with a large catchment, the reservoir will fill up with water quickly and a huge surplus of water will pass over the spillway, where it may cause erosion.

7.4.3. Decommissioning

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 demolition/ decommissioning from the site. The following should be undertaken to restore the environment:

- ✓ Remove all underground facilities from the site
- ✓ The site should be well landscaped by flattening the mounds of soil and planting indigenous trees and flowers
- ✓ All the equipment should be removed from the site
- ✓ Fence and signpost unsafe areas until natural stabilization occurs
- ✓ Backfill surface openings if practical.

8. CONCLUSION AND RECOMMENDATION

8.1. Conclusion

In accordance with EMCA and the Environmental (Impact and Audit) Regulations, 2003, the findings of the EIA carried out for this project indicate that possible environmental impacts generated during construction, operations and decommissioning phases can be addressed effectively by the proponent through the mitigation measures indicated in the matrix above. As per the above analysis of the aspects of both positive and negative environmental impacts of the project's development, we, the experts found **NO SIGNIFICANT NEGATIVE IMPACTS** that could pose adverse effects to the extent of barring the proposed project from being implemented. However, the minor potential negative impacts of the proposed project could be managed with the suggested environmental and social mitigation management plan. Having considered the data collected, analyzed and collated information that is available, it is the experts' considered opinion that:

- i. The project does not pose any serious environmental concerns, other than those of a minor scale that accompany most development activities;
- ii. The positive impacts of the project outweigh the negative ones, which will be adequately contained by following the prescribed environmental and social impact management plans;
- iii. As such, the project could be allowed to commence, and activities be managed within the provided EMP and sound environmental management practices that are internationally recognized.

8.2. Statutory Compliance

The proponent and the contractor shall ensure that they implement and adhere to the statutory provisions of the statutes mentioned in Chapter three of this report and any other relevant ones provided for in Kenya.

9. REFERENCES

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10. APPENDICES

- i. Appendix 10.1: NEMA Experts Practicing License
- ii. Appendix 10.3: Public Participation Minutes
- iii. Appendix 10.4: Project Design Report
- iv. Appendix 10.5: Land Ownership Documents

10.1 Appendix 10.1: NEMA Experts Practicing License

FORM 7 (r.15(2))



NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)
THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT
ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/2720
Application Reference No: NEMA/EIA/EL/4349

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Issued Date: **1/18/2016** Expiry Date: **12/31/2016**


Signature.....
(Seal)
Director General
The National Environment Management
Authority

P. T. O.

ISO 9001 : 2008 Certified

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(r.15(2))



**NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)
THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT**

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/2719

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(r.15(2))



**NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)
THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT**

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

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The National Environment Management Authority

10.2Appendix 10.2: Public Participation Minutes

10.3Appendix 10.3: Project Design Report

10.4Appendix 10.4: Land Ownership Documents

10.5 Appendix 10.5 Stakeholder Meeting Minutes