MINISTRY OF WATER, SANITATION AND IRRIGATION

COAST WATER WORKS DEVELOPMENT AGENCY

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR THE PROPOSED DESIGN AND BUILD OF MAKAMINI DAM PROJECT (PHASE 1) IN MAKAMINI AREA, KINANGO SUB-COUNTY, KWALE COUNTY, KENYA

ESIA STUDY REPORT

JANUARY 2022

DOCUMENT AUTHENTIFICATION

This report has been prepared for the proponent by:

Lead Consultant, ESIA & RAP

Prof. Stanley M. Makindi, Ph.D.

Lead EIA/EA Expert

NEMA Reg. No.: 2782

P.O. Box 136-90100, Machakos, Kenya

Email: ***mankindsm@gmail.com***

Signature: …  ***……. Date: …30/12/2021…***

On behalf of:

Coast Water Works Development Agency

Mikindani Street, Off Nkurumah Road

P.O. Box 90417-80100, Mombasa, Kenya

Name: ……. Designation…….

Signature: ……. Date: ……

PROJECT TEAM

This report has been prepared for the proponent by:

NAME	QUALIFICATIONS	DESIGNATION
Prof. Stanley M. Makindi	Ph.D. (Environmental Science)	Lead Consultant, ESIA & RAP. NEMA licensed lead Expert Reg. No. 2782
Mr. Humphrey Kitonyi	Bachelor of Environmental Planning and Management	Environmentalist. NEMA licensed Associate EIA/EA Expert Reg. No.7547
Mr. Paul Kombo Nakhungu	BA. Sociology, MPhil Environmental Studies (Human Ecology)	Sociologist/RAP Expert
Mr. Wedgener Sindani Mugatsia	B.Sc. (Environmental Science)	Data Analyst. NEMA licensed Associate EIA/EA Expert Reg. No. 11027
Eng. Jayateerth R. Karjigi	Post Graduate Diploma, Fluid Engineering	Water Engineer

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

ACRONYMS AND ABBREVIATIONS

AIDS -	Acquired Immune Deficiency Syndrome
BPS-	Borrow Pit Sites
CBOs -	Community Based Organizations
CEAP-	County Environmental Action Plan
CPP-	Consultation and Public Participation
CWWDA-	Coast Water Works Development Agency
DOSHS-	Directorate of Occupational Safety and Health Services
EA -	Environmental Audit
EHS -	Environment, Health and Safety
EIA -	Environmental Impact Assessment
EMCA -	Environmental Management Coordination Act
ESIA-	Environmental and Social Impact Assessment
ESMP -	Environmental and Social Management Plan
FGD-	Focus Group Discussion
GoK -	Government of Kenya
HIV -	Human Immuno- Deficiency Virus
MoH -	Ministry of Health
NCA	National Construction Authority
NEAP -	National Environment Action Plan
NEMA -	National Environment Management Authority
NIHL-	Permanent Noise Induced Hearing Loss
NGOs -	Non-Governmental Organizations
PC-	Public Consultation
PPE –	Personal Protective Equipment
RAP	Resettlement Action Plan
STIs –	Sexually Transmitted Infections
SW-	Solid Waste
SWMP-	Solid Waste Management Plan
TOR -	Terms of Reference
UTM	Universal Transverse Mercator

WRA-	Water Resources Authority
WTP	Water Treatment Plant
WCD	World Commission on Dams

EXECUTIVE SUMMARY

General Overview

The proposed Makamini dam is located at Co-ordinates 03° 58’ 57.7” S, 39° 13’ 57.5” E and at a bottom valley elevation of 190.0 a.m.s.l. along the confluence of Mulunguni and Vigurungani Rivers which are tributaries of Chigulu River (changes name to Mwache downstream). The site is accessible through Samburu-Kinangoni-Mulunguni tarmac road which covers a distance of 20km then branches via Mulunguni-Makamini earth road. It stretches through a distance of approximately 5.0 km to terminate at Makamini Shopping centre. From the shopping centre, the proposed Makamini dam is located approximately 1.0km towards the western side. The area covered by the dam basin is approximately 277.8 Km^2.

The main components of the project and radial distances of its environmental impact comprises of:

- Makamini dam catchment area and its surrounding
- Proposed area for Water Treatment Plant (WTP)

Proposed important activities of the project during the construction phase include:

- Recruitment and employment
- Construction of temporary construction camp and workshop
- Site clearance
- Construction of dam access road
- Excavation and embankment
- Excavation from borrow areas
- Transport of materials and equipment
- Foundation and construction of dam body
- Construction of spillway
- Construction of Water Treatment Plant
- Spoil disposal

Statutory Framework

Environmental issues are considered an integral part of any development activity. The country's supreme law, the Constitution of Kenya, 2010 safeguards the environment by stipulating that every Kenyan has a right to a clean and healthy environment. Further, with reference to the schedule II of the Environmental Management and Coordination Act 1999(Amended 2015), projects that require undertaking of EIA are categorically listed. The proposed project is classified under high-risk impact project according to the Legal notice 31 & 32 of 2019. In general, Kenya has over 77 statutes, which relate to environmental concerns. Most of these statutes are sector specific, covering issues such as land uses, occupational health and safety, water quality, wildlife, public health; soil erosion; air quality, etc. Therefore, this report has highlighted all the legal, policy and regulatory frameworks relevant to the implementation and operation of the proposed Makamini dam project.

Data Collection

The consultant conducted scoping as part of the preliminary assessment which identified likelihood of significant environmental and social impacts as a result of the implementation of the proposed Makamini dam project. In order to further interrogate the identified issues, the study team employed various data collection methods. This encompassed both primary and secondary data collection methods that were keenly evaluated and analyzed to assist in accurate reporting of this document.

Stakeholder Participation

The proposed construction of Makamini dam laid a lot of emphasis in promoting stakeholder participation and consultation. Stakeholder involvement and consultation was undertaken at both individual and public levels. This study adopted a multi-stakeholder public participation approach which involved seeking the opinions of the relevant government authorities, project affected and interested persons and the surrounding residents within the mapped catchment area. Some of the approaches applied to aid in data collection included; household social and environmental surveys using structured questionnaires, focused group discussions, public meetings and key informant interviews for institutions and lead agencies.

Significant Anticipated Project Impacts

The objective of undertaking this ESIA process was mainly to ensure that the proposed development project is environmentally, economically and socially feasible; thus, reducing conflict between the project interested and affected persons throughout the project cycle. This ESIA report assessed both the social and environmental impacts of the proposed construction of Makamini dam and water treatment plant. It was established that there are significant negative impacts which are likely to be encountered during the implementation and operational phases of the project. It is against this backdrop that the study team grouped these impacts into four categories which encompassed; impacts on socio-economic and built environment, geophysical, water as well as human environment. These impacts have been further discussed in various sub sections explaining their likely causes and their process of occurrence.

The study team identified some of the pertinent negative impacts of the proposed project as follows;

- Issues of land acquisition within reservoir area and the subsequent displacement of the existing population,
- Slope stability,
- Water quality and flow reduction, and
- Water loss through various forms such as evaporation, seepage through possible fissures in the base rock and potential losses of water at consumer points through wanton wastage, leakages in the distribution pipelines and overuse in the farms in the case of irrigation.

Most important positive impacts of the project are:

- Supplying water for domestic use
- Protection against flood and other natural hazards
- Improvement of infrastructure, especially communication roads
- Employment and job opportunities

Mitigation of Negative Impacts

Social and environmental safeguards have been proposed to minimize the anticipated negative impacts and enhance the resultant positive impacts. These are presented in the Environmental and Social Management Plan ESMP in this report for implementation by responsible parties and stakeholders where applicable.

Conclusion and Recommendations

Generally, the study team concluded that the proposed construction of Makamini dam and its associated components if properly implemented according to the guidelines of this report and in compliance with all legal provisions highlighted, then the project will be environmentally, socially and economically feasible. Thus, it is our recommendation that the project be allowed to proceed on the understanding that the proponent will adhere to the mitigation measures proposed herein and further implement the proposed ESMP. In addition, the proponent ought to perform continuous monitoring and evaluation of the various environmental and social parameters by closely ensuring that the Environmental and Social Monitoring Plan is comprehensively adhered to.

1.0 INTRODUCTION

1.1 Background Information

The population of Kenya, the societies they live in and the economy they depend upon are highly vulnerable to erratic climatic patterns and limited water availability due to their reliance on key sectors such as agriculture, tourism, hydro-energy, etc. that depend on rainfall and water availability. Kenya is classified as a water scarce country given that it has limited freshwater bodies. Climate variability and hydro-climatic shocks which include droughts and floods impact disproportionately on the poor, and climate change is projected to exacerbate existing climate risks and water resource constraints. Kenya has yet to adequately manage its highly variable hydrology to improve climate resilience, as evidenced in decades-long underinvestment in water infrastructure.

The development and management of water resources in Kenya is based on the view that water is a social good and is a catalyst for economic development. The current access to clean water in the country is estimated at about 90% in urban areas and approximately 44% in the rural areas while the national average stands at about 57%. At the same time, provision for safe sanitation stands at a national average of 80% (95% in urban areas and 77% in rural areas). In line with socio-economic agenda of Vision 2030, Big 4 Agenda, and Sustainable Development Goals (SDGs), No. 1, 2, 3 & 6, the Government of Kenya (GOK) has recognized the need for comprehensive institutional· reform and increased investment in the water and sanitation sector in order to remove bottlenecks in its overall programme cannot be underscored to alleviate poverty and create employment and wealth. In addition, of importance is the government's big four agenda which has four pillars of enhancing manufacturing, food security & nutrition, universal health coverage and affordable housing. All these components require water as an enabler to help achieve the projected targets throughout the economy.

The proposed Makamini dam is one of the 20 priority projects (including 14 dams, 3 sand storage Dams, Upper Mwache check dam intake, Umba dam intake, Mzima pipeline, Djabias and Kizibe groundwater development) proposed in the master plan prepared under the Consultancy Services for Preparation of Kwale County Water Supply Development Master Plan. The Ministry of Water,

Sanitation and Irrigation through Coast Water Works Development Agency is implementing the Makamini dam project as a Vision 2030 priority project with funding from the Government of Kenya.

1.2 Objective of the ESIA

The main objective of the consultancy services is to carry out Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) studies for the Design and Build of Makamini dam project.

The overall objectives of the Consultancy are to:

1. Take into account environmental, social, economic, cultural and legal considerations in regard to the proposed works;
2. Identify the anticipated environmental impacts of the proposed works and the scale of the impacts;
3. Analyse and evaluate the anticipated impacts of the proposed works on the physical, biological, social-cultural and social- economic environment;
4. Identify and analyse alternatives to the proposed projects;
5. Evaluate the proposed implementation works and consider their effects on safety and convenience of the anticipated users;
6. Propose mitigation measures to be taken during and after the implementation of the proposed construction of Makamini Earth dam;
7. Develop an Environmental Management Plan (EMP) with mechanisms for monitoring and evaluating the compliance and environmental performance which shall include the cost of mitigation measures and the time frame of implementing the measures.

1.3 Project Justification

Following acute shortage of water in most parts of the country (Kenya being a water scarce country), it has become necessary that alternative mechanisms are developed to harness available sources of water to supplement the little available. With intensive surface runoff during heavy rains, significant volumes of storm water are lost. Dam construction has been identified as an alternative to harness the storm water for storage and use during the dry conditions. Makamini Dam is among the priority projects identified in the Kenya Vision 2030 geared towards providing water to the residents of 9 sub-locations (Makamini, Kinagoni, Matumbi, Mtaa, Mabesheni, Bofu,

Kibandaongo, Mnyezeni and Mwamdudu) within Kinango sub-county as well as playing hydrological roles which include being a check dam for the Mwache dam. The design of the dam is taking into consideration all the possible but viable components to ensure maximum benefits. The dam has been slated for implementation in the plan period 2020 – 2024 through the Ministry of Water, Sanitation and Irrigation. The project is in Makamini area, Kinango Sub-county within Kwale County and it is habited by a community who are basically farmers. However, agricultural production is poor due to inadequate rainfall within the region.

1.4 ESIA Methodology

A detailed study for the ESIA was undertaken in light of the legislative requirements of the Environmental Management and Coordination Act (EMCA), 1999 (Amended 2015) and the Environmental Impact Assessment and Environmental Audit Regulations, 2003. During the ESIA study, the key focus was to identify potential environmental, social and cultural impacts of the proposed Design and Build of Makamini dam project and highlights possible mitigation measures for the identified impacts.

The assessment adopted an integrated approach where data collection and analysis were done by a multi-disciplinary team that sought the input of the proponent, the public, key informants and many other stakeholders. Among the broad focal areas addressed in the report include; natural resources, physical environment, socio-economic and cultural issues, health & safety aspects, administrative and institutional arrangements.

1.4.1 Project Screening

From the Water Master Plan of the County, the proponent already identified the need for water development and assessed all possible alternatives of the proposed project and has settled on the preferred option. The screening was done to confirm the need for the ESIA by appraising the type of project option/ alternative and its associated activities throughout the project lifecycle in the context of its biophysical, socio-economic, policy and regulatory environments. Questions were asked as to what the effects of the proposed development on the environment will be and if they were established to be significant. The impacts were ascertained to be significant hence the need for an ESIA study.

1.4.2 Project Scoping

This stage involved defining of the issues to be addressed especially those impacts which have significant effect on the environment. It was important since it helped the study team to focus the available resources on the relevant issues. Therefore, the main objective of scoping was to focus on the key issues, while ensuring that indirect and secondary effects are not overlooked and eliminating irrelevant impacts. Thus, scoping identified the key concerns, evaluated, organized and presented them to aid decision-making.

1.4.3 Data Collection

The consultant ensured instruments of data collection are comprehensively prepared to guide and facilitate collection of adequate data by the field staff. The study process involved reference to secondary sources such as County Environmental Action Plans (CEAP), relevant legal and regulatory frameworks, government polices among others. The primary sources of data collection employed included; checklists, observations, Key stakeholders' interviews, public meetings (*barazas*), photography and geo-referencing.

1.4.4 Public Participation

Generally, in Kenya, various laws and regulations require that beneficiaries and members of the public living near new or improvement project sites (either public or private) are consulted to seek their views and opinions regarding the project before its implementation. Further, EMCA 1999 (Amended, 2015) CAP 387 states that public consultation is an integral component of undertaking any ESIA process. The key principle of consultation is to ensure that the views of stakeholders are taken into account and reported in the ESIA report. Consultative public participation was therefore an important process in this study. The stakeholder's engagement played a critical role in gaining insights into the key environmental and social issues, addressing the concerns of the surrounding communities and other stakeholders, and aiding the development of potential impacts mitigation strategies. Therefore, the consultant undertook several public barazas within project site mainly at Makamini market centre. The views and concerns captured informed the management measures to be instituted in addition to other information collected through other forms of data collection.

1.4.5 Evaluation of Project Alternatives

This phase involved compiling and analyzing the data collected in the various categories. In evaluating alternatives, emphasis was made on project site factoring the economic, human, technological and environmental benefits associated with the proposed project.

1.4.6 Determination of Impacts of the Project

The results of the analysis were used to determine the anticipated negative and positive impacts likely to emanate from the construction of Makamini dam and water treatment plant. The anticipated adverse impacts resulting from the implementation of the project were evaluated based on the environmental, ecological and socio-economic aspects. In addition, the analysis of the impacts also focused on physical environment parameters such as; population, land use, water, soils, air/climate, hydrological conditions and disturbance on vegetation, among others. The negative impacts were further categorized into various project phases of construction, operation and decommissioning.

Subsequently, all the benefits that accrue from the project were identified. In view of the fact that some indirect economic and social benefits arising from the improvement of the proposed project are intangible or difficult to quantify accurately, a detailed qualitative analysis of these benefits was carried out. Only those benefits that can be firmly demonstrated in quantitative terms, were included in the evaluation of the project. The remaining qualitative benefits that could not have been quantified were used as secondary justification for project implementation.

1.4.7 Impact Mitigation

The assessment of the impacts revealed significant negative effects of the project on the receiving environment. However, these effects were alleviated through provision of mitigation measures which encompassed adopting measures to reduce or eradicate the adverse impacts on the environment. Therefore, this phase of the study comprehensively analyzed the identified impacts and provided appropriate mitigation measures with the aim to avoid, minimize or remedy adverse impacts emanating from the activities of construction of the proposed dam and its associated activities. This stage was also meant to further ensure that all residual impacts identified are adequately mitigated to within acceptable levels as well as enhance social and environmental benefits of the project.

1.4.8 Environmental and Social Management Plan (ESMP)

This provided a practical tool for mitigating negative impacts and enhancing the positive ones. It also categorized the project into phases (construction, operation and decommissioning phase) and summarized the impacts together with their mitigation measures as well as attached the estimated costs to mitigate these impacts. Therefore, social and environmental safeguards were highlighted here in relation to the identified adverse impacts for the best interest of the human population and the environment which they live and relate to.

1.4.9 Environmental and Social Monitoring Plan

This provided indicators or criteria for monitoring the implementation and effectiveness of the ESMP and it further included the responsible institutions. Based on the baseline data of the ESIA, the consultant designed a comprehensive monitoring and evaluation plan which acts as a measure of compliance during implementation and operation stages of the project. The consultant also gave specific descriptions and technical details of monitoring measures including; the environmental and social component to be assessed, the parameter/indicator, the location, frequency of assessment, the exact phase of project during which monitoring will be executed and the responsible party. Some of the components that will require monitoring and evaluation will include; air quality, dust, occupational health and safety, noise, soil erosion, groundwater quality, vegetation, public health, water quality, among others.

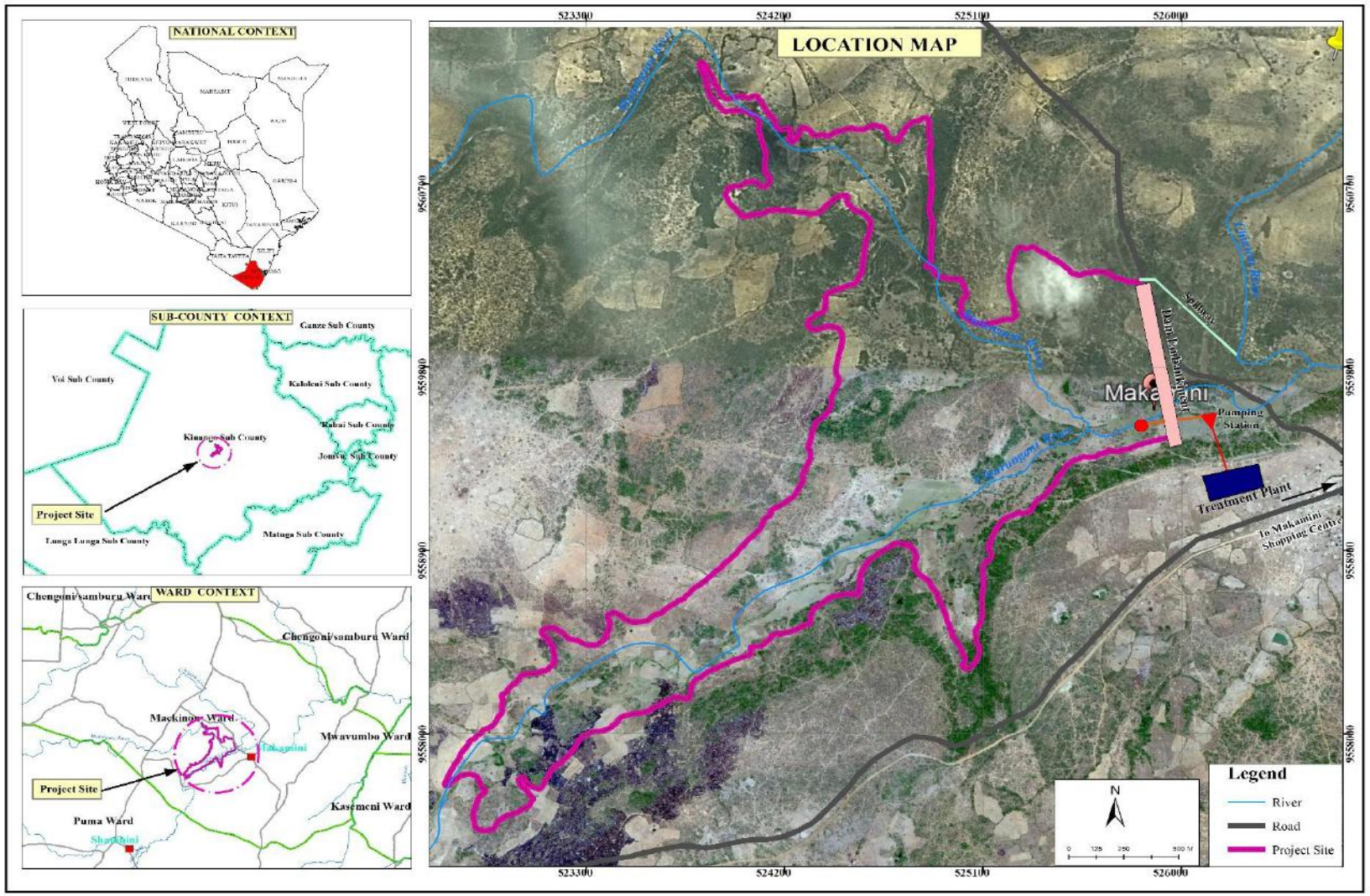
1.5 Reporting Process

The reports (inception, draft and final) were done within pre-agreed time frames and the requirements of the National Environmental Management Authority (NEMA) guidelines. The report schedule comprised a Terms of Reference (TORs), draft final ESIA study report and final ESIA study report. The TORs report was submitted to NEMA and approved after review. Besides, continuous briefings to the Client and NEMA local and national office was undertaken.

2.0 PROJECT DESCRIPTION

2.1 Project Location

The project is located at Co-ordinates 03° 58’ 57.7” S, 39° 13’ 57.5” E [X=525,050, Y= 9,559,709 (UTM, Arc1960, 37S)] and at a bottom valley elevation of 190.0 amsl along the confluence of Rivers Mulunguni and Vigurungani which are tributaries of River Chigulu (Changes name to Mwache downstream). The site is located approximately 1.0km west of Makamini Shopping Centre and is accessible through Samburu-Kinagoni-Mulunguni tarmac road (20km), then Mulunguni-Makamini earth road (5.0km).

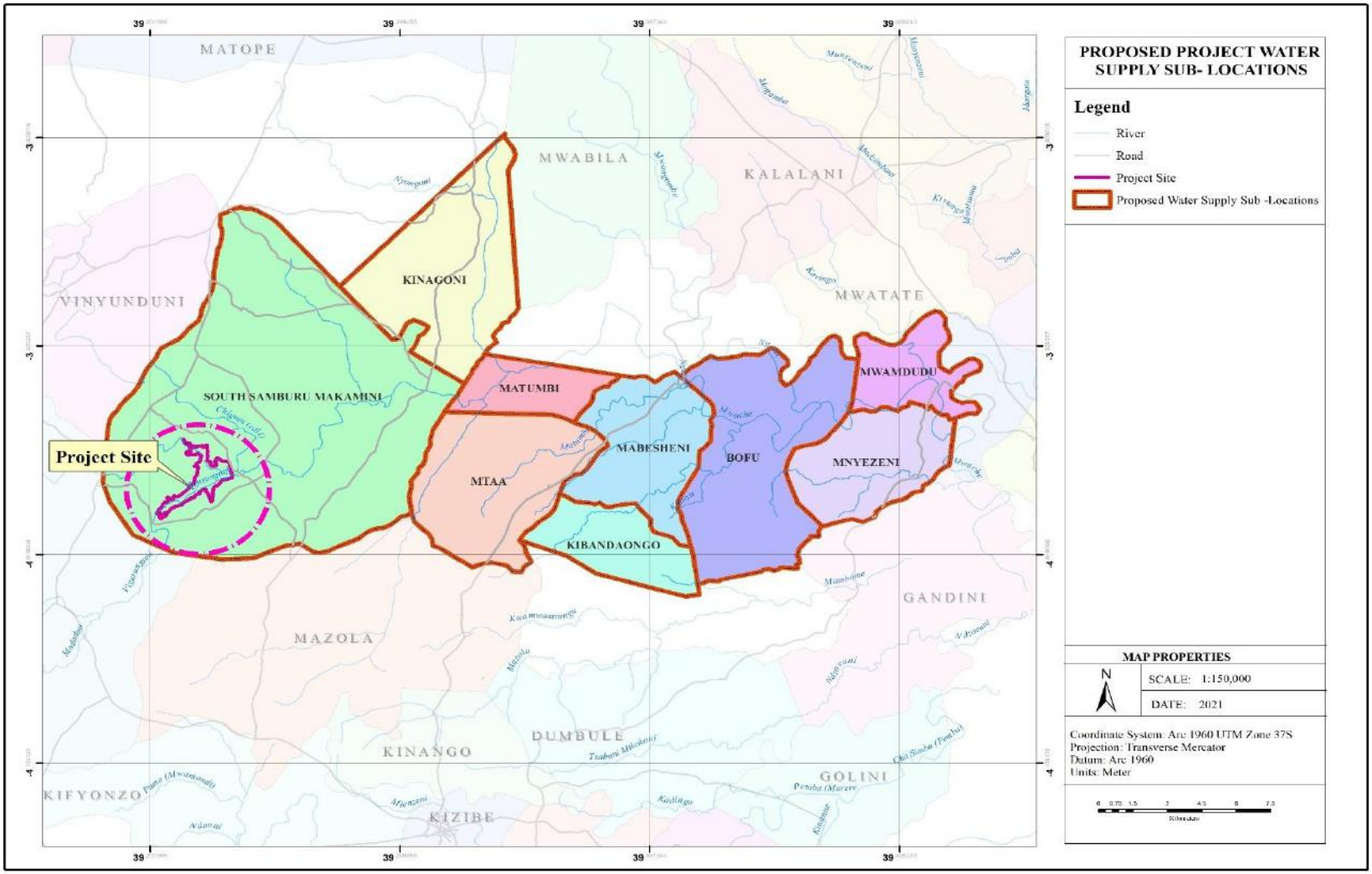


Map 1: Proposed Project Location

2.2 Scope of Works for the Proposed Makamini Dam

The works include:

- Design of the project works;
- Construction of a 9m high Earth Dam – 738m long and 6m wide crest, approximately; 300, 000m^3 volume of earthworks;
- Spillway of 28m length and design flood inflow of 288m^3/s;
- Draw-off system with capacity of 0.0325m^3/s;
- Water Treatment Plant (WTP) with capacity of 2800m^3/day;
- Rising main approximately 710m long and 225mm diameter;
- Pump House and Pump sets including standby power generating set; and
- 3 Clear Water tank, each with a capacity of 1000m^3.



Map 2: Sub-locations to be supplied by the Proposed Makamini Dam

2.3 Selection of Dam Type

The existence of alluvial deposits at the dam axis, makes the embankment dam the only suitable dam type. An embankment dam can have the flexibility to accommodate large total and differential settlements of the foundation. Gravity type dams cannot cope with this and would require huge excavations in order to reach the bedrock.

2.4 Embankment Section and Zoning

The embankment outer slopes will be very mild because both the foundation and the embankment materials will be relatively weak. The upstream slope will be 1:2.5 (vert.:hor.). The downstream slope will be 1:2 (vert.:hor.). It is proposed to use an essentially homogeneous dam with the following zones:

- Zone 1 – Impermeable Clay Material - Dam Core
- Zone 2 – Filters

Zone 2a – Fine Graded Filter Material (downstream)

Zone 2b – Coarse Graded Filter Material

Zone 2c – Fine Graded Filter Material (upstream)

- Zone 3 – Shoulders from rockfill
- Zone 4 – Upstream Slope Protection

Zone 4a – Rip - Rap

Zone 4b – Rip - Rap Bedding Layer

- Zone 5 – Downstream Slope Protection with Topsoil for Grass Cover
- Zone 6 – Capping Layer
- Zone 7 – Jet Grouting Diaphragm

2.4.1 Zone 1 – Impermeable Clay Material – Dam Core

i) Material Requirements

The material proposed for the dam core shall provide low permeability (an indicative value of k=10-7 m/s is considered for the design). The material shall contain at least 30% fines (i.e. passing by the 0.074mm sieve) and exhibit a liquid limit LL<65.

ii) Proposed Borrow Areas

All the area that is mapped as fine alluvial deposits is generally suitable for the construction of the impervious core. Borrow areas 1, 2, 3 and 4 are suggested in Appendix I (Drawing GEO-1 of Geological & Geotechnical Investigations Report). According to the same report, available quantities are sufficient for the construction.

2.4.2 Zone 2 – Filters

2.4.2.1 Fine Graded Filter Material (Zone 2A)

i) Material Requirements

The filter zone placed next to the core is the most important zone because it protects the core from internal erosion. The filters must be composed of very strong particles with high resistance to erosion.

They must have the following minimum properties:

- Resistance in abrasion (Los Angeles test) <40%
- Soundness (Sodium sulphate method) < 15%
- Unconfined compressive strength for parent rock (in crushed filters) >60 Mpa

Filter material after compactions shall be evenly graded between the limits set below:

No more than 5% shall pass the No200 size sieve. The grain size distribution was designed following the guidelines provided from the "United States Department of Agriculture (USDA) – National Engineering Handbook, Part 633 – Gradation Design of Sand and Gravel Filters – Chapter 26". These guidelines represent the international current state of the art in the design of filters that prevent internal erosion of the core.

2.4.2.2 Coarse Graded Filter Material (Zone 2B)

The coarse filter of Zone 2B is placed next to the fine filter (Zone 2A) in order to ensure its adequate drainage and to protect it from losing particles into the shoulders and drains.

i) Material Requirements

The filters must be composed of very strong particles with high resistance to erosion.

They must have the following minimum properties:

- Resistance in abrasion (Los Angeles test) <40%
- Soundness (Sodium sulphate method) < 15%

- Unconfined compressive strength for parent rock (in crushed filters) >60 Mpa

2.4.3 Zone 3 – Shoulders from Random Materials

i) Requirements

Strong materials will be preferred for the construction of the shoulders, but weaker materials can also be incorporated. The design allows for the incorporation of a variety of excavation or borrow areas materials, providing that they are free of high organic content and of very soft clays/silts. Fine sands can also be used, provided they are mixed with other materials. Moisture content of Zone 3 shall be in the range of CM3 to CM3+5% at the time of compaction. Coarse and more permeable material shall be placed in the outer layers of the shoulder zones.

ii) Proposed Borrow Areas

The bulk of the shoulder material will come from Quarry Areas 5 & 6. Other sources for materials should also be considered. It is expected that available quantities are sufficient for the construction of Zone 3.

2.4.4 Zone 4 – Upstream Slope Protection

The primary purpose of the rip rap of the embankment is to prevent erosion and damage from wave action. Strong competent rocks with high resistance to weathering will be used. The required thickness and the gradation of the rip-rap Zone 4A is determined by the height of the waves generated in the reservoir. As described in the Draft Feasibility Report, the design wave height is 0.85m.

2.4.5 Zone 5 – Downstream Slope Protection with Topsoil

Topsoil from the stripping of the foundation for the dam and the borrow areas will be used after temporary stockpiling.

2.4.6 Zone 6 - Embankment Crest Road & Capping Layer

The embankment crest road shall be constructed as follows:

a) Sub-base

The sub-base will comprise hard graded approved stone rolled to compacted thickness of 225mm. The sub-base material shall conform to the following:

- 100% per weight passing 40mm sieve
- 75%-85% per weight passing 20mm sieve
- 40%-50% per weight passing 6mm sieve

b) Road Base

The road base (thickness 150mm) shall comprise reasonable graded gravel or crushed stone of maximum size 20mm

c) Surface Dressing

Surface dressing will be designed according to Specifications.

2.5 Material Sites

Within a distance of about 1.5km upstream of the dam site, six borrow and quarry areas are proposed for the dam construction, and they are shown in the geological map (Appendix I) of the reservoir (Drawing GEO-1 of Geotechincal & Geological Report). All material needs for the construction of the dam are expected to be covered by these areas. A surplus of similar materials also exists in the rest of the reservoir. In addition, similar materials (mainly alluvial deposits and rock of poor quality) will be developed from the excavations for the spillway and dam foundation. It is envisaged that material sites will be approved by the National Environment Management Authority (NEMA) as per the regulations. Similarly, waste disposal areas will be identified and approved by the contractor and/ or proponent as will be advised by the Kwale NEMA and County government before construction.

2.5.1 Borrow Areas 1, 2, 3 and 4

Position: Valley floor, upstream of the dam site.

Type and volume of material: Fine-grained alluvial deposits (EGU-1), suitable for dam core and earth fill construction. According to the implemented investigations (trial pits), shown in Drawing GEO-1 of Geotechincal & Geological Report (Appendix I), the areas enclosed in limits of the borrow areas are expected to contain a thickness of (at least) 5m of suitable material for the construction of an impermeable core. They consist mainly of sandy silts and clays. Taking into

account conservatively 3m of exploitation in these areas (due to topsoil, excavation methods, groundwater level, possible areas of impure material due to organics or sand, etc.) the estimated volumes will be as follows (Table 1):

Table 1: Borrow Areas and Estimated Available Volumes for Clay Core and Earthfill

Borrow Area	Area (m^2)	Volume for 3m of exploitation (m^3)
1	224,000	670,000
2	146,000	440,000
3	135,000	405,000
4	48,000	144,000
Total	**553,000**	**1,659,000**

(Source: CWWDA, Dam Design Report 2021)

2.5.2 Quarry Area 6

Position: Hill at the boundary of the reservoir, 600m upstream from the dam site.

Type and volume of material: Sandstones (and eluvial mantle), suitable after testing and processing for:

- Rubble fill shoulders
- Dam filters
- Slope Protection
- Concrete aggregates

The hill is structured by sandstones. Taking into account borehole M11, the quality of the sandstone in this hill is probably lower than in Quarry 4. The upper 5 to 7m from the ground surface were found of varying quality and are considered at this stage suitable mainly for the construction of Rubble fill shoulders. Below that depth (5-7m) the quality of the sandstone increases and are probably suitable for the additional purposes. The estimated volumes for Quarries 5 and 6 are indicatively presented in Table 2 below.

N.B. The Borrow and Quarry areas will be subjected to a separate EIA and licensed by NEMA.

Table 2: Quarry Areas and Estimated Available Volumes per Purpose

Quarry Area	Area m^2	Total Volume m^3	Estimated Volume for Rumble Fill mainly m^3	Estimated volume for all purposes m^3
5	275,000	1,600,000	640,000(~40%)	960,000(~60%)
6	80,000	400,000	280,000(~70%)	120,000(~30%)
Total	**355,000**	**2,000,000**	**920,000**	**1,080,000**

(Source: CWWDA, Dam Design Report 2021)

2.6 Stability Analysis

The stability of the upstream and downstream slopes was assessed using the software Slide Ver. 5.044, which is available from RocScience. The software has the ability to calculate the factor of safety for circular and non-circular failure surfaces, using various limit equilibrium methods (methods of BISHOP, JANBU, SPENCER, etc.), always in the context of the method of slices.

Both static and seismic conditions were analysed, using the Spencer method (1967) for circular failure surfaces, according to USBR Design Standards No. 13, chapter 4. The status of the water was simulated considering appropriate water levels and in accordance with the seepage analyses. An acceleration factor was applied for the seismic design. For the Operating Basis Earthquake (OBE) scenario presented in the GBR, the acceleration coefficients considered for the seismic design were horizontal ah=0,045g and vertical av=0,0225g.

For the Safety Evaluation Earthquake (SEE) scenario presented in the GBR, the acceleration coefficients considered for the seismic design are horizontal ah=0,10g and vertical: av=0,05g. Material properties used for the analysis are the ones presented in the Geological & Geotechnical Investigations Report (Appendix I). According to Design Criteria Report, the minimum acceptable factors of safety for Makamini Dam are shown in Table 3 below.

Table 3: Minimum Acceptable Dam Safety Factors

Type of Analysis	Static Loading Conditions	Seismic Loading Conditions OBE/SEE (*)
End of Construction	1.25	1.05/1.0
Full Reservoir	1.4	1.05/1.0
Rapid Drawdown	1.30	n.a

(Source: CWWDA, Dam Design Report 2021)

2.7 Dam Foundation

According to the Ground Investigation, in the foundation area the following formations were encountered:

1) Fine-grained Alluvial Deposits (EGU-1)
2) Coarse-grained Alluvial, Eluvial and Colluvial Deposits Deposits (EGU-2)
3) Siltstone Deposits (EGU-3)

The foundation of the dam core will be carried out following the removal of the top 2m. The foundation of the shoulders will be carried out following the removal of the top 1m.

2.7.1 Dam Water Tightness

Given the permeability characteristics of the dam foundation materials, if no measures are taken towards the restriction of the water flow, the total water losses could be unacceptably high. At the same time, high hydraulic gradients could lead to internal erosion of the dam foundation. In order to reduce the total water losses and limit the hydraulic gradient under the dam, water tightness measures are required. More specifically, Jet Grouting Diaphragm will be constructed under the core foundation. The Jet Grouting Diaphragm width will be 0.80m. The Jet Grouting Diaphragm will be 11m long in total. Finally, the tip of the diaphragm will be placed at 1m above dam core foundation.

3.0 BASELINE INFORMATION

3.1 General overview

The study limits of this project, with respect to the main components of the project and radial distances of its environmental impact, comprises of:

- Makamini dam catchment area and its surrounding, and
- Proposed area for Water Treatment Plant (WTP).

In these limits, the physical, biological and economic environments were surveyed in the view of understanding the general characteristics of the project area. The area of dam basin is about 277.8 Km^2. With respect to the intensity and radial distances of the impacts arising from the implementation of the project, the study area can be divided into 3 parts as follows:

Immediate Limits

- Dam site,
- Dam reservoir and the surrounding population,
- Route of Conveyance line,
- Dam access road, and
- Borrow material areas.

Direct Impact Limits

- Immediate basin of dam reservoir with population centres located in this area,
- Rivers Mulunguni and Vigurungani and its fringes on upstream and downstream of the, dam including the confluence of the two rivers,
- Makamini residents, being the nearest market centre to dam site.

Direct Impact Limits

- Catchment areas of the rivers

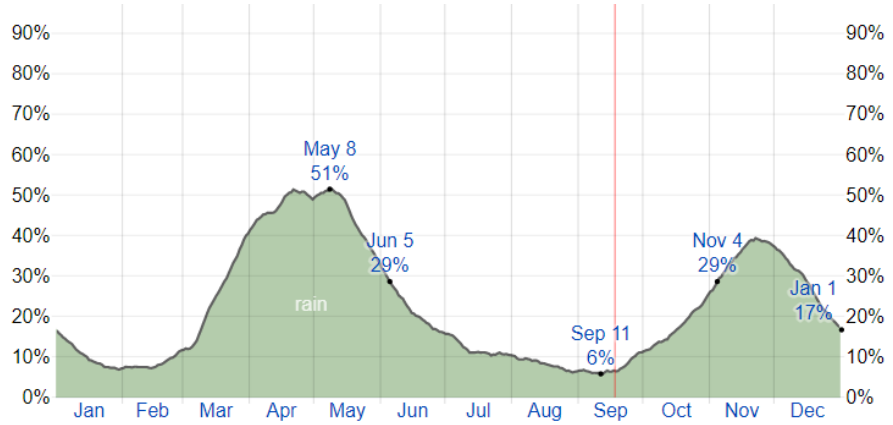
3.2 Climatic Conditions

3.2.1 Average Temperature in Kinango

The hot season lasts for 2.9 months, from January 4 to April 1, with an average daily high temperature above 90°F. The hottest day of the year is March 4, with an average high of 92°F and low of 74°F. The cool season lasts for 3.5 months, from May 27 to September 13, with an average daily high temperature below 83°F. The coldest day of the year is July 22, with an average low of 67°F and high of 81°F.

3.2.2 Precipitation

A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Kinango varies significantly throughout the year. The wetter season lasts 7.0 months, from November 4 to June 5, with a greater than 29% chance of a given day being a wet day. The chance of a wet day peaks at 51% on May 8. The drier season lasts 5.0 months, from June 5 to November 4. The smallest chance of a wet day is 6% on September 11. Among wet days, we distinguish between those that experience rain alone, snow alone, or a mixture of the two. Based on this categorization, the most common form of precipitation throughout the year is rain alone, with a peak probability of 51% on May 8. This is as illustrated in Figure 1.



The percentage of days in which various types of precipitation are observed, excluding trace quantities: rain alone, snow alone, and mixed (both rain and snow fell in the same day).

Figure 1: Daily Chance of Precipitation in Kinango Sub-county

3.2.3 Humidity

Humidity levels are based on comfort level on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. Lower dew points feel drier and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically followed by a muggy night.

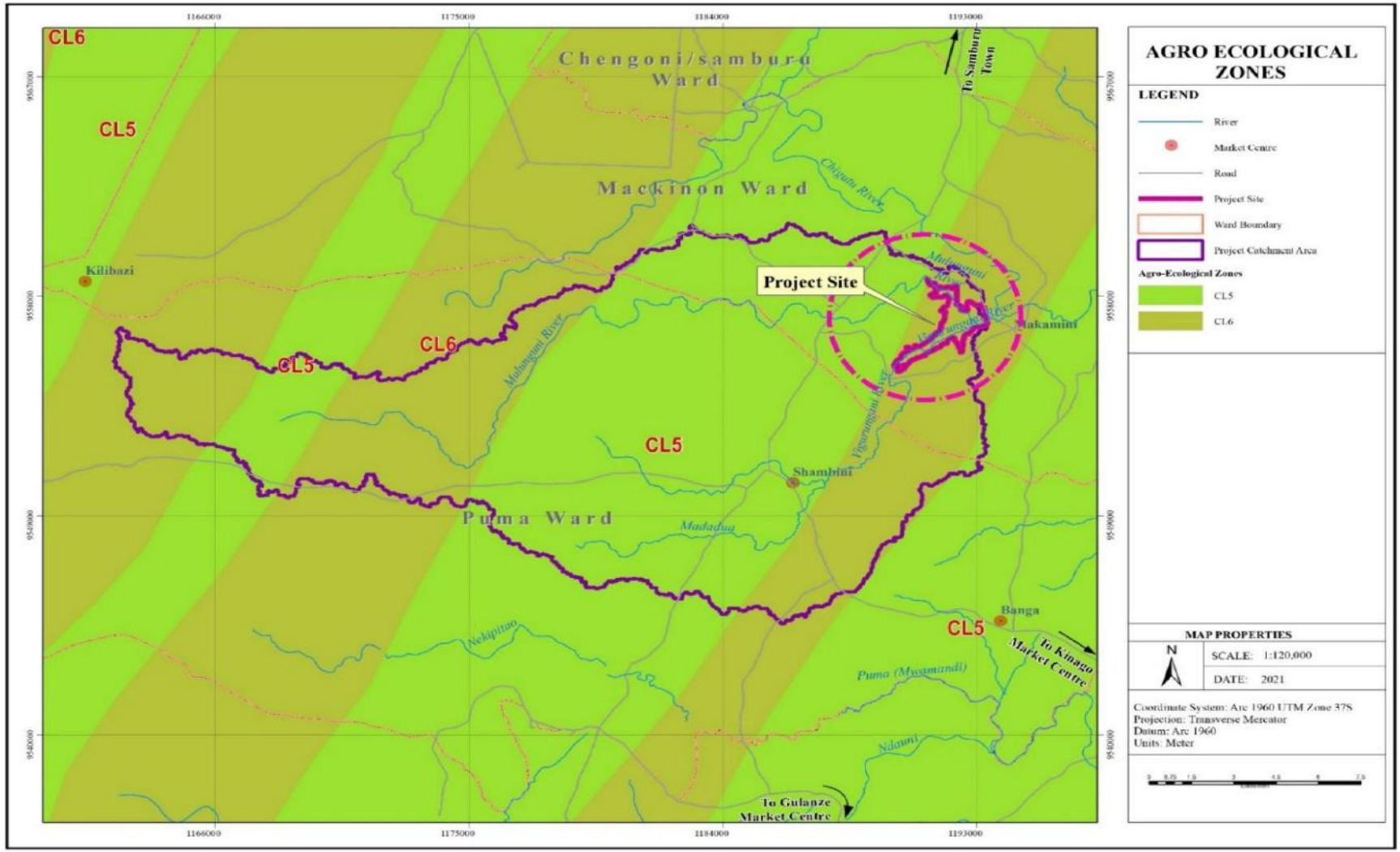
Kinango experiences some seasonal variation in the perceived humidity. The muggier period of the year lasts for 10 months, from September 2 to July 5, during which time the comfort level is muggy, oppressive, or miserable at least 86% of the time. The muggiest day of the year is November 28, with muggy conditions 100% of the time. The least muggy day of the year is August 8, with muggy conditions 81% of the time.

3.3 Agro-ecological Zone

The catchment area lies within agro-ecological zones of Coastal Lowland (CL) 5 and 6. These are zones which are adaptable and suitable for various agricultural activities. Coastal Lowland 5 is suitable for the growth of millet and keeping of livestock while Coastal Lowland 6 is mainly suitable for ranching activities. However, with the construction of the Makamini dam reservoir, it is expected that the farmers will be able to grow a range of crops for both subsistence and commercial purposes. Table 4 below highlights the two agro-ecological zones within the project area while Map 3 below illustrates the zones in the context of the natural setting.

Table 4: Agro-ecological zones with suitable agricultural activities

No.	Agro-Ecological Zone	Suitable Crop and Activities
1.	Coastal Lowland (CL) 5	Livestock-Millet
2.	Coastal Lowland (CL) 6	Ranching Zone



Map 3: Agro-ecological Zones within the project area

(Source: Farm Management Handbook, 2009)

3.4 Water Resources and Water Supply

3.4.1 Surface Water Sources

The project area is not endowed with surface water sources as almost all the streams and rivers are seasonal including the target River Mwache and are characterized with flush floods, normally influenced from the highlands, including Taita Hills, Mambesheni hills and Pemba hills, among others. The flush floods discharge into the sea since there is minimal storage save for limited pools along the riverbed with little benefits to the residents. The local surface area may not be suitable to trap storm water in any quantified forms due to topographical and geographical conditions.

3.4.2 Groundwater

Groundwater in the area has not been exploited to any significant levels either due to high costs involved and potentially undesirable quality associated with the seawater intrusion. This aspect has, therefore, not been discussed in detail under this report and even in the feasibility study process.

3.4.3 Rainwater

The project area of Makamini as well as the larger Kinango sub-county are generally limited in regard to the precipitation levels. While there are no initiatives to trap rainwater in the area, the construction of the dam and water treatment plant is expected to provide a significant opportunity for water supply sustainability. However, investment in rainwater harvesting has not been fully exploited and is mainly practised by institutions such as schools and health facilities. This is perhaps an important component to be integrated into the proposed project as a back-up measure towards drinking water sustainability.

3.4.4 Water supply

The project area is not endowed with adequate surface water sources since all streams and rivers are seasonal. Flash floods originating from the highlands flows into the area during the rains (though the project area also receives limited rainfall). It has not been possible to quantify how much water is effectively drawn from the rivers for social and economic use. The seasonal rivers are characterized with stagnant pools in most sections on which most of the residents relies on for washing, watering livestock and limited farming along the river flood plain. There is no piped water and majority of the residents depend on water pans and the rivers for domestic purposes like drinking, bathing and washing.

Figure 2: Water fetching
(Source: Field Survey, 2021)

3.5 Biodiversity

There are no endangered or endemic species in the project influence area. All animal and plant types found in the area are indigenous spread out in wider areas as the species banks. The specific features observed within the project areas are described below.

3.5.1 Fauna

There are no significant presence of wildlife in the project area. However, there exists a range of fauna within the project area. The most notable animal species include, snakes, birds, squirrels, butterflies, bees, millipedes, among many others.

3.5.2 Flora

Among the vegetation types in the project area are; Baobab (*Adansonia digitata),* Neem tree (*Azadiracta indica)*. *Acacia* Sp, *Ziziphus spina-christi*, C*atatonia silique, Euphorbia lactea,*

Opuntia ficus-indica, Senna siamea, Black Jack (*Bidens pilosa),* Reeds, Grasses/ Sedges, and Forbs, among others

3.6 Geology, Topography and Soils

3.6.1 Mineral Resources

The project area is endowed with limited minerals' deposits though not significantly exploited owing to the low economic deposits but appropriate investigation, however, is yet to be carried out. Makamini area where the dam is proposed for location is heavily endowed with the Triassic rocks (Duruma Sandstones), particularly, the Mazeras sandstone slabs which the local residents extract for commercial purposes. The mazeras are commonly used for construction activities. The figure 3 below shows some of the geological formation adjacent to the proposed site.

Figure 3: Typical Geological Formations at the Dam Site
(Source: Field Survey, 2021)

3.6.2 Topography (Slope analysis)

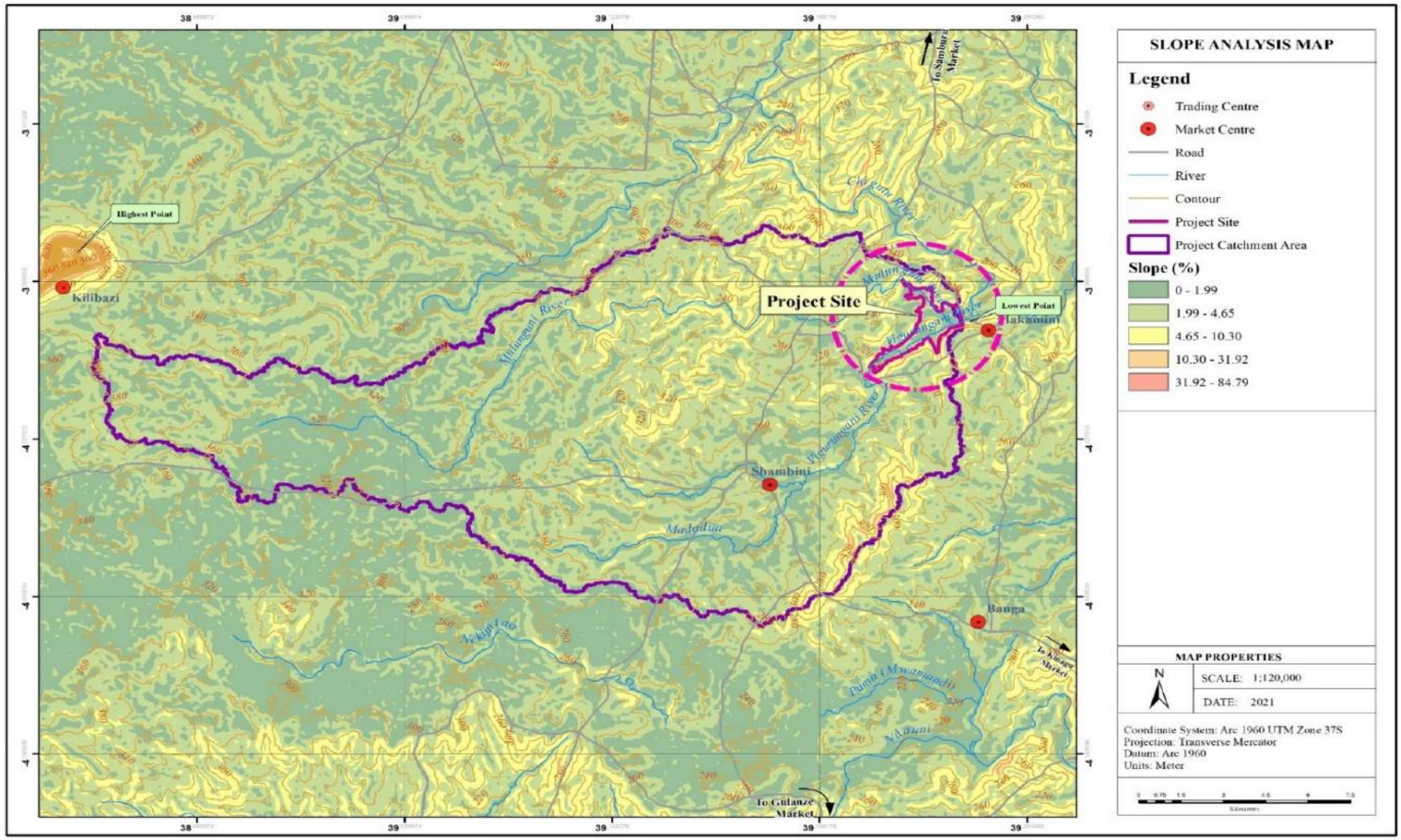
The dam's reservoir area has a slope that ranges between 0-1.99percent as indicated in the map below. Therefore, according to the classification in the table below, any slope between 0-2% is usually characterized as generally flat with insignificant denudation process. On the other hand, the catchment area has a slope design that ranges from 0-10.3%. Hence, this area can be described to be ranging from; gentle, low speed ground motion to a gentler, low speed ground motion with a slightly higher magnitude. The catchment area as a whole is thus susceptible to both sheet and rill erosion. Kilibazi as indicated in the map is the highest point with a varying of steepness between 10.3 to 31.92%. The section with 31.92% can be described to be steep, with intensive denudation process and ground movements which are considered to be a common occurrence.

However, of note is that Kalibazi is not within the catchment area. The slope description of the project area is as indicated in Table 5 and Map 4.

Table 5: Slope Class and its description

Slope Class	Slope Class Nature, Process and Natural Conditions
0-2%	Flat to almost flat, no meaningful denudation process
2-7%	Gentle, low-speed ground motion, soil erosion (sheet & rill erosion), erosion swamps.
7-15%	More Gentle, the same as above, but with a higher magnitude.
15-30%	Slightly steep, a lot of ground movement and erosion, especially landslides that are flat.
30-70%)	Steep, intensive denudation processes and ground movements are common.
(70-140%)	Very steep, rocks generally begin to unfold, a very intensive denudational process, have begun to produce rework material.
>140%	Very steep, exposed rocks, a very strong denudational process and prone to falling rocks, rarely grown plants (limited)

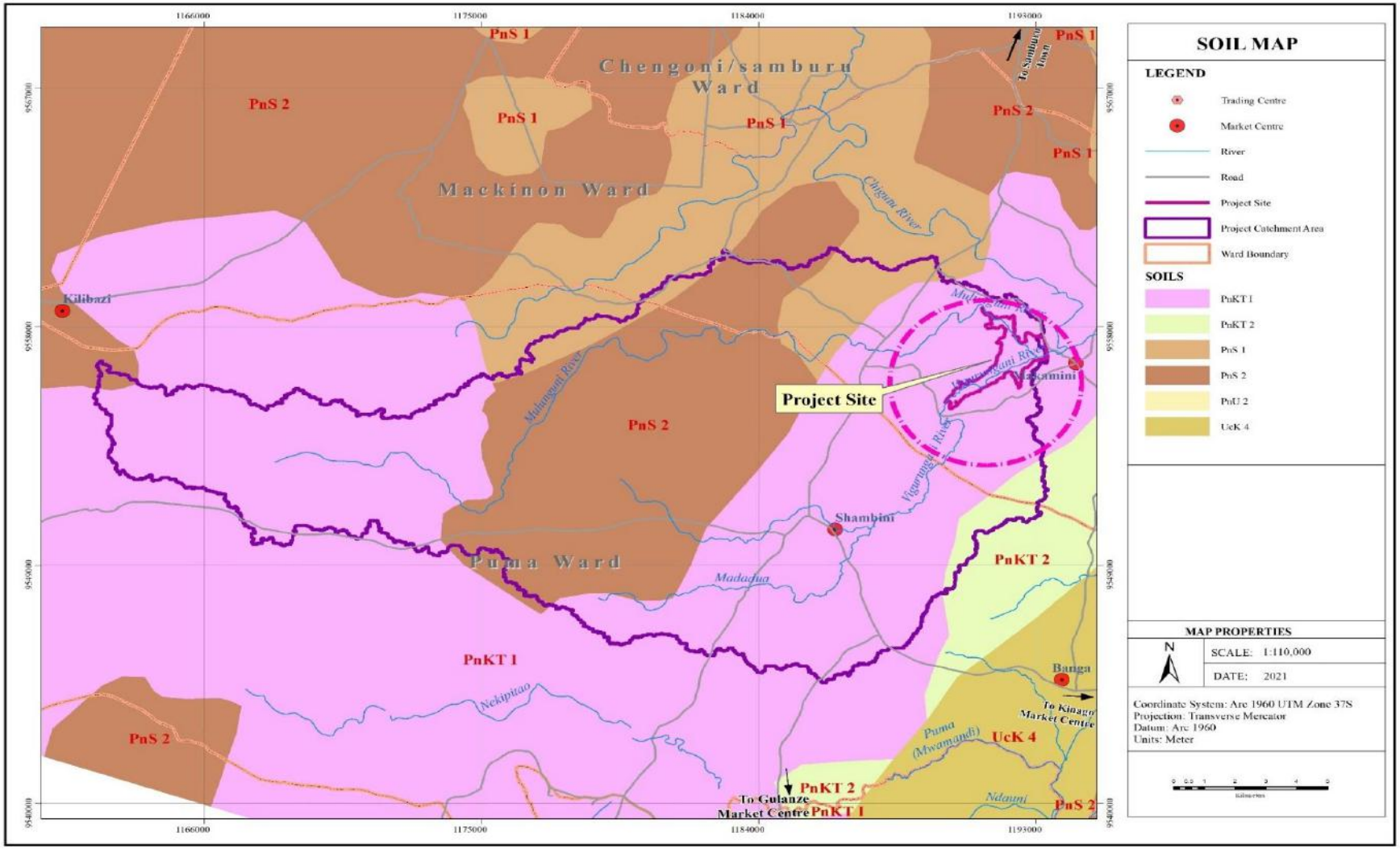
(Source: Van Zuidam, 1973)



Map 4: Slope Analysis for Makamini Catchment Area

3.6.3 Soils

Generally, soil types have a strong correlation with the geology and topography of the region and differ widely in depth, texture, physical and chemical properties with variations running parallel to the coastal line due to sedimentation process. The significance of this geological and soil characteristics is the porosity associated with the sedimentary type of soils. Infiltration to the groundwater aquifers of polluting substances from the ground surface is also highly likely. There are two types of soils which are dominant within the entire catchment area. These are PnS2 and PnKT soils (the most expansive in the catchment area). PnS2 are considered to be well drained, deep brown to dark brown, firm, sandy clay loam to clay with a topsoil of loamy sand to sandy loam. They are commonly referred to as Orthic LUVISOLS with orthic ACRISOLS. PnKT are also known as Eutric CAMBISOLS, lithic phase with LITHOSOLS. This type of soil is characterized by being well-drained, shallow, dark reddish brown to very dark brown, firm, sandy clay loam to clay. Map 5 below shows the distribution of the two types of soils within the project area.



Map 5: Soil Map for the Project Area

3.7 Socio-Economic Activities

3.7.1. Demographics

The population of the Makamini area is predominantly rural in character and the main economic activity of the area is subsistence farming. Makamini Location has four sub-locations which are; Chigutu, Makamini, Dzivani& Vinyunduni. According to the 2019 Population and Housing Census Report (KNBS), Makamini location had a population of 14,358 comprising of 2,169 households. Makamini location is an administrative unit of Samburu Division within Kinango Sub County where the proposed Dam Project falls. The administrative setting of Makamini location and population distribution is shown below.

Table 6: Administrative setting and population distribution

Sub-location	Population (2019)	Area (Sq. Km)	Density/PP (sq.km)	No. of Households
Chigutu	4,053	66	61	649
Makamini	1,906	76	26	309
Dzivani	4,592	62	74	707
Vinyunduni	3,807	120.9	31	504
Total	14,358	324.9	44	2,169

(Source: 2019 Kenya Population and Housing Census Report, Vol II)

3.7.2 Land ownership and land use

The land ownership in the project area is being addressed in detail under the RAP process on a separate report. Observations shows that land in the area is not registered to individual ownership. Land use is subsistence farming with very low land productivity value. Family homestead clusters are generally distributed on all sides of the dam site creating a significant interaction and potential conflict with the dam components.

3.7.3 Economic livelihood activities

The Makamini dam project is located within Makamini sub-location. The access road to the dam traverses through Makamini market centre where the local residents are engaged in various economic activities to support their livelihoods. Most of the businesses can be categorised as

informal in nature and include non-farm economic activities, such as, *boda boda* (motor bikes) operations, small-scale retail shops, quarry activities e.g. crushing stones and collecting sand from the river, selling of traditional brooms, firewood and vegetables. Figure 4 below indicates some business structures at the centre.

Figure 4: Informal business within Makamini trading centre
(Source: Field Survey, 2021)

3.7.4 Education

The project area is served by various educational institutions which are critical in boosting the literacy levels of the population of Makamini. These institutions include ECDE, primary and secondary schools. The following primary schools are within the project area; Makamini Primary school, Bumburi Primary school, Kituu Primary school, Kajiweni Primary school, Maiyini Primary school, Mulunguni Primary school, Chigutu Primary school, Mdomo Primary school, Vinyunduni Primary school, Sakake Primary school and Dzisuhuni Primary school. Makamini secondary school is the only secondary school within the project area, and there is no tertiary college in the area. It was pointed out that children from poor families were likely to repeat a grade, be expelled or suspended from school or drop out of high school due to financial problems. Marriage at young age and premature pregnancies are also indicators of poor school enrolment levels. Figure 5 and 6 below show Makamini Primary school and Makamini ECDE centre, respectively.

Figure 5: Makamini Primary School
(Source: Field Survey, 2021)

Figure 6: Makamini ECDE Centre
(Source: Field Survey, 2021)

3.7.5 Health

i) Health facilities

The project area has two notable health facilities that offer treatment services to its population. These include; Makamini Dispensary (Figure 7) and Vinyunduni Health Centre. Makamini dispensary has a maternity wing where maternal health is offered. This wing is instrumental in providing a safe and accessible service for local women, their babies and families. It further helps in planning pregnancies, through pregnancy duration and subsequent labour as well as during post-natal period.

Figure 7: Makamini Dispensary within the project area
(Source: Field Survey, 2021)

ii) Sanitation and hygiene

The project area can generally be termed to have poor sanitation. Makamini Location has a total population of 12, 050 persons with a total number of 1644 households (KNBS, 2019). In addition, the entire project area has only 205 latrines (Kwale County Public Health, 2021). The absolute poverty of the people in the area has had a direct link to lack of basic sanitation facilities. Without improved sanitation, people continue to suffer from ill health, lost incomes, inconveniences and indignity. Lack of access to improved sanitation facilities has forced the community to resort to open defecation or other unsanitary forms of defecation. Most of the homesteads interviewed lacked sanitation facilities and therefore admitted to practising open defecation which is regarded to be a serious public health issue. Open defecation is mostly done in the bushed and cultivated land as well as in deep valleys including the river beds. This is a very alarming concern in the region which requires address in order to promote human dignity and safeguard both surface and underground water from possible effects of contamination. The outcome of this practice presents substantial adverse public health risks as the waste could contaminate drinking water in the river and cause life-threatening forms of diarrhea and other water borne related diseases or direct infection, especially to children. Figure 8 below shows a dilapidated pit latrine in the area.

Figure 8: A dilapidated Pit-latrine within Makamini Trading Centre
(Source: Field Survey, 2021)

3.7.6 Road Network

The project site is accessible through the Mulunguni-Makamini road which can be classified as an earth/gravel road (Figure 9). Construction machinery and project vehicles are bound to use this route during implementation. Due to the unpaved nature of the access route, it is expected that its condition may deteriorate owing to the heavy Lorries carrying materials into and out of the project site. In addition, the route is likely to be a possible cause of air pollution as a result of high dust levels expected once the construction activities commence.

Figure 9: Condition of the access road leading to the project site
(Source: Field Survey, 2021)

3.7.7 Electrical Connectivity

The project area is not vastly supplied to the national grid. Notable connections are evident within the market centre as well as in educational and health facilities (Figure 10). Majority of the homes lack electrical connectivity thus making the population to rely on alternative sources of energy.

Figure 10: Electrical connectivity within the Makamini trading centre
(Source: Field Survey, 2021)

3.7.8 Poverty and Income Levels

The Makamini Dam is located in Makamini Location, which is one of the poorest areas, in Kinango sub-county, of Kwale County, Kenya. The area is classified as rangeland and is less productive agriculturally but has potential for ranching and general livestock husbandry. According to the 2019 Population and Housing Census Report, it has a total population of 296,455 people with a poverty index of 84.5%. Most of Kinango land mass is semi-arid. Although smallholder farming is indisputably the primary occupation and source of income and subsistence for the majority of the population in the project area, non-farm livelihood and income generating activities play a role in the local economy and in the livelihoods of households in the project area. These include activities such as small-scale trade and the collection and sale of firewood, daily wage labour, amongst other.

Overall, incomes are very low and poverty is widespread and deep in many parts of the project area. This is due to a combination of factors and causes such as; (i) Low and dwindling resource base (land productivity, water resources, livestock, etc.); (ii) Low productivity and the subsistence nature of production; (iv) Limited access to public services and amenities; and (v) Exposure to shocks and vulnerability (drought, human and livestock disease).

3.7.9 Housing Typology

The housing structures within the project area resemble typical rural homesteads. There are both permanent and semi-permanent housing structures within the project area. Most of the permanent structures are largely within Makamini trading centre. These housing structures are constructed using stones for the walls and iron sheets for roofing. On the other hand, the semi-permanent housing structures are mainly found within residential settlements and are built using mud for the walls and grass as the most common roofing material. Figure 11 and 12 below demonstrate the housing typology in the project area.

Figure 11: Permanent structure within Makamini trading centre
(Source: Field Survey, 2021)

Figure 12: Semi-permanent housing structures within Makamini sub-location
(Source: Field Survey, 2021)

3.7.10 Communication Infrastructure

Mobile phones reception and coverage is good as there are mobile phones communication satellites boosters. The project area supports both Safaricom and Airtel communication although with varying signal strengths. Safaricom network signal is largely stronger than Airtel owing to the good network coverage boosted by availability of Base transceiver stations within the area. Makamini trading centre hosts one telecommunication mast as shown in the figure 13 below;

Figure 13: Base Transceiver Station at Makamini Trading Centre
(Source: Field Survey, 2021)

3.7.11. Energy sources

Access to affordable energy alternatives is limited by the intense poverty in the area. This has contributed to high level of direct reliance on wood fuel as source of energy. The main energy sources include;

i. Firewood/charcoal is the most common sources of energy, though with potential serious implications to the environment
ii. Electricity poorly served to the low-income areas and is limited to institutional premises and the market area
iii. Fuel normally applied for lighting (kerosene) and diesel for running posho mills and water pumps as well as power generators at selected household levels
iv. Solar with very limited use.

3.7.12 Agriculture and Livestock Production

Erratic and unreliable rainfall has destroyed the community's productive bases in agriculture giving rise to food shortages, leading to hunger and malnutrition. There are different farming systems which are influenced by agro-climatic and socio-economic constraints, and these include vegetable-based mixed farming systems and retreat flood cultivation in the river banks and basins. Maize is the major food crop that is cultivated in the location. Other crops grown in the area include, cereals (beans, cow peas, pigeon peas, and green grams), cassava, watermelon, *sukuma wiki* (Kales), tomato and groundnuts. Given the scarcity of grazing land, lack of water and extreme levels of poverty, few households currently keep large numbers of livestock. Common livestock in the area include, cattle, goats and poultry.

3.8 Environmental Degradation

3.8.1 Deforestation

The project area can be regarded as an arid and semi-arid (ASAL) region. Despite the presence of scanty vegetation, the local residents are still engaging in destructive activities of charcoal burning (Figure 14). This activity highly degrades the environment and exposes the land to agents of erosion especially if no efforts are made to replace the lost vegetation cover. In addition, the population depends on firewood as a major source of energy, and this further continues to deplete the few available trees within Makamini and its environs.

Figure 14: Charcoal burning activity within the project area
(Source: Field Survey, 2021)

3.8.2 Solid Waste Disposal

The community within the project area has no waste disposal facilities. The households usually practise the open dumping and burning of waste as the only way of managing domestic waste. This leads to air pollution and impacts on climate change as a result of the generated smoke (soot) emanating from the burning of waste substances. Besides, this practice leading to environmental degradation, may increase the risk of heart diseases, aggravate respiratory ailments such as asthma and emphysema that can cause rashes, nausea or headaches, and damage to the nervous system.

4.0 POLICY, LEGAL AND REGULATORY FRAMEWORK

4.1 General Overview

Environmental Impact Assessment (EIA) is a tool for ensuring new projects and programmes incorporate appropriate measures to mitigate adverse impacts to the environment and peoples' health and safety as well as enhancing sustainable operations with respect to environmental resources and co-existence with other socio-economic activities in their neighbourhood. Necessary policies and legislation that ensures annual environmental audits (EA) are carried out on every running project, activity or programme and a report submitted to National Environmental Management Authority (NEMA) for approval and issuance of relevant certificates.

According to the Kenya National Environment Action Plan (NEAP, 1994), the Government recognized the negative impacts on ecosystems emanating from industrial, economic and social development programmes that disregarded environmental sustainability. Following on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished and/or are in the process of development. The NEAP process introduced environmental assessments in the country with among the key stakeholders being industrialists, business community and local authorities. This culminated into the enactment of the Policy on Environment and Development under the Sessional Paper No. 6 of 1999.

4.2 National Policy Framework

4.2.1 National Environment Policy, 2013

This policy aims to protect the environment. Section 5.6 on Infrastructural Development and Environment, 5.6.1 states that infrastructural development includes among others buildings, roads, ports, railways, ICT, pipelines, irrigation systems, airports and electricity transmission. This section also emphasizes that the environment aspects of such infrastructural developments are distinct and unique such as effects on flora and fauna, social and psychological disruption, vegetation clearance, excavation works and spillages during construction. This policy states that the government will:

- Ensure Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), Social Impact Assessment (SIA) and public participation in the planning and approval of infrastructural projects.
- Develop and implement environmentally friendly national infrastructural development strategy and action plan.
- Ensure that periodic Environmental Audits are carried out for all infrastructural projects.
- Integrated National Transport Policy.

This is a national policy which aims to develop, operate and maintain an efficient, cost effective, safe, secure and integrated transport system that links the transport policy with other sectoral policies, in order to achieve national and international development objectives in a socially, economically and environmentally sustainable manner.

Relevance

This policy offers the framework for an integrated approach to planning and sustainable management of natural resources. It also recognises the various vulnerable ecosystems and further recommends various policy measures in order to protect the quality of the environment.

4.2.2 Land Policy (2009)

Environmental management principles: To restore the environmental integrity the government shall introduce incentives and encourage use of technology and scientific methods for soil conservation. Fragile ecosystems shall be managed and protected by developing a comprehensive land use policy bearing in mind the needs of the surrounding communities. The sustainable management of land based natural resources depends largely on the governance system that defines the relationships between people, and between people and resources.

Relevance

To achieve an integrated approach to management of land based natural resources, this policy together with other regulations and laws dealing with these resources shall be harmonized with the framework established by the Environmental Management and Coordination Act ,1999 (Amended 2015).

4.2.3 Kenya National Gender and Development Policy (2000)

The overall objective of the policy is to facilitate the mainstreaming of the needs and concerns of both men and women in national development. The Gender and Development Policy provides a framework for advancement of women's interests in resource allocation and utilization to ensure greater efficiency. The Policy echoes the government's commitment to implementing the National Plan of Action which is anchored on the Beijing resolutions.

The following are the areas targeted by the policy: Equality before the law-for Kenyan men and women as provided for in the Constitution and under the obligations of the Kenyan State in international law; Equal access to economic and employment opportunities- for both men and women in Kenya; Reducing gender disparity in political participation and decision-making; Sustainable Livelihoods - to remove obstacles to women's access to and control of productive assets, economic opportunities, and environmental resources; Education and Training - to enhance and sustain measures to eliminate gender disparities in access, retention, transition and performance in education for both boys and girls; To achieve the highest attainable standard of health for both men and women by addressing gender disparities pertaining to access and use of basic health services and facilities; To increase the participation of women in the media and communications sector and promote gender sensitive portrayal of both men and women in the media; Empowering both men and women to be equal partners in development for an affirmative action to address gender disparities. With regard to the environment, the policy advocates for programmes that take into consideration issues that concern women, men, girls and boys. The policy acknowledges that certain environmental issues have specific relevance to women.

Relevance

Most job openings in the proposed construction project are likely to be more suitable for men due to the nature of the works involving operating heavy machinery and equipment, tasks requiring working at heights and being absent from home for long hours. Social norms restrict women's sphere of activity, but they are also likely to benefit if the contractor employs a quota system that would oversee a certain number of women given employment. Women may also benefit from the influx of people in the area by engaging in small income generating activities.

4.2.4 Kenya National HIV/AIDS Strategic Plan, 2006-2010

The overarching theme of the strategic plan is social change to reduce poverty and HIV/AIDS. The goal of the plan is to reduce the spread of the HIV virus, improve the quality of life of the affected persons and mitigate its socio-economic impact at the individual, community, sector and national levels. The priority areas for the HIV/AIDS Strategic Plan are:

- Prevention of new infections- the objective of this priority area is to reduce the number of new HIV infections among both vulnerable groups and the general population.
- Improving the quality of life of people infected and affected by HIV/AIDS- the objective of this priority area is to improve the treatment and care, protection of rights and access to effective services for infected and affected people by HIV/AIDS in Kenya.
- Mitigation of socio-economic impact- the objective of this priority area is to adapt existing programmes and develop innovative responses to reduce the impact of the epidemic on communities, social services and economic productivity.

Relevance

The proponent recognizes that construction activities influence social behaviour in a manner that may perpetuate the spread of HIV/AIDs. Budgetary allocation should be made to complement sensitization and management efforts of agencies dealing with HIV/AIDs issues in the project area.

4.2.5 National Climate Change Action Plan 2013-2017

It is widely recognized that climate change is happening and that its effects can be devastating. The Government of Kenya developed the National Climate Change Action Plan to help in tackling the effects of climate change. The Action Plan equips the country to take decisive action in responding to the challenges of climate change by encouraging people-centred development that ensures that climate change actions support achievement of national development goals. This Action Plan guides the Country towards a low carbon climate resilient development pathway.

Relevance

The ESIA Study will identify the potential climate change impacts and their mitigation options.

4.2.6 National Climate Change Response Strategy 2010

Globally, climate change is considered one of the most serious threats to sustainable development. Climate change can affect many sectors such as agriculture, health, forestry, wildlife, amongst others, and its impacts can be felt by several generations. The National Climate Change Response Strategy puts in place measures to address the challenges posed by climate change and climate variability. The strategy recommends massive awareness campaigns so that the public can be sensitized and mobilized to adapt and mitigate impacts of climate change.

Relevance

The strategy recognizes the need to enhance coordination of climate change activities in the country with a view of ensuring climate-proof socio-economic development anchored on a low carbon path.

4.2.7 Environment and Development Policy (Sessional Paper No.6 1999)

The goal of this policy is to harmonize environmental and developmental goals so as to ensure sustainability. The paper provides comprehensive guidelines and strategies for government action regarding environment and development. To observe the requirements of this policy, it is recommended that environment friendly practices should be undertaken during project implementation such as; increasing tree cover and using clean energy to reduce deforestation, taking measures to reduce pollutants leading to pollution of both ground and surface water, and rehabilitation of areas of completed works.

Relevance

The proponent will ensure and endeavor to promote the conservation and rehabilitation of the project area and seek to improve the socio-economic conditions of the residents.

4.2.8 National Irrigation and Drainage Development Policy

The policy seeks to stimulate irrigation development through targeted technical support, effective co-ordination of the sector, institutional reforms, and the enactment of a comprehensive legal framework for irrigation development. It intends to guide, coordinate and harmonize sustainable sector development. The policy with its corresponding instruments anchors strategic interventions

and legal safeguards, which in turn support and fast track policy implementation for the growth and sustainability of irrigation, drainage and water storage in Kenya.

Relevance

The policy is important in coordinating all relevant stakeholders within the sector by establishing the requisite reforms and legal structures for enhancement of irrigation activities in the country. Further, water being a key component in promoting irrigation activities, the activities within the sector will be properly guided to achieve sustainable levels of food security.

4.3 National Environmental Legal Framework

Application of national statutes and regulations on environmental conservation suggest that the Proponent has a legal duty and social responsibility to ensure that the proposed development is carried out without compromising the status of the environment, natural resources, public health and safety. This position enhances the importance of this environmental impact assessment for the proposed site to provide a benchmark for its sustainable operation.

Kenya has approximately 77 statutes that relate to environmental concerns. Most of these statutes are sector specific, covering issues such as public health; soil erosion; protected areas; endangered species; water rights and water quality; air quality, noise and vibration; cultural, historical, scientific and archaeological sites; land use; resettlement; etc. Previously, environmental management activities were implemented through a variety of instruments such as policy statements and sectoral laws, and also through permits and licences. For example, the Physical Planning Act of 1996 empowers local authorities to request existing facilities to conduct environmental assessments, while under the Local Government Act of 1998, it is an offence to emit smoke, fumes or dust which may be a source of danger, discomfort or annoyance.

The key national laws that govern the management of environmental resources in the country have been briefly discussed below, although it is important to note that wherever any of the laws contradict each other, the Environmental Management and Co-ordination Act 1999 prevails.

4.3.1 The Constitution of Kenya, 2010

Article 42 of the Constitution states that every person has the right to a clean and healthy environment, which includes the right:

- To have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69; and to have obligations relating to the environment fulfilled under Article 70.
- Article 69(2) states that every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.
- Article 70 (1) states that if a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress in addition to any other legal remedies that are available in respect to the same matter.

Relevance

In an effort to comply with the constitutional requirements, the project Proponent commissioned this ESIA study. The Constitution also requires the proponent to uphold other people's rights and entitlements by putting in place measures to protect the environment throughout the project life (construction; operation and decommissioning phases).

4.3.2. The Environmental Management and Coordination Act 1999 (Amended 2015)

The Act entitles every person in Kenya to a clean and healthy environment and aims to safeguard and enhance the environment. Though there are other sectoral laws on environmental conservation, this is the supreme Act. It provides guidelines on issues of environment, stipulates offences and penalties and establishes NEMA. The Act also lists the types of projects which must be subjected to EIA, and how to conduct a project report study to comply and meet the requirements of this legislation.

Part II of the Environment Management & Coordination Act, 1999 states that every person in Kenya is entitled to a clean and healthy environment and has the duty to safeguard and enhance the environment. In order to partly ensure this is achieved, Part VI of the Act directs that any new

programme, activity or operation should undergo environmental impact assessment and a report prepared for submission to NEMA, who in turn may issue an EIA licence as appropriate.

Part VIII section 72 of the Act prohibits discharging or applying poisonous, toxic, noxious or obstructing matter, radioactive or any other pollutants into aquatic environment. Section 73 require that operators of projects which discharges effluent or other pollutants to submit to NEMA accurate information about the quantity and quality of the effluent. Section 74 demands that all effluent generated from point sources be discharged only into the existing sewerage system upon issuance of prescribed permit from the local authorities or from the licensee. Finally, section 75 requires that parties operating a sewerage system obtain a discharge license from NEMA to discharge any effluent or pollutant into the environment.

Section 87 sub-section 1 states that no person shall discharge or dispose of any wastes, whether generated within or outside Kenya, in such a manner as to cause pollution to the environment or ill health to any person, while section 88 provides for acquiring of a licence for generation, transporting or operating waste disposal facility. According to section 89, any person who, at the commencement of this Act, owns or operates a waste disposal site or plant or generate hazardous waste, shall apply to the NEMA for a licence.

Sections 90 through 100 outlines more regulations on management of hazardous and toxic substances including oils, chemicals and pesticides. Finally, the environmental impact assessment guidelines require that the ESIA study 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.

Relevance

This is the principal Act in safeguarding environmental activities in Kenya. This is the law upon which all other environmental laws are anchored. Therefore, in case of any conflict that may arise from all other written laws regarding the environment, this Act will always prevail. The

legislation also establishes NEMA as the watchdog of all environmental matters in Kenya and this ESIA report will therefore require approval of the authority for the project to commence.

4.3.3 The Factories and Other Place of Work Act (Cap. 154)

The Factories and Other Places of Work Act makes provision for the health, safety and welfare of persons at such workplaces. The Act is predominantly socio-economic in nature and focuses on the shop floor conditions of the factory, safety devices, machine maintenance, safety precautions in case of fire, gas explosions, electrical faults, provisions of protective equipment, among others. In 2004, a subsidiary legislation (legal Notice No.30) was enacted to provide for the formation of Safety Committees by the occupier of every factory or other workplaces. The Committee is responsible for all health and safety issues of enterprises including undertaking safety audits.

Part VI provides for the general welfare of the workers. Part VII section 51 states in part "In every factory or work place in which, in connection with any process carried on, there is given off any dust or fumes or other impurity of such a character and to such an extent as to be likely to be injurious or offensive to the persons employed, or any substantial quantity of dust of any kind, all practicable measures shall be taken to protect the persons employed against inhalation of the dust or fume or other impurity and to prevent it accumulation in any workroom, and in particular, where the nature of the process makes it practicable exhaust appliances shall be provided and maintained as near as possible to the point of origin of the dust or fumes … ".

Section 4 of Kenya subsidiary legislation of 2004, Legal Notice No. 31 of Kenya Gazette Supplement No. 25 of 24th May, 2004 of the Factories Act Cap 514, requires that, all factories or other workplace owners to establish a safety and health committee, which shall consist of safety representatives from the management and the workers. The number of the committee members will range from 3 to 7 depending on the size (number) of employees. The Act also requires the management to appoint a competent person who is a member of the management staff to be responsible for safety, health and welfare in the factory or workplace.

Section 13 goes ahead to state that a health and safety audit of the workplace be carried out every twelve months by a registered Health and Safety Adviser. If the owner(s) or management

contravenes any of the rules, he/she shall be guilty of an offence. Part IV of the Factories Act. Chapter 514 addresses provisions concerning health. These provisions are to be enforced by the Department of Occupational Health and Safety of the Ministry of Labour. Part V of the Factories Act elaborately deals with safety requirements, mainly from the point of view of avoiding accidents and injuries at work.

Noise Prevention and Control Rules: These rules are described in Legal Notice No. 25 of the Kenya Gazette Supplement No. 22 of April 2005 and state the noise regulations that apply to every factory, premises, place, process and operations to which the provisions of the Factories and Other Places of Work Act (Cap 514) applies.

Health and Safety Committee Rules: These rules are described in Legal Notice No.31 of the Kenya Gazette Supplement No.25 of May 14, 2004, and apply to all factories and other workplaces that regularly employ twenty or more employees. Among other items, the rules state that:

- The occupier of every factory or other workplace shall establish a Health and Safety committee. The Committee shall consist of safety representatives from the management and the workers;
- The occupier of every factory or workplace shall cause a health and safety audit of the workplace to be carried out at least once in every period of twelve months by a registered health and safety Adviser;

The above legal notice also describes the functions and duties of the Health and Safety committees, meetings and minutes, and roles in the Committee. It further describes the duties of the occupier and those of the Health and Safety Adviser.

Relevance

This piece of legislation is relevant in ensuring the workplace meets the minimum required standards in regard to health and safety of the workers and their working environment.

4.3.4 The Public Health Act (Cap. 242)

Part IX, section 115 of the Act states that no person or institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires local authorities to take all lawful, necessary and reasonably practicable measures to maintain areas under their jurisdiction clean and sanitary conditions up to standard and to prevent occurrence of nuisance or condition that can expose workers to injury such as may occur at construction work sites. Such nuisance or conditions are defined under section 188 as wastes, sewers drain or refuse pits in such a state, situated or constructed in the opinion of the medical officer of health to be offensive or injurious to health. Other nuisance is noxious matter or waste flowing or discharged from any site into a public street or into the gutter or side channel or nuisance. Additional nuisances are accumulation of materials or refuse which in the opinion of the Medical Officer of Health is likely to harbour rats or other vermin.

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

Relevance

This piece of legislation is relevant in ensuring the workplace meets the minimum required standards in regard to public health.

4.3.5 Water Act (2016)

The Act provides for national monitoring and information systems on water resources. The Act regulates abstraction and storage of water from water courses depressions or channels. Section 25 is on water rights and works and Section 26 on situations where permit not required for certain activities. To formalize the project, the proponent should notify the Water Resources Authority Sub-Regional Office on the project and its components.

Part IX section 115 of the Act states that no person/institution shall cause nuisance or condition liable to be injurious or dangerous to human health. Section 116 requires Local Authorities to take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and

sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 and include nuisances caused by accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbour rats or other vermin.

Relevance

The dam as a water resource has to comply with the provisions of this Act and ensure that no activity undertaken throughout the project cycle may be considered to be posing serious risk to human health. Further, the activities should be governed by WRA regulations.

4.3.6 The Occupational Health and Safety 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 has the following functions among others:

- Secures safety and health for people legally in all workplaces,
- Prevents employment of children in workplaces where their safety and health is at risk,
- Encourages entrepreneurs to set achievable safety targets for their enterprises,
- Promotes reporting of work-place accidents, dangerous occurrences and ill health with a view to finding out their causes and preventing of similar occurrences in future, and
- Promotes creation of a safety culture at workplaces through education and training in occupational safety and health.

4.3.7 The Physical and Land Use Planning Act, 2019

Part II Section 8 provides guidelines on management of public land by National Land Commission (NLC) on behalf of both National and County Governments. This law in Section 8(b) stipulates that the Commission shall evaluate all parcels of public land based on land capability classification, land resources mapping consideration, overall potential for use, and resource evaluation data for land use planning. Section 8(d) stipulates that the Commission may require the land to be used for specified purposes subject to such conditions, covenants, encumbrances or reservations as are specified in the relevant order or other instrument.

In managing public land, the Commission is further required in Section 10(1) to prescribe guidelines for the management of public land by all public agencies, statutory bodies and state corporations in actual occupation or use. In these guidelines, management priorities and operational principles for the management of public land resources for identified uses shall be stated. This in essence means that the Commission shall take appropriate action to maintain public land that has endangered or endemic species of flora and fauna, critical habitats or protected areas. As well, the Commission shall identify ecologically sensitive areas that are within public lands and demarcate or take any other justified action on those areas and act to prevent environmental degradation and climate change.

Relevance

This part of the law seeks to preserve and direct management of fragile public land held by the various public bodies for sustainable development. Coast Water Works Development Agency is a public body and once land has been acquired for intended purpose, powers are vested to their custody as the acquiring body. It is then expected to comply with this law.

4.3.8 The Agriculture Act

Part IV no. 48 states that if the Cabinet Secretary considers it necessary or expedient so to do for the purposes of the conservation of the soil of, or the prevention of the adverse effects of soil erosion on, any land, he may, with the concurrence of the Central Agricultural Board, make rules to ensure the preservation of the environment. These rules may include;

- Breaking or clearing of land for the purpose of cultivation is prohibited
- Control, regulation or prohibition of grazing or watering animals.

With this prohibiting rule, the clearing or destruction of vegetation is deemed necessary by the minister for the preservation of soil and its fertility.

Part IV no. 48(b) the act requires the regulating or controlling of:

i. The afforestation or reforestation of the land,

ii. The protection of slopes, catchment areas or areas where rules made under (e) stating- for the maintenance of water in a body of water within the meaning of the Local Government Act,

iii. Rules made under section 48 may provide for the seizure and forfeiture of any stock pastured in contravention of a land preservation order.

.

4.3.9 Land Registration Act, 2012

The Act principally concerns the registration of interests in land. This Act shall apply to: (a) registration of interests in all public land as declared by Article 62 of the Constitution; (b) registration of interests in all private land as declared by Article 64 of the Constitution; and (c) registration and recording of community interests in land.

Creation of easement under the Act

According to section 98 (1), an owner of land or a lessor may, by an instrument in the prescribed form, grant an easement over the land, lease or a part of that land to the owner of another parcel of land or a lessee for the benefit of that other parcel of land.

(3) An instrument creating an easement shall clearly specify; (a) The nature of the easement and any conditions, limitations or restrictions subject to which it is granted; (b) the period of time for which it is granted; (c) the land, or the specific part of it burdened by the easement; and (d) the land to benefit from the easement, and shall, required by the Registrar, include in a plan that sufficiently defines the easement.

(4) If a co-owner, by a disposition, severs any building or part of it or land separated by a common dividing wall or other structure, whether that wall or other structure is a party wall or other structure, cross- easements of support of the dividing wall or other structure in respect of the severed buildings or land and the owners of the severed buildings or land shall be implied in the disposition and their successors in title shall be entitled to the benefit subject to the burdens of the cross-easements.

(5) There shall be implied in every grant of an easement the grant of all ancillary rights which may be reasonably necessary for the full and effective enjoyment of the grant.

Under the Land Registration Act, 2012, the Commission shall:

- Constitute registration units in consultation with National and County Governments,
- Determine the form of a land register that shall be maintained, in each registration unit,
- Appoint a date for geo–referencing plans to be kept in a land registry,
- Serve as the depository of maps; the office or authority responsible for the survey of land shall submit to the Commission a copy of the cadastral maps for depositing,
- Prescribe (through regulations) guidelines that the registrar shall follow before question has been obtained by fraud, and
- Advice the cabinet secretary in making regulations, rules or prescribing any matters required under this Act and such regulations or rules shall be tabled before Parliament.

Relevance

The proponent is required to follow the requirements of this Law as it is where any easement may be required in the course of the implementation of the project.

4.3.10 Penal Code Cap 63

The Penal Code prohibits the releasing of foul air that can affect human health. It states that anyone who voluntarily violates the atmosphere at any place, to make it noxious to the health of people in the neighbourhood of a public way is guilty of a misdemeanour and is liable for imprisonment not exceeding two years with no option of a fine. The code prohibits fouling of air by industrialists and manufacturers, etc. Under this code, any person who for the purpose of a trade or otherwise makes loud noise or offensive or awful smells in such places and circumstances as to annoy a considerable number of persons in the exercise of their rights, commits an offence and is liable to be punished for a common nuisance through imprisonment not exceeding one year with no option of a fine. It further prohibits the voluntary corruption or fouling of water or public springs or reservoirs, rendering it less fit for its ordinary use.

Relevance

The Proponent will be required to take the necessary measures to ensure that foul air is not emitted into the atmosphere. Workmen in sections emitting dust or particulate matter will need to be issued with protective masks and respirators. The Proponent will also be required to protect water sources and not to contaminate them during construction activities.

4.3.11 Sexual Offences Act No.3 of 2006

The Act defines sexual offences and makes provisions for prevention and the protection of all persons from harm resulting from unlawful sexual acts. The Act describes the types of sexual offences punishable by law and this includes rape, attempted rape, assault, defilement, gang rape, and indecent act with a child or adult, promotion of sexual offence with children, child trafficking, child sex tourism, and child prostitution, child pornography, and sexual harassment, cultural and religious sexual offences, among others. Section 8 Sub section 2 states that if the person commits an offence of defilement with a child aged eleven years or less shall upon conviction be sentenced to imprisonment for life.

Section 3 explains that any person who commits an offence of defilement with a child between the age of twelve and fifteen years is liable upon conviction to imprisonment for a term of not less than twenty years. Section 23 warns those in a position of authority, or holding a public office, from persistently making sexual advances or requests which are unwelcome and states that they will be guilty of the offence of sexual harassment and shall be liable to imprisonment for a term of not less than three years or to a fine of not less than one hundred thousand shillings or to both.

Relevance

The Act empowers Kenyans to take legal action in the event of a sexual offence. The code of conduct for the proposed construction project should uphold the provisions of this law.

4.3.12 The Work Injury Benefits Act (WIBA), 2007

The WIBA Act provides for compensation to employees for work related injuries and diseases contracted in the course of their employment and for connected purposes. Section 7(a) of the Act, on the obligations of the employer, requires an employer to obtain and maintain an insurance policy

with an insurer approved by the State in respect of any liability that the employer may incur under this Act to any of his employees.

Section 10(1) States that 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 this Act. It also states explicitly that an employer is liable to pay compensation in accordance with the provisions of this Act to an employee injured while at work.

On First Aid covered in section 45(1), an employer is supposed to provide and maintain such appliances and services for the rendering of first aid to the employees in case of any accident as may be prescribed in any other written law in respect of the trade or business in which the employer is engaged.

Relevance

As workers are employed by project contractors, they face myriad challenges to their health, safety and security, either from the equipment of use or work processes. WIBA offers legal backing on the incidents or accidents at the workplace or while on duty, including First Aid and compensation aspects. It is thus important to integrate the relevant provisions of this Act in the proposed project activities.

4.3.13. Community Land Act of 2016

PART V on conversion of land, Section 39 (3), requires that before conversion of community land into any other category of land a general meeting of the community must grant approval for such conversion. Section 40 (2) (3) state that Community land shall be compulsorily acquired only if it is for a public purpose or public interest subject to prompt payment in full of just compensation to the community and that transfer of community land shall, subject to the approval of the members of the community in a general meeting, be done in accordance with the Land Act. Section 41(2) requires that Conversion of land requires approval of members of the community in a general meeting in the case of land managed and administered by a Committee. Section 44 requires that adequate compensation shall be made to the affected community where land is set aside for public purposes.

Relevance

The land earmarked for the proposed project is a community land registered under Samburu South Group Ranch. The affected households whose land is to be acquired have been widely consulted and they have unanimously agreed to ease the land for construction of Makamini Dam as evident in the letter for land easement annexed in this report. A RAP report has been prepared for this project and sets out mechanisms on how the affected persons will be compensated.

4.3.14. National Construction Authority Act of 2011

The Act was assented to on 2nd December 2011 and operationalized on 8th June 2012. The National Construction Authority Regulations, which operationalized the Act, were passed on June 6th, 2014. The Act defines what constitutes construction works - means the construction, extension, installation, repair, maintenance, renewal, removal, renovation, alteration, dismantling, or demolition of:

(a) any building, erection, edifice, structure, wall, fence or chimney, whether constructed wholly or partly above or below ground level;

(b) any road, harbour works, railway, cableway, canal or aerodrome;

(c) any drainage, irrigation or river control works;

(d) any electrical, mechanical, water, gas, petrochemical or telecommunication works; or any bridge, viaduct, dam, reservoir, earthworks, pipeline, sewer, aqueduct, culvert, drive, shaft, tunnel or reclamation works, and includes any works' which form an integral part of, or are preparatory to or temporary for the works described in paragraphs (a) to (e), including site clearance, soil investigation and improvement, earth-moving, excavation, laying of foundation, site restoration and landscaping.

The Act is a precursor to the establishment of the National Construction Authority, which has the mandate to oversee the construction industry/sector and coordinate its development in Kenya. This Act is meant to regulate the conduct of contractors to ensure they adhere to professional code of conduct including compliance with associated statutory legislations.

For the purposes of this Act, a person carries on business as a contractor where such person, for reward or other valuable consideration, undertakes the construction, installation or erection, for

any other person, of any structure situated below, on or above the ground, or other work connected therewith, or the execution, for any other person, of any alteration or otherwise to any structure or other work connected therewith, and undertakes to supply:

a) the materials necessary for the work, or is authorized to exercise control over the type, quality or use of the materials supplied by any other person;

b) the labour necessary for the work, or is authorized on behalf of the person for whom the work is undertaken or any other person, to employ or select workmen for employment for the purposes of the execution of the work, whether under a contract of service or otherwise:

Provided that a person shall not be deemed to be a contractor if the work undertaken—

(i) does not incur a cost exceeding such sum or sums as the Board may from time to time determine; or

(ii) consists of a residential house for private use, not requiring a structural design

Relevance

The contractor undertaking the construction of the dam is fully registered with NCA and all the construction materials to be used in the project will adhere to the standards recommended by the authority.

4.3.15. County Government Act No.17 of 2012

The Act empowers County Government's authorities to make by-laws in respect of suppression of nuisances, imposing fees for any license or permit issued in respect of trade or charges for any services. County governments are given power to control or prohibit all developments which, by reason of smoke, fumes, chemicals, gases, dust, smell, noise, vibration or other cause, may be or become a source of danger, discomfort or annoyance to the neighbourhoods, and to prescribe the conditions subject to which such developments shall be carried on.

Relevance

The contractor will be required to adhere to all by-laws guiding development works within County Government of Kwale in order to avoid unnecessary delays in the execution of the dam project.

4.4 Regulatory Framework

4.4.1 Environmental (Impact Assessment and Audit) Regulations, 2003

The Environmental (Impact Assessment and Audit) Regulations of 2003 provide guidelines on conduct, report preparation, submission, and other relevant information on EIA/EA studies. It outlines the methodology of carrying out EIA and contents of an EIA study report.

The EIA and Audit Regulations state in Regulation 3 that "the regulations should apply to all policies, plans, programmes, projects and activities specified in Part IV, Part V and the Second Schedule of the Act. Part II of the Regulations indicates the procedures to be taken during preparation, submission and approval of this project report. The Regulation also stipulate when Environmental Audits in a bid to promote environmental soundness.

Relevance

The proposed project must undergo environmental impact assessment and a report written following the outline recommended in this regulation. It also recommends the period under which the initial environmental audit will be conducted.

4.4.2 Environmental Management and Coordination (Air Quality) Regulations, 2014

These Regulations cover air quality standards that are requisite to protect human health and allow an adequate margin of safety. These Regulations specify priority air pollutants, mobile and stationary sources as well as stipulates emission standards.

Relevance

The emissions generated from construction activities (such as burning waste on site and vehicle and equipment combustion engines) have the potential of polluting the immediate atmospheric environment. Bush clearing, earthworks and bulk delivery of construction material, if not managed well may also result in generation of a lot of dust. Thus, need for strict adherence to these regulations and standards.

4.4.3 Environmental Management and Coordination (Water Quality) Regulations, 2006

This regulation was published in the Kenya Gazette Supplement No. 68, Legislative Supplement No. 36, and Legal Notice No. 120 of 29th September 2006. The regulation provides for sustainable

management of water resources including prevention of water pollution and protection of water sources (lakes, rivers, streams, springs, wells and other water sources). It is an offence under Regulation No. 4 (2), for any person to throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution. Regulation No. 11 further makes it an offence for any person to discharge or apply any poison, toxic, noxious or obstructing matter, radioactive waste or other pollutants or permit the dumping or discharge of such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards for effluent discharge into the environment.

Relevance

It is already anticipated that the proposed road project will generate wastewater from vehicles oil, asphalt plant, asphalt products and at the batching site. Furthermore, the camp site may also produce wastewater in form of effluents and kitchen wastewater. Therefore, the wastewater discharge ought to comply with the standards stipulated in this regulation.

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

This regulation was published in the Kenya Gazette Supplement No. 69, Legislative Supplement No. 37, and Legal Notice No. 121 of 29th September 2006. The regulations provide details on management (handling, storage, transportation, treatment and disposal) of various waste streams including:

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

Regulation No. 4 (1) makes it an offence for any person to dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. Regulation 5 (1) provides categories of cleaner production methods that should be adopted by waste generators in order to minimize the amount of waste generated and they include:
(i) Improvement of production process through

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

(ii) Monitoring the product cycle from beginning to end by

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

Regulation 6 requires waste generators to segregate waste by separating hazardous waste from non-hazardous waste for appropriate disposal. Regulation 15 prohibits any industry from discharging or disposing of any untreated waste in any state into the environment. Regulation 17 (1) makes it an offence for any person to engage in any activity likely to generate any hazardous waste without a valid EIA licence issued by NEMA.

Relevance

The project activities during construction phase are anticipated to generate a lot of wastes in form of fugitive soil, debris, cement bags, plastic containers, vehicles spare parts, waste oil, old tyres, obsolete equipment, metal end cuts especially at steel section, iron sheets at the camp site, stripped off vegetation etc. All these sorts of wastes should be disposed as per the guidelines stipulated in the regulations.

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

Part II section 3 (I) states that: no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment and section 3 (2) states that in determining whether noise is loud, unreasonable, unnecessary or unusual, the following factors may be considered:

- time of the day;
- proximity to residential area;
- whether the noise is recurrent, intermittent or constant;
- the level and intensity of the noise;
- whether the noise has been enhanced in level or range by any type of electronic or mechanical means; and,
- whether the noise can be controlled without much effort or expense to the person making the noise.

Part II Section 4 states that: except as otherwise provided in these Regulations, no person Shall (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

Part III, Section 11 (1) states that any person wishing to (a) operate or repair any machinery, motor vehicle, construction equipment or other equipment, pump, fan, air-conditioning apparatus or similar mechanical device; or (b) engage in any commercial or industrial activity, which is likely to emit noise or excessive vibrations shall carry out the activity or activities within the relevant levels prescribed in the First Schedule to these Regulations. Any person who contravenes this Regulation commits an offence.

Section 13 (1) states that except for the purposes specified in sub-Regulation (2) hereunder, no person shall operate construction equipment (including but not limited to any pile driver, steam shovel, pneumatic hammer, derrick or steam or electric hoist) or perform any outside construction

or repair work so as to emit noise in excess of the permissible levels as set out in the Second Schedule to these Regulations. These purposes include emergencies, those of a domestic nature and /or public utility construction.

Section 14 relates to noise, excessive vibrations from construction, demolition, mining or quarrying sites, and states that: where defined work of construction, demolition, mining or quarrying is to be carried out in an area, the Authority may impose requirements on how the work is to be carried out including but not limited to requirements regarding (a) machinery that may be used, and (b) the permitted levels of noise as stipulated in the Second and Third Schedules to these Regulations. It further states that the relevant lead agency shall ensure that mines and quarries where explosives and machinery used are located in designated areas and not less than two kilometres away from human settlements and any person carrying out construction, demolition, mining or quarrying work shall ensure that the vibration levels do not exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

Relevance

The excessive noise and vibrations during road construction are likely to be produced from haulage of materials especially at the source (construction site, borrow pits, etc.). The contractor while undertaking civil works will be required to ensure compliance with the above stated regulations so as to promote a healthy and safe working environment throughout the construction phase. Therefore, this shall call for regular inspection and maintenance of equipment as well as prohibition of unnecessary hooting of vehicles especially at sensitize receptors such as schools, hospitals, markets, etc.

4.5. International standards

In addition to the applicable host Country Laws, this ESIA Report presents the Project impacts and mitigation measures with explicit reference to the following international standards and guidelines:

- International law, including conventions and treaties adopted by the host country and applicable to the Project;
- International Finance Corporation (IFC) Performance Standards (2012); and

- World Bank (WB) Group's EHS Guidelines, as applicable to the Project, including EHS General Guidelines.

4.5.1: World Bank Operational Policy OP4.37 - Safety of Dams

The WB Operational Policies (OPs) have been identified by WB as being particularly important in ensuring that Bank operations do no harm to people and the environment. There are ten (10) Safeguard Policies (SPs), comprising the Bank's policy on EIA and policies on:

- Cultural property;
- Disputed areas;
- Forestry;
- Indigenous peoples;
- International waterways;
- Involuntary resettlement;
- Natural habitats;
- Pest management; and,
- Safety of dams.

OP 4.37 (issued in October 2001 and revised in April 2013) refers to Safety on Dams. For the life of any dam, the owner is responsible for ensuring that appropriate measures are taken and sufficient resources provided for the safety of the dam, irrespective of its funding sources or construction status. Because there are serious consequences if a dam does not function properly or fails, the Bank is concerned about the safety of new dams it finances and existing dams on which a Bank-financed project is directly dependent.

The Policy requires that experienced and competent professionals design and supervise construction, and that the borrower adopts and implements dam safety measures throughout the project cycle. The policy also applies to existing dams where they influence the performance of a project. In this case, a dam safety assessment should be carried out and necessary additional dam safety measures implemented. OP 4.37 recommends, where appropriate, that Bank staff discuss with the borrowers any measures necessary to strengthen the institutional, legislative, and regulatory frameworks for dam safety programmes in those countries.

Relevance

The bank's policies are people and environmental centered. They are important in safeguarding the interests of the affected population through restoring and preserving cultural heritage, promoting proper relocation of the project affected persons (PAPs) as well ensuring the structural design and integrity of the dam meets the recommended standards in order to enhance safety.

4.5.2 The World Commission on Dams

The World Commission on Dams (WCD) was a global multi-stakeholder body initiated in 1997 by the WB and the International Union for Conservation of Nature (IUCN) in response to growing opposition to large dam projects. The WCD established comprehensive guidelines for dam building (in the WCD Report, 2000) that are intended to protect dam affected people and the environment and ensure that the benefits from dams are more equitably distributed.

The WCD has developed five core values that must be applied to all decisions relating to water and energy development projects. If applied throughout the project cycle, these values will ensure improved decision-making processes that will deliver improved outcomes for all stakeholders. The WCD has grouped the core values under five principal headings:

- Equity;
- Efficiency;
- Participatory decision-making;
- Sustainability; and
- Accountability.

Seven Strategic Priorities (SP) and related policy principles have been identified by the WCD for future decision-making. These strategic priorities provide guidelines for achieving equitable and sustainable development through a process that successfully integrates social, economic and environmental considerations into decision-making on large dams and their alternatives (WCD, 2000).

Relevance

This policy is geared towards protecting the dam affected persons and striking a balance through consideration of environmental, economic and social components associated with dam

construction. These aspects are deemed to be integral in all decision-making exercises so as to promote sustainability of dams and further ensure that all benefits are equitably shared across the target population.

5.0 PUBLIC CONSULTATION AND PARTICIPATION

5.1 Introduction

The Public Participation Process is a policy requirement by the Government of Kenya (CoK, 2010) and a mandatory procedure as stipulated by EMCA 1999 (Amended 2015) section 58, on ESIA. It is an important process through which stakeholders including beneficiaries and members of public living in or along project areas, both public and private, are given an opportunity to contribute to the overall project design by making recommendations and raising project concerns before they are implemented. In addition, the process creates a sense of responsibility, commitment and local ownership for smooth implementation.

This chapter describes the process of the public consultation and participation that was followed in order to identify the key issues and impacts of the proposed for the Design and Build of Makamini dam project.

5.2 Consultation and Public Participation (CPP)

The objective of the consultation and public participation was to:

- Disseminate and inform the stakeholders about the project with special reference to its key components and location,
- Create awareness among the public on the need for the ESIA for the proposed project,
- Gather comments, suggestions and concerns of the interested and affected parties,
- Incorporate the information collected in the ESIA study, and
- Comply with EMCA 1999 (Amended, 2015) Section 58 regulations.

In addition, the process enabled the establishment of a communication and fostering of synergy channel among the general public, consultant, project proponent and both county and national governments. The views collected were very crucial in helping decision makers to fully understand the concerns of the locals and the anticipated impacts of the project at an early phase of project planning.

5.3 Socio-Economic Surveys

Surveys on the social linkages of the proposed Makamini Dam involved observations as well as direct interactions with the local communities and other stakeholders. This informed the preparation of the RAP report. Part of this interaction involved face to face interviews through a questionnaire that sought to obtain the basic household status, particularly for those communities within the areas to be affected. A quantitative survey was conducted at village level using structured questionnaire and it was designed to generate data and information. The data was to be generated on among other things, the availability or lack of social service facilities, existing levels of access to education, health, potable water and related services, local market prices as well as agricultural production and productivity, all of which were useful in valuation of assets and computation of compensation rates.

A series of consultations were held using both formal and informal meetings with carefully selected members of the communities and all PAPs. The purpose of this survey was to identify types of impact and accordingly categorize affected persons, develop entitlements and prepare resettlement plan for each family. The following information about each family was collected.

i. Human resource base of each family.
ii. Economic status of each individual member of the family.
iii. Ownership of property – movable and immovable.
iv. Property including lands, structures, trees and houses either occupied or owned with tenancy rights or even as encroachers or those de-facto in possession.
v. Means of livelihood due to stagnation of developmental activities soon after the project, loss of property, loss of access to clientele, loss of livelihoods due to physical re-location, loss of gainful employment, loss of access to income generating resources.
vi. Community life, community properties and resource base, community amenities and services, socio-cultural value.
vii. Loss of habitats and lands, degradation of land and water resources, environmental degradation, adverse impact on health etc. as an after effect of the project.

5.4 Stakeholder Consultation Forums

The stakeholder identification and analysis has been considered during ESIA process. Just as the degree of stakeholder relevance may vary throughout the Project lifecycle, the most appropriate communication and consultation method also vary between stakeholders. The following approaches were applied in order to ensure an all-consultative public participation.

5.4.1 Questionnaire Administration

The consultant prepared questionnaires to be administered to both the general public and the key opinion leaders within the project areas and more so among the project affected persons. The questionnaires were mainly open-ended in order to give the target groups an opportunity to express their views and concerns appropriately and widely. These instruments of data collection were then analyzed, and information synthesized in this ESIA report.

5.4.2 Direct Interviews

Direct interviews were used to get responses from the proponent, opinion leaders within the community; local politicians; National Government Administration and County Government administration. Others included; representatives from the national and county departments, e.g., Agriculture, Livestock and Fisheries Development, Environment and Natural Resources, Medical and Public Health as well as Water Services. Other stakeholders engaged were National Land Commission (NLC), Water Resources Authority (WRA), Civil Society and Religious groups. Their comments were sought through engaging them in discussions about the proposed project and the impacts likely to occur as a result of its implementation. This kind of engagement gave the respondents the opportunity to give insights and details about the issues at hand.

5.4.3 Community Consultative meetings (Public Fora)

Several community consultative meetings were held in various venues and times as a way of reaching as many stakeholders as possible. It meant to give more members of the stakeholder community an opportunity to express their views, fears and expectations, if any, about the proposed dam construction, water treatment plant and their associated activities. As a follow up to the community engagements, public barazas were held within Makamini market centre. The main objective of the meetings was to share information on the project with stakeholders and also give

them opportunity to further express their views about the proposed project. However, due to the prevailing covid-19 pandemic, all precautionary measures were taken by the consultant by ensuring that; social distancing was maintained, all members had face masks on, sanitizers were availed, and a limited number of attendees are allowed to avoid congestion and any possible spread of the disease.

The table 7 and figures 15-17 below show the consultative meetings were conducted throughout the public participation process.

Table 7: A list of public meetings held

No.	Venue	Type of meeting	Date
1.	Makamini trading centre-Chief's compound	Introduction meeting with PAPs	9/08/2021
2.	Makamini trading centre-Chief's compound	Community stakeholder Meeting	25/08/2021
3.	Meeting with RAP& Land acquisition Committee	Introductory Meeting	27/08/2021
4.	Kinango Sub-county ward offices	National and County government representatives	23/09/2021

Figure 15: A meeting with committee steering RAP process
(Source: Field Survey, 2021)

Figure 16: Meeting with Key informants from National and County government at Kinango Sub-county
(Source: Field Survey, 2021)

Figure 17: Community Stakeholder ESIA meeting
(Source: Field Survey, 2021)

5.4 Views of the public concerning the project

From all the consultation and public participation forums, various opinions and views were collected. All the relevant stakeholders and interest holders expressed the anticipated benefits likely to emanate from the implementation of the dam project. The project is generally acceptable to a majority of the stakeholders and members of public on condition their views and concerns were put into consideration.

Some of the anticipated perceived benefits include:

i. The dam is expected to create significant economic and social benefits to the communities and contribute to the attainment of the country's priority goals and ongoing national efforts to accelerate economic growth and alleviate poverty.
ii. The project will provide employment and job opportunities for the local people.
iii. There will be enhanced food security and improved nutrition at the household level.
iv. The community will be assured an all-year-round access to water from the dam, directly or through alternative distribution systems than before.

During the three scheduled consultative meetings (barazas) the leaders and affected persons further highlighted some negative impacts and raised some pertinent issues of concern expected to arise from the proposed project which are hereby summarized as follows.

1. *Sensitization/Education of the community.* There is need for further consultations and sensitizations of the Makamini community regarding project related issues like resettlements/compensations, extent of dam area as per the produced map(s) of dam sites, buffer zones and catchment area. Members requested that financial education was also important owing to the large amounts likely to be paid to project affected amounts.
2. *Involvement of all categories of the society in the project.* The community suggested the need for inclusion and consultation of men, women, youth, and persons with disabilities at all stages of the project planning and implementation.
3. *Delay in compensation.* The members were concerned about the amount and the process of compensation for the lost lands towards the proposed implementation of the project. The PAPs were assured that resettlement action plan was being undertaken and the surveyor and valuers had started undertaking census and inventory of losses. Therefore, once the process was complete, compensation process will be effected.
4. *Benefits of Dam to Community.* Whereas the benefits of the proposed dam are known, the local community wanted to be assured that they would get subsidised rates when supplied with treated water from the proposed dam. They also requested for employment opportunities of skilled and unskilled labour to be sourced from the local people. This was in a bid to help alleviate the poverty levels in the area through generation of incomes.

5. *Corporate Social Responsibility (CSR).* The Makamini community requested for CSR project from the contractor once the implementation of the project is done. the infrastructure to be funded by contractor were unanimously resolved to be: (i) Build one toilet at the chiefs camp, (ii) Build one public toilet near the camp site, (iii) Build two classrooms, and, four toilets with two bathrooms for girls and four toilets with urinary for boys at Makamini primary school.
6. *Displacement of persons*. The local community were assured that there would be no physical displacement of people by the dam project except for the area earmarked for water treatment plant and its associated works. However, there would be compensation for the project affected persons and their affected properties.
7. *Damage of access road leading to the proposed dam site.* The community were concerned about the anticipated damage of the access road by the construction vehicles and machinery used in the delivery of materials and transportation of spoil from the project site. They were assured that the road will be left in a good condition once the construction works are completed.

N.B. Attached in the Appendix E, F & H are the minutes, attendance list, photos and the questionnaire used to collect the local community members' view on the project.

5.5 Project Acceptance

Majority of the community members expressed their awareness of the proposed Makamini dam project. In addition, during the ESIA public participation, the community were 99% in support of the implementation of the proposed project as shown in the figure 18 below;

Figure 18: Community members showing their support for the proposed project
(Source: Field Survey, 2021)

6.0 ANALYSIS OF PROJECT ALTERNATIVES

6.1 General Overview

Given the objectives of the Makamini dam, the results of the policy and legal framework and key issues identified in the field, two alternatives were selected for study.

6.2 Alternative 1: Status Quo/No project alternative

The "no action" or no project alternative would maintain the status quo of the situation within the catchment area. As such, the project proposed interventions would not be implemented. This alternative would thus result in (i) the ongoing scarcity of potable drinking water, (ii) little or no improvement in the low agricultural production of farms in the project area, the high poverty levels of catchment communities, and the social hardships endured by local populations. In fact, the social situations and environmental degradation can only become worse with rising populations, with continued unsustainable exploitation of the natural resources, making the poverty–environmental degradation cycle even more vicious. Indeed, the project concept identifies poverty as the main cause of environmental degradation, which leads to even worse poverty levels in the long term. This makes the no project alternative both expensive and unacceptable to the local communities. For these reasons, this alternative was rejected in favour of the proposed project of dam construction, together with the water treatment plant and its associated activities.

6.3 Alternative 2: Proposed Dam Alternative

The main goal of the proposed dam construction project is to contribute to reduction of rural poverty in the project area through increased access to clean water supplies, sustainable food production and incomes for poor rural households and as well as promotion of a healthy population. To meet the objectives, the following were taken into consideration. This ESIA process is happening after the geographical location of the dam had been determined through feasibility study and substantial work in the design process undertaken. However, in order to make maximum use of the water stored, sub projects comprising of water supply (through water treatment plant) and promotion of irrigation activities were conceptualized. The dam setting influences the optimisation of these activities by promoting gravitational flow of treated water to the various sub-locations within Kinango sub-county. Subsequently, with the location of the dam determined then

that leaves the alternatives to be evaluated to include; Mode or process of how it would be done, timing and detailed implementation of the proposed project.

In consideration of the mode or process of how things should be done there were considerations of technologies or methods that can meet the need with less environmental damage. Therefore, this called for utilization of modern acceptable technologies as opposed to the traditional ones. The project also proposes to use the most environmentally friendly technologies available. This will include promoting piped conveyance over open canals when supplying water from the treatment plant to the end users. The technologies chosen for both construction and operational phases are also simple, easy to use and of moderate cost.

Taking cognisance of the timing and detailed implementation of the project, issues to take note include; when, in what form and sequence should the development be carried out in order to maximise the economic, human, technological and environmental benefits associated with the proposed project. Therefore, this component evaluated the details that matter, and the necessary requirements needed to ensure the effective implementation of the dam project together with its subsequent activities. Further, since the sub-activities (water supply) as conceptualized radiated from the proposed existence of the dam to utilize the stored water, then the logical sequence would be to give the first priority to the construction of the dam. Thereafter, in their order of importance, water supply would come second followed by the irrigation activities, if any, to promote food security and improve their livelihoods. This alternative evaluates the impacts of fully implementing the Makamini dam (and its key objectives of: harnessing storm water that would otherwise be lost, increased water supply emanating from storage and subsequent treatment works and finally anticipated increase in food supply through farming enhanced by availability of irrigation water.

The key thrust of this ESIA is to obtain data on the environmental suitability and feasibility of the proposed sub-activities, namely;

1. Dam Embankment, and
2. Water Treatment Plant and subsequent supply.

For each of the above-mentioned project components, the Consultant has evaluated the positive and negative impacts likely to be experienced. For the adverse impacts, mitigation measures were identified while measures for enhancement of opportunities were also sought. Where 'win-win' scenarios are not possible, the more common scenario involving both 'winners' and 'losers' necessitating 'trade-off' shall be considered.

6.4. Alternative 3: Alternative Analysis of Dam Site and Axis

The design consultants compared three dam axis options and adopted the downstream axis due to favourable topography. Taking into account the topography and the geological conditions, the multi-disciplinary experts for the project believes that the dam site selected does not have any "fatal flaws" such as faults, seismic risk, reservoir leakage or reservoir slope instability.

- Location – Based on reconnaissance visits, detailed topographical survey and geological investigations of the project area, the dam site is located at Co-ordinates 03° 58' 57.7" S, 39° 13' 57.5" E [X=525,050, Y= 9,559,709 (UTM, Arc1960, 37S))] and at a bottom valley elevation of 190.0 amsl along the confluence of Rivers Mulunguni and Vigurungani which are tributaries of River Chigulu (Changes name to Mwache downstream). In this context, it may be mentioned that no suitable dam site could be identified upstream. The selected site is also suitable since the dam is expected to be a check dam for Mwache Dam.

- Type of dam - Considering topography, geological condition, availability of construction materials and cost criteria, a rockfill dam has been proposed. Hence the choice for constructing the rockfill dam was found to align with the stipulated timeframe and would not exceed the total budget for the project.

- Construction of a 9m high Earth Dam – 738m long and 6m wide crest, approximately; 300, 000m^3 volume of earthworks was found optimum considering water availability and sediment management.

6.5. Alternative 4: Alternative sources of water

The Kwale County Water Supply Development Master Plan evaluated various scenarios for meeting water demands for residents of Kinango sub-county and Kwale County as a whole. These scenarios included different combinations, and phasing, of potential sources of water, including well fields, springs, aquifers and dams. A multi-criteria analysis consisting of four parameters (engineering, economics, environmental and social aspects, and political economy) was used to evaluate these scenarios. The proposed Makamini dam is one of the 20 priority projects (including 14 dams, 3 sand storage Dams, Upper Mwache check dam intake, Umba dam intake, Mzima pipeline, Djabias and Kizibe groundwater development). The selected priority projects which include Makamini dam has advantages from an economic, engineering and environmental point of view.

This project, upon completion in 2024 (and after construction of Phase II, distribution and last mile), will supply piped water to meet demands of Makamini, Kinagoni, Matumbi, Mtaa, Mabesheni, Bofu, Kibandaongo, Mnyezeni and Mwamdudu sub-locations within Kinango Sub-County. It is estimated that 40,000 people (over 10,000 households) will be provided with portable water. The area currently has a water supply coverage of 4%

7. 0 ANTICIPATED IMPACTS AND MITIGATION MEASURES

7.1 General Overview

Environmental Impact Assessment (EIA) is a planning tool to promote sustainable development by integrating environmental costs and benefits into proposed development activities. In the long term, it should minimize environmental impacts and save costs by preventing unnecessary environmental degradation. An ESIA study must factor preventive measures concerning environmental destruction, confronting investment wastage, attaining development objectives and improvement in the socio-economic sphere. Consequently, in such conditions, not only the actual value of ESIA study will be specified, but the consequences and the obstacles will be reduced and the ESIA report can be utilized as a guideline by the project designers. The ESIA informs decision making to ensure the decision is based on a complete and clear description of the positive and negative impacts to achieve sustainable developments.

In this regard, the National Environment Action Plan (NEAP) process introduced environmental assessments in the country with among the key stakeholders being industrialists, business community and local authorities. This culminated into the enactment of the Policy on Environment and Development under the Sessional Paper No. 6 of 1999.

7.2 Impact Assessment Methodology

The key components of the project are described and analyzed in order to identify and assess all the potential project-related environmental and social impacts and to identify the measures and procedures to mitigate them.

7.2.1 Impacts Identification

In order to identify all of the potential impacts (positive and negative), any single project activity is analyzed in relation to the investigated environmental, social and health components related to the construction and operation phase. In many cases, impacts on environmental, social or health issues are interconnected. Therefore, it is important that integrated impacts identification is undertaken, so that the relationships between individual components are recognized and understood and indirect but relevant consequences on the affected area are considered.

7.2.2 Impacts Assessment

This section describes the procedure implemented to assess the significance of the impacts potentially induced by the different components of the project (the Dam, the Water Treatment Plant and the reticulation system) on the environmental and social components. The predicted impacts are evaluated using a significance ranking process. This assessment is done taking into full account the regulatory requirements described in Chapter 4. Once identified, potential impacts need to be assessed in order to enable a judgement of their significance that allows a prioritization of the mitigation/enhancement and management measures. Potential Project impacts are assessed in relation to baseline information (environmental and biological resources as well as socio-economic resources- community, individuals, and social, economic and cultural assets) within the Project area of influence.

In assessing the significance of all the impacts (positive or negative), the criteria presented in table 8 below are applied.

Table 8: Impact Assessment Criteria

Temporal scale	***Short-term***: impacts limited to the duration of the activity.	***Long-term***: impacts that may last for longer periods of time.	***Permanent***: impacts that cause a permanent change in the baseline conditions.
Spatial scale	***Local:*** impact affecting the communities.	***Regional:*** impact affecting a wider area or socioeconomic asset of importance going beyond the communities	***National:*** impact extending to the national level or affecting assets of national importance.
Probability	***Likely:*** past experiences in similar projects give some substantiated evidence that the impact frequently occurs in a similar context	***Possible:*** could occur but is not frequent	***Unlikely:*** very rare in the country and in a similar context, very low probability
Intensity	***Low:*** limited impact that does not lead to any long-lasting change.	***Medium:*** impact causing change but not affecting the core livelihood of affected people or main structure of the socioeconomic asset.	***High:*** impact causing a complete change of livelihood; or change/destruction of the asset.

Based on the aforementioned criteria, a comprehensive evaluation is provided for each impact, considering a four-level rating of impact significance: negligible, low, medium, high. These evaluations are then tailored to the main features of the involved receptors, the local environment and socio-economic context and the definitions below.

Table 9: Definitions of the Impact Significance Assessment Rating

Negligible	Negligible magnitude impacts on low or medium sensitive environmental, biological and socio-economic resources. The impact is hardly distinguishable from background conditions and expected development in a no-project situation.
Low	Low impact on medium or low sensitive environmental, biological and socio-economic resources, medium impact on low sensitive resources. The negative impact can still be minimized to a negligible level through best practices and mitigation measures
Medium	Low magnitude impact on highly sensitive environmental, biological and socio-economic resources, medium magnitude impact on medium sensitive resources, high magnitude impact on low sensitive resources. For negative impacts, mitigation measures are required and, as needed, compensation measures.
High	High or medium magnitude impact on highly sensitive environmental, biological and socio-economic resources. Negative impact must be avoided, mitigated or compensated to an acceptable level through implementation of specific mitigation or compensation measures.

Once the impact is identified and assessed, suitable mitigation measures are defined to reduce or totally avoid the impacts. Positive impacts should be enhanced through enhancement measures. Mitigation measures are proposed based on national requirements, best practices, preliminary stakeholders' views, ESIA experts' advice, and according to the following mitigation hierarchy:

- avoid as much as possible;
- where avoidance is not possible, minimize following best practices;
- where minimization is not sufficient, mitigate through specific measures;
- where mitigation is not sufficient, compensate for residual risks and impacts.

Impacts have been assessed separately for the different Project phases, construction and operation, and for the different Project components, as explained above.

7.3 Potential Impacts by Dam and Water Treatment Works

Dams have impact on the physical, biological and social components of the environment, and the human population around the project. The overall impacts arising from the dam construction are positive in all respects of environmental, social and economic perspective. Physical impacts include changes in water quantity or quality, or soil erosion and sedimentation, while biological effects can be on terrestrial and aquatic fauna and flora. The involuntary resettlement of people and the disruption of their lifestyles are social effects, as well as the impact of resettlement on the affected population. All these impacts together affect the project's viability and its benefits and costs. Indirect impacts need also to be taken into account just as much as the direct output of drinking water supply, irrigation water or flood control.

The impacts are primarily based on the environmental baseline study, the consultative and public participation findings and the regulatory frameworks reviewed. Specific impacts associated with the proposed Makamini dam in relation to the construction and operation phases are discussed below.

7.3.1. Impacts on Socio-Economic and Built Environment

The main aim of every development project is the improvement of socio-economic status of the local people residing within the limits of the project. Action on the environment includes all the purposes for which the proposed dam is built in addition to induced effects. The main anticipated beneficial effects to the people in this project include, drinking water supply and other domestic use. Anticipated adverse impacts include population displacement, the submerging of arable lands and danger to downstream population. With due attention to the above mentioned, the survey of socio-economic impacts dominating the project region, is one of the main indices, the consideration of which is necessary. Therefore, in this section, the socio-economic impacts arising from the project, as to the construction and operation phases are separately foreseen and specified.

7.3.1.1. Employment (Labour Influx) and Migration

Construction Phase

The construction activities of the dam, water treatment plant and conveyance channels will offer various job opportunities during construction phase of the project. The employment will mainly entail the unskilled, semi-skilled and the skilled worker category. This means that the employed population will generate income which will automatically boost their living standards. This beneficial effect will mostly be felt at Makamini area where the proposed dam will be situated. However, these kinds of occupations are temporary and do not create a long-lasting effect on aspects such as job security, welfare and income increment for the local inhabitants. This effect is assessed as a positive and direct impact, with medium suitability and importance.

Employment in the construction activities is the main motivation for migration to the project area during construction phase. So, the Makamini Dam Project impacting on the migration of people is very likely in the region. The requirement of manpower in construction activities, especially unskilled and semi-skilled workers, which are usually supplied from the rural areas nearby the project, can be the cause of attracting active population especially young men to the project area.

Operation Phase

The subsequent operation of the project will create job opportunities, direct and indirect occupations in various sections. Some of the available employment opportunities will include; dam operation team, surveillance team, repair and maintenance of the dam, water pipeline monitoring team as well as water treatment plant personnel. Therefore, this phase has desirable impacts concerning the creation of jobs, welfare of the inhabitants and income, with higher suitability in the area. The effect of operational phase of Makamini Dam and water treatment plant on the employment factor is assessed as positive, indirect and long-term impact.

The impact of the operation phase of the project with respect to migration is assessed positive due to the following reasons; the direct job opportunities such as dam operation team, surveillance team, repair and maintenance of the dam, water pipeline monitoring team as well as water treatment plant personnel.

7.3.1.2 Transport and Communication (Roads)

Construction Phase

The main route corridor to the dam site is through the already improved to bitumen standards of Samburu-Kinagoni-Mulunguni road. The link adjoining the main corridor to the proposed dam is Mulunguni-Makamini earth road approximated to be 5km. Therefore, as a result of the impending construction activities and need for transportation of construction materials and commuting staff, then paving of this road is necessary to ensure its usability is maintained. Improving of this road will not only be beneficial for the project and its personnel, but for inhabitants of different population centers located along the corridor. Since, this road is main link to the Samburu-Kinagoni-Mulunguni road, it can be said that the inhabitants of these population centres will be affected indirectly by this positive effect of the project as well as all other villages located along this way. Hence, the scope of this impact is beyond the borders of the project area.

Operation Phase

Since transport and communication routes should be improved during construction phase, all advantages and disadvantages usually relate to that phase and thus no meaningful impact is expected during operation phase. However, as a long-term impact, its benefits remain. The improvement and development of the local road conditions will enhance various socio-economic activities.

7.3.1.3 Land Value

Construction Phase

Through the field visits and other methods of public participation applied, the local people particularly PAPs within the reservoir area were aware of the implementation of the Makamini dam project. When local people are aware that their homes and agricultural lands shall be submerged by formation of the dam (or occupied by side facilities such as water treatment plant) they expect the authorities to compensate the damages. This can lead to increase in the land values.

Operation Phase

In addition, the availability of water in any area is usually regarded as a pull factor for migration. Once the proposed dam project is complete and operational, and the water infrastructure is laid, then the area will be declared water sufficient. Therefore, increased migrations are anticipated which will lead to high demand for land, and this will further increase the value of land in the area.

7.3.1.4 Social Changes and Acceptance

Construction and Operation phase

The total activities of the project in general, during the construction phase, from various angles create disturbances in the life of the local inhabitants. The most tangible consequences of this project during construction, include movement of trucks and heavy vehicles, causing dust and noise.

Field study and interview with local people (especially with residents of the dam reservoir area) shows that, although they are aware about the consequences of the dam project on their farmland and few interruptions on their houses, specifically, to the location of the water treatment plant, there is a positive public opinion towards the project. Probably, high level of poverty, deprivation, financial expectations for lost houses and farms and hope for a better future are the main motivation behind this positive idea. Therefore, it is predicted that on completion of the construction activities and the commencement of the operations, social acceptance in the construction phase shall be extremely strong and convincing. From the above mentioned, social acceptance of the project is assessed as a positive impact.

Mitigation Measures

- The process of land acquisition in the reservoir area by the authorities should be completed because the consent of the inhabitants must be attained prior to the water intake of the dam reservoir.
- Appropriate compensations and/or provision of alternative settlements and livelihoods for the affected communities shall be accomplished before commencement of the project.
- Put in place supportive and cushioning mechanisms and programmes for those affected such as training, enhancing access to alternative resources and livelihood means

7.3.1.5 Domestic Water Supply

Construction Phase

No impact anticipated during this phase of construction.

Operation Phase

The area being an ASAL area records inadequate supply of drinking water and water for domestic use. The population has to cover a long distance to access the nearest water pan which does not offer clean water. Therefore, the local population has to purchase water at exaggerated prices of about Kenya shillings fifty for a 20 litre jerrican. Considering the area has a high poverty index, purchasing water at such prices does not help in improving the livelihood of the locals. The location of the water treatment plant at the dam site and its associated conveyance infrastructure will definitely lead to unquantifiable benefits for the local residents during project operation phase.

7.3.1.6 Health and Diseases

Construction Phase

Large dams often have negative social impacts such as increases in communicable diseases. In the construction phase, the occurrence of water related diseases is minimal and less significant. However, the current Covid-19 pandemic should not be assumed and its effects which can be detrimental to the local workers and their families. The impact of the project on the health and disease factor in the construction phase is a negative one with low intensity and moderate importance.

Operation Phase

Changes to water courses can include epidemics of water-associated diseases, such as, malaria and bilharzia. On the other hand, dams particularly with aims of securing drinking water can provide suitable opportunities for improvement of health index. Generally, the problem of increment of the possibility of incidence of water borne diseases can result from entrance of water pollutants into the dam reservoir, and habitat for insects as carriers of diseases. The possibility of water borne diseases is an issue relative to the operation period of dams. However, the possibility of incidence of water borne diseases in Makamini dam project is not expected to be high because of the scattered

form of human settlement with a few numbers of villages in the dam basin. On this basis, this impact is assessed as a negative one with low intensity and moderate importance.

Mitigation Measures

- Control and the monitoring of sanitation and health
- Regular creation of fluctuation on the dam water surface, so as to prevent the spawning of carrier insects.
- Prevention of the growth of reeds and the presence of a red rush and vegetation on the edges of the dam.
- Public awareness campaigns and civic education.
- Staff training before the commencement of construction activities.
- Monitoring of health and disease indices.

Health Impacts of COVID-19

The World Health Organization (WHO) declared COVID-19 a global pandemic after assessing both its alarming levels of spread and severity, and the alarming levels of inaction. Consequentially, WHO issued various guidance and measures to prevent the spread of the virus. The measures have been adopted worldwide.

During project execution (civil works), large numbers of workers will be required to assemble together in meetings, toolbox talks and even at work sites; varied number of workforce including suppliers of material and services are also expected to come in from various places in the country which may be COVID-19 hot spots; and interaction of workers with the project host community will happen as workers find accommodation close to work sites, and/or return to their homes after work. The potential for the spread of any infectious disease like COVID-19 by projects is high. There is also the risk that the project may experience large numbers of its workforce becoming ill and will need to consider how they will receive treatment, and whether this will impact on local healthcare services including the project host community.

Recently, the WHO has warned that the virus is here to stay for a long time and might persist and become our new way. The Government of Kenya has also lifted some of the initial movement

controls and allowed the resumption of business, with certain industry specific guidelines being enforced. The duty of care has now been transferred to individual citizens and enterprises. Recognizing the potent risk this may present, it is difficult to clearly outline exhaustive mitigation measures under the mitigation impacts. As such, there is need for the client and the contractor to develop and adopt COVID-19 Standard Operating Procedures (SOPs) in line with the World Bank guidance, Ministry of Health Directives and site-specific project conditions. These SOPs need to be communicated to all workers and enforced to the latter without fail. In addition to the requirement of the SOPs, the following mitigation measure shall also be adopted:

COVID-19 – Mitigation Measures against spread of COVID-19:

(i) The Contractors will develop SOPs for managing the spread of Covid-19 during project execution and submit them for the approval of the Supervision Engineer and the Client before mobilizing to site. The SOPs shall be in line with the Ministry of Health Directives and site-specific project conditions;

(ii) Mandatory provision and use of appropriate Personal Protective Equipment (PPE) shall be required for all project personnel including workers and visitors;

(iii) Avoid concentration of more than 15 workers at one location where necessary. Where there are two or more people gathered, maintain social distancing of at least 2 meters;

(iv) All workers and visitors accessing worksites every day or attending meetings shall be subjected to rapid Covid-19 screening which may include temperature check and other vital signs;

(v) The project shall put in place means to support rapid testing of suspected workers for covid-19;

(vi) Install handwashing facilities with adequate running water and soap, or sanitizing facilities at entrance to work sites including consultation venues and meetings and ensure they are used;

(vii) Ensure routine sanitization of shared social facilities and other communal places routinely including wiping of workstations, door knobs, hand rails etc.

7.3.1.7 Land Acquisition and Potential Population Displacement

Construction Phase

Discussion regarding land possession is usually the most crucial social matter relevant to dam projects that are considered as negative impact. The issue of land possession in the construction phase pertains to the limits of the dam site, access roads (access road to dam body) and water treatment plant. These lands must be purchased from the genuine owners and the approval of the inhabitants sought, prior to the construction activities. The real price of lands should be paid, and land rights taken. The effects of these impacts are considered as negative and short-term ones. Though, for the people who are compelled to relocate from the area, the consequences shall remain for a long time.

Therefore, population displacement and resettlement is an important subject that should be under consideration due to land acquisition. Population displacement in this phase is related to the people whose houses or agricultural lands are located in the immediate area of the project and construction activities. With the number of these people being not high, this effect is moderate. Concerning the people whose properties are located in the reservoir area, initial talks with local people, including compromise to purchase and taking possession of lands, usually commences prior to the dam construction, however, it is possible that this is prolonged till the termination of the construction stage of the dam. Therefore, the due procedures of the resettlement plan must be performed as ascribed in the RAP. Thereby, this impact is considered and valued in the operation phase. These issues will be adequately addressed through a comprehensive resettlement action plan (RAP).

Other issues delved into during the assessment touched on;

1) Potential dissatisfaction to the project affected persons (PAPs) on the mode of compensation and quality of alternative settlements may be a challenge to the project. This could arise from inadequate preparation and sensitization of the PAPs,
2) The water treatment plant, transmission pipelines and distribution tank locations could also have implications to the immediate landowners and residents. Considering that majority of the people live below the poverty line, it would mean that prior relocation without support would not be possible unless support is made available.

Operation Phase

As it is mentioned earlier, there are not a large number of people living in the dam reservoir. The housing structures and farmlands situated in the limits of the dam reservoir, upon approval of the owners, will be purchased and possession taken over by the proponent (Coast Water Works Development Agency). So, the displacement of population arising from the implementation of the project is minimal. This effect is assessed as a negative, inevitable and irreversible impact with medium intensity and importance.

Mitigation Measures

To mitigate the above, the following will be considered:

- Consultation and participation of the residents to ensure acceptability and ownership of the project by all stakeholders, irrespective of the implications to the individuals.
- Involve the communities in identifying and advising on acceptable handling procedures of the traditional and cultural sites to avoid conflicts.
- Timely information supply to the landowners.
- Explanations to landowners in relation to the project objectives and its positive impacts,
- Obtaining public views particularly as to the mode of compensation and payment for damages.
- An all-inclusive participatory Land Acquisition and Resettlement Action Plan (LAP and RAP) should be systematically conducted to establish who owns (interested parties and shareholders) what so as to determine the rightful owners who should benefit and the share each should receive.

7.3.1.8 Land use and Biodiversity loss

Construction Phase

During the construction phase, land use at the location of the dam site, upstream and downstream, positioning of the water treatment plant and its associated infrastructure and access roads will be altered. The current land use of these lands is agricultural though majority of the land is covered by arable farms and indigenous vegetation such as grasses, shrubs and natural trees. Construction of the dam implies removal of existing vegetation while clearing the areas to be inundated and/or

possibility of submerging of others potentially losing certain species. It is likely that certain plant species will be lost while others are likely to get introduced.

Operation Phase

Land use in the limits of the dam reservoir that shall be submerged due to the water intake, consists mainly of agricultural lands. The change of land use is relevant to the limits of the dam reservoir. Upon inundation of the dam area, riparian aquatic vegetation could develop on the new water/land transition zones with new species introduced and flourishing of the existing species (e.g. grasses, reeds, etc.). Completely new ecosystem will possibly be established around the inundated areas including planktons, periphytons and aquatic macrophytes established and changing the characteristics of the current aquatic life. Presence of water might also attract other species of wildlife, especially grazers with potential transformation of the ecological characteristics. This situation could create a new human-wildlife conflict.

Mitigation Measures

- Minimizing clearing and disruption to riparian vegetation.
- Re-vegetation of disturbed areas with native plant species (plant prominent trees of the region such as Acacia)
- Protect all the ecologically critical areas such as riparian zones by clear delineation and planting of suitable indigenous plant species.
- Prevention from spilling oil and inflammable compounds of vehicles and machinery on the ground so as to prevent soil pollution in the terrestrial ecosystem and its secondary impacts as to wildlife through the food chain.
- Develop a database of animal and plant species found in the dam area as a basis for conservation and monitoring of newly introduced species in the future.
- Establish community interests and values in the evolving ecological setting and enhance economic benefits and cultural values from the same. Fishing and livestock keeping are notable economic benefits.

7.3.2. Geophysical Impacts

7.3.2.1 Morphology

Construction Phase

The topography and landform during the construction phase will change due to the activities, such as, soil excavation, embankment, cutting rocks, construction of access roads, excavation from borrow areas, etc. relative to the dam body, spillway, water intake, and conveyance pipeline. These changes are accounted for as being the adverse impacts of the project, as these kinds of activities, usually cause changes to the natural status of the land. This negative impact is limited to the length of the construction period, which occurs with great intensity, however, is accounted as an irreversible effect.

Operation Phase

In the operation stage, the formation of the dam will cause a transformation in the general landscape of the area. In fact, upon the completion of the construction, on implementation, the water conveyance pipeline is implemented under the ground, which is not noticed after implementation.

7.3.2.2. Flooding and Soil Erosion

Construction Phase

Flooding is not anticipated during construction works since the works are being undertaken with close monitoring of the meteorological calendar. Activities, such as, diverting the river course, the construction of a diversion tunnel, the clearance of ground cover in the locations where construction activities is taking place, soil excavations and embankment, excavation of construction materials from the bed rock, debit depot, access roads, commuting heavy vehicles and construction machinery, the water conveyance and pipeline in association with water treatment plant are aspects that create an impact on the surface prone to erosion, along with the possibility of accelerated erosion. This negative impact is limited to the construction period and appears on in a temporary manner.

Operation Phase

Flooding will be managed from the viewpoint of dam design with regard to the capacity of the diversion tunnel and the spillway. The presence of the villages and population centres in the downstream of the Makamini dam, emphasizes on the importance of cushioning them against the effects of flooding.

In connection with soil erosion in the operation period, soil erosion is taken into consideration from two points of view. One is the impact of the project on soil erosion and the other is the impact of soil erosion on the project. This can be attributed to and explained as follows:

- At the reservoir water intake stage, erosion of riverbed and flanks attain the maximum level, and the sedimentation process in the reservoir, due to the intense turbulence of river water in the dam slope, gets to its minimum.
- The farms in the basin of the Makamini dam can particularly, in the rainy seasons cause soil erosion and sediment deposition in the reservoir. Agricultural development in the future, in the upstream, could be a factor in accelerating erosion prospect. The predicament of soil erosion from the viewpoint of the deposition of the load of sediment and suspended solids in the reservoir is of utmost importance.

Mitigation Measures

- Construct a diversion channel prior to commencement works to divert the river water in case it rains unexpectedly.
- Compaction of loose material and diversion of runoff flows from construction sites
- Run-off from rainfall is a water source that can be stored and used for construction activities
- Soil excavation and embankment must be made for the immediate project area and unessential activities should be refrained from.
- Improvement of riverbed such as building some short barriers to trap sediments.
- Appropriate terracing in surroundings of the dam if possible.
- Minimize soil exposure through intensive vegetative patterns.
- Land use control in the basin and catchment areas
- Preventing over-grazing in the basin

7.3.2.3. Slope Stability

Construction Phase

No impact is anticipated during the phase of construction.

Operation Phase

One of the natural processes that take place is the permeation of the water into the stratum of lands surrounding it. In the case that the stratum is inappropriate, and there is a steep slope towards the dam reservoir, due to water permeation the durability between the layers decreases and the stability of the slope is disrupted, resulting in landslides and the vibration of soil masses and rock. The unsuitable exploitation from the fringes of the reservoir for construction materials and steep slopes in the flanks of the reservoir can exacerbate the vibration of the slope. Such disruptions can create high waves on the dam surface, the danger of overflow and an intense pressure on the body of slope, shall form breakages and a complete destruction of the installations, which culminates in intense human and financial loss. Therefore, on the whole, it can be expected that the impact of the formation of the dam on the slope stability occurs with a low intensity.

7.3.2.4 Soil Contamination

Construction Phase

Due to the activities of the machineries, so as to construct the various components of the project and the settling of oil compounds and fuel, soil contamination may be witnessed in some areas of the immediate limits of the dam. Soil contamination in the construction phase is mainly due to spilling of oil compounds on the ground, oil refill of machinery, oil and gasoline leakage due to machinery activities and machinery repair, effluent disposal, land filling and waste depot.

Operation Phase

There will be minimal and insignificant impact on soil contamination during operation as the dam is not for irrigation.

Mitigation Measures

- Oil residuals including waste oil, lubricants, used filters, should be carefully collected and stored for safe disposal, in order to prevent spilling of contaminant hydrocarbons into runoff or groundwater.
- Regular maintenance of site equipment and machinery should be carried out to ensure any leakages are detected and controlled.

7.3.3. Impact on Water

7.3.3.1. Biology, Physico-chemistry and Salinity (River)

Since the Makamini dam is constructed on the confluence of Rivers Mulunguni and Vigurungani, all the construction activities will have effect on the water quality directly or indirectly. Fortunately, these rivers are considered to be seasonal in nature and therefore currently they are dry with no trace of water in them. With the commencement of the construction phase of the project, temporary residential camps for workers and staff, construction workshops, warehouse of materials and repair workshops for light and heavy machinery are erected, each of these have a special impact of their own.

For the construction of the Makamini dam and its main components, including its side installations, the most critical of these impacts is the accelerated erosion and an increment in the sedimentation, which enters the river and results in the reduction of the river water quality. Sewage and wastes produced in the temporary residential camps is considered as an important pollutant factor during construction phase. In the case of the absence of a sanitary system for sewage and waste burial, these pollutants may impact negatively on the ground water sources.

In the operational phase, in case the issue of sanitation in the area is not resolved by construction of more sanitation facilities, then this waste may eventually enter the dam causing the BOD, COD and biology parameters to increase. This effect is an adverse, inevitable and reversible impact of the project that is apparent on a short-term basis during construction phase. Although, if care is not taken to tackle the poor sanitation on the area, then these effects may spill to the operational phase.

Mitigation Measures

- The recommended structural design and integrity to be adhered to as much as possible to minimize any resultant soil erosion that may negatively impact on the dam by causing high sedimentation levels
- The contractor to provide temporary sanitary facilities and workers sensitized on their proper usage
- Ensure the location of sanitary facilities is far away from the confines of the proposed dam to reduce any possible likelihood of land contamination.
- Institute a broad water quality monitoring system such as to focus on the entire dam water quality variations, treated water and water downstream of the dam location. Maintain appropriate records on water quality upon commissioning of the dam, including the implications of the dam to the water quality downstream need to be monitored.
- Regenerate indigenous vegetation along the dam boundary to minimize surface runoffs and soil erosion into the dam that might increase salinity
- Maximize cropping opportunities and minimize fallow lands

7.3.3.2. Water loss

This impact is related to the dam and water treatment plant.

Construction Phase

No impact.

Operation Phase

The general rate of surface water loss from the dam area could increase through exposure to weak geological points and increased surface area. Evaporation from the dam water surface impacts on the microclimate and salinity. The evaporation from the dam lake surface brings about an increase in the amount of sodium that remains in the water. In the case that this is intense, this leads to the salinity of the dam water. If the output water from the dam is used for irrigation, it is accounted as an indirect adverse impact of the project on the proposed area for agricultural development within Makamini and further downstream. The implications of the evaporation would be more

pronounced on increased surface area of water exposure. While this could not be quantified at this point, it is expected to be relatively significant.

Other water loss pathways effectively imply;

1) Unaccounted for water losses from the dam structures such as seepage through possible fissures in the base rock and hence unachieved desired dam expectations,
2) The scenario could also cause possible weaknesses to housing foundations downstream of the dam location, though there are no significant settlement downstream and the few present are likely to be relocated,
3) Micro-climate moderation (lower temperatures and higher humidity) through increased atmospheric moisture arising from evaporation and transpiration. This would be enhanced by the breeze arising from the sea blowing westwards,
4) Potential losses of water at consumer points through wanton wastage, leakages in the distribution pipelines and overuse in the farms in the case of irrigation.

Mitigation Measures

- Geological profiles throughout the area proposed for inundation should be continuously monitored and areas of weaknesses noted for incorporation of appropriate strengthening measures (this constituted an important part of the feasibility and design stages of the project),
- Sub-surface water infiltration trends on affected areas should be monitored over a period of time with respect to effects on houses and other structures downstream. However, it is noted that there might be no residuals on the lower zones of the dam,
- Indigenous trees and shrubs with low water dissipation capacity should be encouraged around the dam buffer zone to minimize loss of water through evapo-transpiration processes,
- Ensure enhanced monitoring maintenance of the transmission and distribution pipelines upon commissioning to ensure minimal loss of water through leakages,
- Introduce economic and financial initiatives towards water saving and responsible utilization at all consumer points. Water Service Providers have a significant role in this regard.

7.3.3.3. River Water Flow

Construction Phase

The Mulunguni and Vigurungani Rivers are seasonal rivers and currently they are very dry with no evidence of water. Therefore, no impact is anticipated during the construction phase in relation to the river flow.

Operation Phase

The river flow regime of Mulunguni and Vigurungani Rivers, upon the water intake of the reservoir shall undergo outstanding transformations. That is a change from a river to dam system, including the formation of a reservoir with an approximate capacity of 300,000 m^3. This leads to a change in the flood regime of the rivers. This also accounts for an indirect impact on the river ecosystem. This change has several environmental impacts, from the viewpoint of transformation in the riverbed, at the reservoir location and or in the downstream of the dam, the quality and power of self-purification (of the river) and similarly, the ecological connection of aqua life (between upstream and downstream). In rivers with rich biodiversity in relative to aqua life species, this factor causes a disturbance in the balance of the environmental river ecosystem and is hazardous for fish life. However, the rivers in the project area are seasonal and therefore devoid of any bio-matter. Flooding caused by the overflow of Mulunguni and Vigurungani Rivers will be eliminated as a result of the construction of the proposed dam reservoir. Throughout the year, the number of substantial amounts of water will be required for treatment to help meet the water demands of the population within the project area and its environs.

Mitigation Measures

- With commencement of the operation of the Makamini Dam, Mulunguni and Vigurungani Rivers flow will be regulated in accordance with the water resources guidelines of the dam, so that, in the warm months of summer, with release of the environmental water flow, the minimum river flow is conserved in the downstream.
- The decrease of river flow in the downstream, during the operation period is accounted for being an adverse impact of the project, however, with supervision and management of the environmental water flow, it is not as a high intensely impact considering these rivers are normally dry within larger periods of the year.

- Creation of small weirs in the riverbeds, consisting of a system of meshes of logs driven in or anchored to the bottom and protected by stony material and impermeable or semi-permeable earth, so as to create an over-flowable barrier, where the meteoric waters or those discharged by the spillway are held; the number of weirs and their heights are adapted to the morphology of the riverbed and depend on the necessity and the uses foreseen.

7.3.3.4. Water Quality

Construction Phase

At this phase, there is likelihood to have adverse impact on groundwater quality through sewage disposal from temporary settlement camps, debris and solid waste deposit in case of lack of proper management. But, due to lack of any important or large aquifer in the region (based on the preliminary geological data) and the role of soil in filtration of these types of pollutants, this impact would be negligible.

- The vegetation (biomass accumulation) in the dam area could render high humic (organic concentration) conditions in the dam water and downstream if not removed during construction period. It also has a potential to increase the nutrients and other minerals associated with plant decaying matter.
- There are graveyards around the dam area (locations based on family villages) that would not be inundated in the dam water due to the actual and perceived implications on water quality. This situation should be addressed during construction phase.
- Like the graveyards, pit latrines in the settlement areas will not be inundated due to their long-term potential contamination of water but will be decommissioned and the earth scooped for safe disposal to pre-agreed sites. The exact locations for all pit latrines, therefore, will be established to enable smooth relocation.

Operation Phase

Overall, no effect on groundwater quality from the dam or water treatment plant during operation phase that is expected.

- Residual faecal and organic matter from pit latrine, open-air toilets and waste holding sites from the displaced and residual homesteads and social locations, would particularly impact

on the health of the water consumers and their animals, within the dam area as well as the ultimate piped destinations in the long-term,

- Nutrients (nitrogen, phosphorous potassium) among other trace elements in the soil are expected from the geological discharges, organic decompositions of plants matter and surface runoff discharges from farms and settlement areas around the dam. This could create potential for eutrophication of the dam water,
- Turbidity and suspended settable matter of water from the inflows, surface runoff discharges and organic reactions among other sources is also a potential challenge to water quality. This situation may lead to limited light penetration that has got direct linkage to biological quality of the water,
- Limited water mixing, aeration and light penetration reduces available oxygen resulting into anoxic conditions at the lower layers of water in deep reservoirs. Anaerobic conditions in the lower layers of the water generate carbon dioxide, methane, hydrogen sulphide and create low pH scenarios, particularly if the organic content is high. Due to the lowered pH, the geologically held iron and manganese and other heavy metals are likely to be released into the water effectively changing the water quality,
- Implications on water quality would be felt by the water consumers in the immediate location of the dam as well as social and ecological dependents of Chigulu River (Changes name to Mwache downstream) downstream in terms of habitat pollution, people's health and cost of water treatment at various stages.

Mitigation Measures

- Institute a broad water quality monitoring system such as to focus on the catchment sources, incoming flows, entire dam water quality variations, treated water and water downstream of the dam location.
- Maintain appropriate records on water quality as required by the law upon commissioning of the dam, including the implications of the dam to the water quality downstream (Chigulu River) need to be monitored,
- All vegetation materials (live and dead) at the dam site shall be cleared and removed before the area is excavated and inundated. This will ensure controlled release of organic matter

into the dam water. Proliferation of aquatic macro-flora could be encouraged along the periphery of the dam to ensure natural aeration and purification of the water,

- All identifiable graves falling within areas to be inundated will require decommissioning and relocating to prevent contamination of water. The exercise will, however, be undertaken in full observance of traditional rites as well as the wishes of the affected families.

7.3.3.5 Sedimentation in the Reservoir

Construction Phase

Construction activities will involve massive earth moving within the river flood plains and sections of the adjoining riverbanks and lands. This loosening of the soil creates a situation where any heavy rains will freely wash down the silt into the downstream areas including.

Operation Phase

One of the critical problems in the dam reservoirs is sediment and sedimentation. River sediments are deposited in the reservoir which make the water clear. So clear water (without sediment) emits from the valves and or spillway. The impacts of sediment deposition in the reservoir can be surveyed from various points of view, as described below:

a) Decrease in the beneficial life of the dam;

Deposition of sediments causes a rapid increase in the dead volume of the reservoir and decreases the beneficial life of the dam. The direct impacts of which, is apparent economically in the plan as a loss in national investment and social difficulties.

b) A decrease in the nutrients of water in the dam downstream;

Totally, in a natural river flow, a large amount of nutritional materials comprising of azote, phosphorous and other elements are transported through the sediment flow of the river and gets to the downstream; usually with the water diverting towards the agricultural lands, the soil texture is rectified and the nutrients which have been taken from the land by the crops, is compensated. But the presence of dam and control of river water causes a change in the natural behavioral pattern of sedimentation and the transfer of sediments to the downstream of the

river, as well as a decrease in the load of suspended solids in the river, which culminate in a decrement of sedimentation in the agricultural lands.

c) The acceleration of erosion in the dam downstream;

In a gradient and a constant waterflow, the erosion capacity of a river, due to the increment of the concentration of suspended solids decreases. If the concentration of the sediments elevates to more than a certain level, erosion and transportation of sediments is not possible by the river. Waterflow released from the dam is usually transparent and limpid and provides immense capacities for erosion and transporting sediments. It can lead to a transformation in the morphology of the river in the downstream. Usually, the impacts arising from this erosion, can be clearly observed in the walls flanking the river, but as it mentioned before, since during the operation of the Makamini dam, an immense portion of the water will be transferred to water treatment plant and therefore the volume of water released (for environment and drinking water) is not enough for intense erosion in the flanks of the river walls.

d) Damage to control systems;

It is possible that the sediments and other materials which are transported by the river, can lead to a disturbance in the functioning systems and installations of dams. For example, sediment such as, grains of sand and sandy siliceous matters encountering with the edges of the partition walls or interior compilations of valves, body of pipes and discharge tunnels, causing them to get erosive and worn out; and sedimentation of suspended solids behind the discharging valves.

e) Possibility of water leakage from the reservoir;

The permeation and leakage of water from the dam reservoir, is more or less possible to take place in several ways. The fine-grained sediment that settles at the base of the reservoir, are at times taken to be utilized as a certified element in the prevention of water leakage. (Though, dam designers must not utilize this characteristic for the prevention of water leakage).

f) Eutrophication in the reservoir

Eutrophication is a process that occurs in water bodies, as a result of the presence of high amount of nutrients, organic matters (particularly nitrogen and phosphorous), algae and aqua plant growth which leads to a decrease in the quality of the reservoir. Totally, incidence of eutrophication in the reservoir is assessed as a negative and indirect impact with low intensity and moderate to major importance.

g) *Disposal of removed Sediment (Desilting of the dam and check dams)*

The persistent need of managing dam reservoirs in view of preserving the capacity has resulted in siltation activities. The issue of silting reservoirs in as much as may seem to be beneficial, it also has its negative aspect. Siltation may negatively impact on the aquatic ecosystems by killing the aquatic life. Therefore, to minimize any anticipated negative effects in this regard, flushing may be undertaken mainly when the reservoir is devoid of water. This approach may prove to be more effective and with minimal impact on the ecosystem..

Other impacts of sedimentation in reservoirs are such as mentioned below:

- Impact on water quality (reservoir and downstream), and
- Effect regarding the absorption of waste material.

Even though, sedimentation in the reservoir is accounted for as being a negative impact confronting the project and the environment, but with due attention to the fact that for the anticipated 50-year sediment volume (dead volume of the reservoir), in comparison with the total volume of the reservoir, a relative logic is applied. Therefore, the negative impact of this phenomenon in regards the project is not of high intensity.

Mitigation Measures

- Construction activities should take place during the dry conditions.
- Topsoil removed will need to be transported away from the site to a location not accessible to storm water.
- Provide a soil trap downstream the dam site to intercept excessive silt during the construction.
- Provide sand check dams upstream of the dam to intercept excessive silt from the catchment and effectively increase the capacity of the dam in the long term.

7.3.4 Impacts on Human Environment

7.3.4.1 Air Pollution

Construction Phase

Almost all of the activities of the construction phase of the dam such as excavation and embankment, explosion, traffic of vehicles and trucks, transportation of construction materials,

dam body, spillway, access roads, camps, land clearance, etc. with the creation of dust, suspended solids and dispersion of pollutant gases such as carbon monoxide (CO), nitogen oxides (NOx), and hydrocarbons (HC) into the air make air pollution. Since the machineries in major work with diesel or gasoline, the amount of nitrogen oxide, sulfur oxide and hydrocarbons increase in the air. The amount of gases dispersed and particles emitted from the diesel and gasoline engines (motors), is compared with each other. This impact is temporary and is limited to the construction phase. Air pollution affects mainly on the workers, staff and residents in the proximities of these activities. Due to similar construction activities of dam and water treatment plant, their impacts on air are the same, only affected locations are different. It is assessed as a negative impact with medium intensity and importance.

Operation Phase

The impacts of the project in the operation period with respect to the air quality are capable of being surveyed from two angles:

1) *The emission of greenhouse gases from the reservoir*

The eutrophication created in the dam reservoir leads to the emission of greenhouse gases from the reservoir into the atmosphere. Agricultural lands in the Makamini basin are accounted for as a critical potential of eutrophication. Similarly, due to potentials of erosion and sedimentation in the basin, organic material enters into the reservoir through flood. The deposition of these matter at the bottom of the reservoir and decomposition process due to non-aerobic condition, increase dispersion of greenhouse gases such as carbon dioxide and methane into the atmosphere.

2) *Impacts of humidity with respect to dust*

With the formation of the lake dam, the relative humidity present in the air increases. An increment of humidity leads to the dust particles suspended in the air to become heavy as a result of which, the dust particles subside.

Mitigation Measures

- Pave the main access road to the project area if possible
- Sprinkle water on exposed dusty surfaces to reduce dust generation
- Trucks hauling soil should be covered with tarpaulins

- All machineries and equipment should be maintained in good working order to ensure minimum emissions including carbon monoxide, oxides of nitrogen and sulphur, as well as suspended particles.
- Staff training before the commencement of construction activities.
- Ensure the recommendations of Environmental Management and Coordination Act (Air Quality) Regulations 2014 are adhered to.

7.3.4.2. Noise Pollution

Construction Phase

As the construction activities progress, staff and nearby homesteads are affected by the noise generated at the project sites. Two kinds of noise pollution are generally recognized and are often tackled with quite different kinds of legislation. Firstly, there is "occupational noise" which affects workers in the course of their jobs and is due to the work environment and/or to the machinery which they must operate. Secondly, there is "environmental noise", such as traffic noise, and which is not related to job.

Almost all the activities in the construction period of the Makamini dam Project, in particular with the explosions, culminate in elevating the level of noise in the region; such that the level of noise can increase till approximately 85 to 105 decibels during the peak hours of work. The level of noise during operations, at a distance of more than 150 to 250 meters from the operational area can gain the level of 70 decibels. Noise pollution is confined to the construction period and its impacts are in major on the workers and personnel engaged in project activities. The resources creating noise pollution in the construction phase of the project.

Operation Phase

No specific and meaningful noise pollution is expected during operation phase of the dam site. With due attention to existing simple and low-cost mitigation measures, and having sufficient distance from rural areas, it is assessed as a negligible negative impact.

Mitigation measures

- Ensuring construction machinery and equipment are serviced as per the manufacturers recommendations to promote optimum efficiency within the acceptable noise levels
- Conduct periodic noise assessments in areas of high noise generation to ensure that the permissible levels are not exceeded.
- Sensitize drivers of construction vehicles and machinery operators to switch off engines or machinery that are not being used.
- All equipment should be maintained in good mechanical order and fitted with the appropriate silencers, mufflers, or acoustic covers where applicable.
- Stationary noise sources should be sited as far away as possible from noise-sensitive areas, and where necessary acoustic barriers should be used to shield them.
- Workers should be given noise protection equipment such as earmuffs and be taught how to use them and supervised to ensure such safety procedures are being adhered to.
- The public should be informed that short periods of noise may be inevitable but prior warning of when extremely noisy activities are to take place. Therefore, prior notice should be given indicating the day(s) and times for such activities.
- Use of portable acoustic barriers to shield compressors and other noisy equipment where necessary.
- Ensure the recommendations of Environmental Management and Coordination Act (Noise and Excessive Vibration Pollution) (Control) Regulations 2009 are observed and practised.

7.3.4.3 Public Health

Construction and Operation Phases

Construction, rehabilitation work and traffic during operation will create dust, air and noise pollution, which can have an impact on public health. Oil wastes from vehicles can also impact on public health if they find their way into water sources. The leaded compounds will accumulate on any vegetation planted for consumption purposes. Sanitation and hygiene in the workmen's camp are also issues of concern, and if not properly addressed can lead to outbreaks of illness such as hepatitis, typhoid, intestinal worms, etc.

Mitigation measures

- Toilet facilities supplied by the contractor for the workers shall occur at a minimum ratio of 1 toilet per 30 workers (preferred 1:15).
- Sanitation facilities shall be located within 100m from any point of work, but not closer than 50 m to any water body.
- All temporary/portable toilets shall be secured to the ground to prevent them toppling due to wind or any other cause.
- The contractor shall ensure that the entrances to toilets are adequately screened from public view.
- Sanitary facilities shall be maintained in a hygienic state and serviced regularly.
- Only approved portable toilets with adequate water should be used.
- Toilet paper shall be provided.
- The contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are removed from site to an approved disposal site.
- Discharge of waste from toilets into the environment and burying of waste is strictly prohibited.
- Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas, which include groundwater, are not polluted.

7.3.4.4 Increase in HIV/AIDS and other diseases

Employment opportunities for the locals will mean more income generation and subsequently more disposable income. Construction work schedules can be involving at times to the extent of denying workers family time especially for those who stay away from their homes. The resultant effect of this prolonged stay away from families may prompt men to indulge in promiscuous activities, hence promoting prostitution. In addition, such work travels may influence negatively some social and guiding principles of these workers who may be tempted to engage in adventurous sexual explorations away from their homes.

Mitigation Measures

- Development of training and awareness materials for dissemination of information on HIV/AIDS.

- Sensitization and awareness campaigns on prevention of HIV/AIDS should be conducted.
- Have VCT services on site and encourage workers to voluntarily undergo the same.
- Allow for the availability of male and female condoms to workers and staff strategically and socially presented for the duration of the contract especially at the campsite.
- Allow workers regular time-off to be with their families to reduce promiscuity and susceptibility to STDs and HIV/AIDS.

7.3.4.4 Occupational Safety and Health (OSH)

As in any normal workplace, there are occupational hazards. To prevent personal injury and deleterious health effects, good occupational safety and health practice has to be followed.

Mitigation measures

- Workers to be provided with appropriate personal protective equipment, such as coveralls, boots, mittens, gloves, dust and fume masks, all of which must be regularly replaced.
- The abstract of the Occupational Safety & Health Act 2007 must be displayed at prominent places within the site.
- Well stocked first aid box which is easily available and accessible should be provided within the construction site
- Ensure that all site personnel are provided with an adequate supply of safe drinking water, which should be at accessible points at all time.
- Provide conveniently accessible, clean, orderly, adequate and suitable washing facilities within the site.

7.3.4.5. Dam Safety

Damages to environmental features, human life and properties could arise from the following scenarios

I. The dam breaking,
II. The spillways giving in,
III. Collapsing of the raised storage tanks,
IV. Overflows onto upstream roads and bridges,
V. Accidental drowning of residents and their livestock.

Risk impacts associated with these scenarios varies depending on location, public awareness and preparedness, habitats and land use affected and duration of occurrence.

- *Immediate upstream*

(i) There are a number of farmers along the banks of Rivers Mulunguni and Vigurungani immediately downstream the embankment wall having formed Chigutu River. The farmers and their crops are at risk of damage in the event of a dam break.

(ii) The local communities graze and water their animals on residuals of water left after the floods. The dam instability also poses a risk to the grazers and their livestock.

- *Downstream Areas*

The Makamini Dam will serve as a check dam for Mwache Dam and in case the former destabilizes, the latter will be adversely impacted in terms of sediment loading and a possible dam break.

- *Dam Components*

The dam will be provided with in addition to the support infrastructure, the key facilities including water treatment plant, pump house, standby power generating sets, water tanks as well as staff operation houses among other facilities. These are perhaps the most immediate victims of a dam break or other malfunctioning

- *Health risks*

Breeding of water borne vectors will potentially thrive in the dam water threatening the health of the local communities. The water quality is also an issue to the health of the local communities including their livestock. Appropriate interventions may be necessary.

- *Risk preventive measures*

The Following interventions will be necessary for minimization or preventive.

(i) Undertake a detailed Assessment study for the proposed dam and establish quantifiable risks to social, economic and ecological features at dam site and downstream. The assessment will involve an evaluation of the dam features including the dam wall,

inventory of the features at risk downstream, capacity of the risk features to withstand and establish appropriate precautionary measures among other considerations.

(ii) Initiate awareness and sensitization campaign for residents, institutions and public installations downstream the dam site on potential risks associated with the dam. Appropriate measures would also be correctively instituted on continuous basis.

(iii) Institute an early warning system for any indications on dam weakness and emergency response measures necessary. Among the measures would include emergency release of water from the dam, evacuation plans for the affected population and protection measures for the critical installations downstream.

8.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 General Overview

The management of environmental and social impacts and consequences of every proposed project is a regular, all purpose and continuous activity, which commences from the beginning of the project and the initial plan of its establishment until termination of the project life and thereafter. The purpose of the following Environmental and Social Management Plan (ESMP) for the proposed dam project is to initiate a mechanism for implementing mitigation measures for the potential negative environmental impacts and monitor the efficiency of these mitigation measures based on relevant environmental indicators. The ESMP identifies certain roles and responsibilities for different stakeholders for implementation, supervision and monitoring.

The objectives of the ESMP are:

- To provide evidence of practical and achievable plans for the management of the proposed project.
- To provide the Proponent and the relevant Lead Agencies with a framework to confirm compliance with relevant laws and regulations.
- To provide community with evidence of the management of the project in an environmentally acceptable manner.

This ESMP is prepared for the three project stages where potential significant negative impacts manifest. These are:

1) Construction Phase
2) Operation Phase and
3) Decommissioning Phase

Environmental and social management plan for the construction and operation phases is summarized and presented below (Table 10).

Table 10: Environmental and Social Management Plan

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
CONSTRUCTION PHASE				
1.	**Water quality & pollution**	• Proper and regular maintenance of vehicles.	Contractor	No Direct Cost
		• Consideration of all mitigation measures for soil erosion.	Contractor	
		• Refraining from the spilling of fuel matter, kerosene and oil compounds into the river and streams.	Contractor	No Direct Cost
		• Institute a broad water quality monitoring system such as to focus on the catchment sources, incoming flows, entire dam water quality variations, treated water and water downstream of the dam location. • Maintain appropriate records on water quality as required by the law upon commissioning of the dam, including the implications of the dam to the water quality downstream (Chigulu River) need to be monitored	Contractor Water Service Provider	100,000 O & M cost
		• All vegetation materials (live and dead) at the dam site shall be cleared and removed before the area is excavated and inundated. This will ensure controlled release of organic matter into the dam water. • Proliferation of aquatic macro-flora could be encouraged along the periphery of the dam to ensure natural aeration and purification of the water	Contractor	No Direct Cost
		• Pit latrines in the acquired land will not be inundated due to their long-term potential contamination of	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		water but will be decommissioned and the earth scooped for safe disposal to pre-agreed sites. The exact locations for all pit latrines, therefore, will be established to enable smooth relocation. Identify specific point sources of water pollution during construction (cattle pens, market centers, agro-chemical use points, etc.) for isolation and safe management		
		• All identifiable graves falling within areas to be inundated will require decommissioning and relocation to prevent contamination of water. The exercise will, however, be undertaken in full observance of traditional rites as well as the wishes of the affected families.	Contractor	No Direct Cost
		• Sanitary burial of solid wastes (in a sufficient distance from the Mulunguni and Vigurungani Rivers) and the prevention of wastewaters from entering the river.	Contractor	No Direct Cost
		• Construction solid waste generated by activities can be disposed in areas approved by the county government and NEMA that will be identified before commencement of construction activities.	Contractor	No Direct Cost
2.	**Decrease of Self-purification capability of the River**	• Implement all the mitigation measures for soil erosion and water quality.	Contractor	100,000
		• Debris should be disposed in a manner that minimizes wash outs by rainfall leading to siltation of water bodies.	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
3.	**Soil erosion**	• Compaction of any loose soil material to prevent wash away effects	Contractor	No Direct Cost
		• Diversion of runoff flows from construction sites.	Contractor	No Direct Cost
		• In order to compensate the damages incurred, due to the accelerated erosion, arising from construction activities, a control of natural erosion during the construction period must be taken under consideration.	Contractor	No Direct Cost
		• Regular inspections to identify soil erosion prone areas in need of priority attention. This helps to provide preventive/corrective measures in the early stages.	Contractor	No Direct Cost
		• Improvement riverbed such as building some short barriers to trap sediments.	Contractor	No Direct Cost
4.	**Soil contamination**	• Oil residuals including waste oil, lubricants, used filters, should be carefully collected and stored for safe disposal, in order to prevent spilling of contaminant hydrocarbons into runoff or groundwater.	Contractor	No Direct Cost
		• Regular maintenance of site equipment and machinery should be carried out to ensure any leakages are detected and controlled.	Contractor	No Direct Cost
		• All solid waste generated by construction activities should be disposed in areas approved by the project Engineer as well as that will be identified before commencement of construction activities.	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
5.	**Air Quality and Dust emission**	• Pave the main access road leading to the project site.	Contractor	No Direct Cost
		• Sprinkle water on exposed dusty surfaces to reduce dust generation.	Contractor	No Direct Cost
		• Covering heaps and berms of soil	Contractor	No Direct Cost
		• Trucks hauling soil should be covered with tarpaulins to minimize wind-blown dust	Contractor	No Direct Cost
		• All machineries and equipment should be maintained in good working order to ensure minimum emissions including carbon monoxide, oxides of nitrogen and sulphur, as well as suspended particles.	Contractor	No Direct Cost
		• Affixing filters on the exhausts remove all of the harmful NOx and soot from the exhaust.	Contractor	No Direct Cost
		• Providing personal protective equipment such as face masks and enforcing their usage in areas which are likely to have a lot of dust generation	Contractor	No Direct Cost
		• Ensure provisions of Environmental Management and Coordination Act (Air Quality) Regulations, 2014 are enforced	Contractor	No Direct Cost
6.	**Noise Pollution**	• Conduct periodic noise assessments in areas of high noise generation to ensure that the permissible levels are not exceeded.	Contractor	400,000
		• Ensuring construction machinery and equipment are serviced as per the manufacturers recommendations to promote optimum efficiency within the acceptable noise levels	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		• Sensitize drivers of construction vehicles and machinery operators to switch off engines or machinery that are not being used.	Contractor	No Direct Cost
		• All equipment should be maintained in good mechanical order and fitted with the appropriate silencers, mufflers, or acoustic covers where applicable.	Contractor	No Direct Cost
		• Stationary noise sources should be sited as far away as possible from noise-sensitive areas, and where necessary acoustic barriers should be used to shield them.	Contractor	No Direct Cost
		• Workers should be given noise protection equipment such as earmuffs and be taught how to use them and supervised to ensure such safety procedures are being adhered to.	Contractor	No Direct Cost
		• The public should be informed that short periods of noise may be inevitable but prior warning of when extremely noisy activities are to take place. Therefore, prior notice should be given indicating the day(s) and times for such activities.	Contractor	No Direct Cost
		• Use of portable acoustic barriers to shield compressors and other noisy equipment where necessary.	Contractor	No Direct Cost
		• Ensure the recommendations of Environmental Management and Coordination Act (Noise and Excessive Vibration Pollution) (Control) Regulations 2009 are adhered to.	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
7.	**Loss of biodiversity**	• Ensure the clearing of vegetation is confined to where the construction works are intended to prevent unnecessary loss of vegetation	Contractor	No Direct Cost
		• Vegetation stock should be undertaken to identify the types and species within the project area in order to ensure that during revegetation, only adaptable species are replanted to recover lost vegetation	Contractor	350,000
		• Avoid oils spills and inflammable compounds of vehicles and machinery onto the ground as to prevent soil pollution in the terrestrial ecosystem and its secondary impacts through the food chain.	Contractor	No Direct Cost
		• Avoid felling of trees especially where they have minimal effect on the on-going activities rather encourage trimming e.g. adjacent lands to borrow sites	Contractor	No Direct Cost
8.	**Land acquisition**	• Timely information disclosure to the Project Affected Persons (PAPs).	Contractor CWWDA	No Direct Cost
		• Involvement of the residents through consultations and participation will be necessary to ensure acceptability and ownership of the project by all stakeholders, irrespective of the implications to the individuals,	Contractor CWWDA	No Direct Cost
		• Conduct an all-inclusive participatory Land Acquisition and Resettlement Action Plan (LAP & RAP) that is systematically conducted to establish who owns (interested parties and shareholders) what	Contractor CWWDA	800,000

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		so as to determine the rightful owners who should benefit and the share each should receive		
		• Introduce a public education and awareness forums on the catchment management and protection of the dam, especially the immediate neighbouring landowners. Involving school children in this regard would also see long-term sustainability.	Contractor CWWDA WRA	500,000
		• Preparation and inclusion of the affected persons into existing social associations of their choice in the "new" settlement alternatives through education, awareness creation and facilitation. There may be need to pay for disturbance costs to those affected	Contractor CWWDA	No Direct Cost
9.	**Occupational Safety and Health (OSH)**	• Workers shall be provided with appropriate personal protective equipment, such as overalls, safety boots, mittens, gloves, dust and fume masks, all of which must be regularly replaced.	Contractor	200,000
		• Acquire an Incident Register from DOSHS for reporting major, minor to near miss incidences in the project.	Contractor	20,000
		• Well-stocked first aid box which is easily available and accessible should be provided within the construction campsite	Contractor	30,000
		• Training of workers in safety issues related to their activities.	Contractor	No Direct Cost
		• Hoisting and lifting equipment should be rated and properly maintained and operators trained in their use.	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		• Prepare an emergency preparedness and response plan in coordination with the local community and local emergency responders.	Contractor	No Direct Cost
		• Register all workstations, e.g., campsite as workplaces as provided in OSHA 2007.	Contractor	10,0000
		• Comply with all requirements of the Certificate of Registration of Workplace.	Contractor	No Direct Cost
		• Ensure that all site personnel are provided with an adequate supply of safe drinking water, which should be at accessible points at all times.	Contractor	No Direct Cost
		• Provide conveniently accessible, clean, orderly, adequate and suitable washing facilities within the site.	Contractor	No Direct Cost
10.	**Reduced downstream flows**	• Adherence to permit conditions on abstraction levels	Contractor	No Direct Cost
		• Monitoring the hydrology to determine whether there is reduced downstream flow and to determine the right levels of abstraction	Contractor, WRA	No Direct Cost
		• Farmer sensitization on water conservation	Contractor	No Direct Cost
11.	**Landscape**	• Prevent unessential environmental destruction, particularly the severing of bushes, trees and small trees by the workers.	Contractor	No Direct Cost
		• Selection of a proper location for dumping construction waste such as spoils in order to ensure that no haphazard disposals are conducted leading	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		physical and aesthetic disfigurement of the environment		
		• Decommission all utilised borrow pits and restore the sites to their natural or near natural state through backfilling and re-vegetation in order to maintain the aesthetic values of the landscape	Contractor	2,000,000
		• Ensuring that all construction works are conducted as per the schedule to avoid prolonging the implementation period	Contractor	No Direct Cost
12.	**Public Health**	• Toilet facilities supplied by the contractor for the workers shall occur at a minimum ratio of 1 toilet per 30 workers (preferred 1:15).	Public Health Department Contractor	No Direct Cost
		• Sanitation facilities shall be located within 100m from any point of work, but not closer than 50 m to any water body.		No Direct Cost
		• All temporary/portable toilets shall be secured to the ground to prevent them toppling due to wind or any other cause.		No Direct Cost
		• The contractor shall ensure that the entrances to toilets are adequately screened from public view.		No Direct Cost
		• Sanitary facilities shall be maintained in a hygienic state and serviced regularly.		No Direct Cost
		• Only approved portable toilets should be used		No Direct Cost
		• Toilet paper shall be provided		No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		• The contractor shall ensure that no spillage occurs when the toilets are cleaned or emptied and that the contents are removed from site to an approved disposal site.		No Direct Cost
		• Discharge of waste from toilets into the environment and burying of waste is strictly prohibited.		No Direct Cost
		• Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas, which include groundwater, are not polluted		No Direct Cost
13.	**Migration and Labour Influx**	• Proper records of work force on site while avoiding child and forced labour	Contractor	No Direct Cost
		• Effective community engagement and strong grievance mechanisms on matters related to labour	Contractor	No Direct Cost
		• Effective contractual obligations for the contractor to adhere to the mitigation of risks against labour influx, as well as engage a local community liaison person	Contractor	No Direct Cost
		• Foster efforts to include at least 1/3 of women/men as employees during implementation of the project	Contractor	No Direct Cost
		• Comply to provisions of WIBA 2007	Contractor	No Direct Cost
		• Give preference to local youth for employment opportunities	Contractor	No Direct Cost
		• Conduct awareness and educational programmes to workers and minors on the issue of sexual exploitation and child abuse	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		• Provide hotlines for the reporting of such cases	Contractor	No Direct Cost
		• Ensure that stern action is taken for offenders found to have committed sexual exploitation	Contractor	No Direct Cost
		• Develop and implement children Protection Strategy, this strategy will ensure that no child under the legal age of 18years in employed to the Project	Contractor	No Direct Cost
14.	**Increase in spread of HIV/AIDS**	• Development of training and awareness materials for dissemination of information on HIV/AIDS	Contractor	150,000
		• Sensitization and awareness campaigns on prevention of HIV/AIDS should be conducted		300,000
		• Have VCT services on site and encourage workers to voluntarily undergo the same.		50,000
		• Allow for the availability of male and female condoms to workers and staff strategically and socially presented for the duration of the contract especially at the campsite		50,000
		• Allow workers regular time-off to be with their families to reduce promiscuity and susceptibility to STDs and HIV/AIDS.		No Direct Cost
15.	**Community Conflicts**	• Ensure all stakeholders and the public are involved in the planning process.	Contractor	No Direct Cost
		• Obtain necessary permissions and approvals from the County Governments.	Contractor	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		• Ensure EIAs are conducted for specific project material collection activities, such as, borrow and quarrying sites.	Contractor	300,000
		• Ensure local residents are accorded opportunities for employment especially for the semi-skilled and unskilled labour.	Contractor	No Direct Cost
16.	**Security Risks**	• Thoroughly screen workers, suppliers and distributors accessing the campsite	Contractor	No Direct Cost
		• Ensure 24-hour surveillance by engaging the security services during the day and night.	Contractor	No Direct Cost
		• Ensure proper fencing, installation of security gates, and employment of security guards at the campsite	Contractor	No Direct Cost
OPERATION PHASE				
17.	**Water quality & pollution**	• Sensitization of the community to embrace proper hygiene standards through shunning the practice of open defecation which may result into water contamination.	CWWDA WRA Kwale County Department of Water Services Kwale County Department of Agriculture	250,000
		• Periodic sampling and monitoring of the rivers especially during rainy seasons in order to obtain the qualitative aspects of the water in order to institute any corrective measures upstream in case of evidence of pollution.		280,000
		• Watershed management and effective planning with aims to conserve the catchment, soil resources and		500,000

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		the Makamini dam, by the relevant organizations in the management and operation of the dam activities		
		• Suitable site locations for the solid waste disposal in the upstream basin of dam. Sanitary waste disposal and the prevention of the entrance of the leachate of wastes into the river should be considered		No Direct Cost
		• Utilizing sustainable pesticides, which get decomposed faster in the environment, should be considered.		No Direct Cost
		• Training farmers by regular programmes in relative to the dangers of using an excessive amount of chemical fertilizers and pesticides and its impacts on the environment.		100,000
		• Develop and implement an appropriate OSH policy to guide the operation of the constructed dam		50,000
		• Control and regulation in handling, storage, application and disposal of agrochemical containers.		No Direct Cost
18.	**Water Loss**	• Geological profiles throughout the area proposed for inundation should be continuously monitored and areas of weaknesses noted for incorporation of appropriate strengthening measures (this constituted an important part of the feasibility and design stages of the project)	CWWDA, WRA and Kwale County Department of Water Services	No Direct Cost
		• Sub-surface water infiltration trends on affected areas should be monitored over a period of time with respect to effects on houses and other structures downstream. However, it is noted that there might be no residuals on the lower zones of the dam,		No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		• Indigenous trees and shrubs with low water dissipation capacity should be encouraged around the dam buffer zone to minimize loss of water through evapo-transpiration processes,		No Direct Cost
		• Ensure enhanced monitoring maintenance of the transmission and distribution pipelines upon commissioning to ensure minimal loss of water through leakages,		No Direct Cost
		• Introduce economic and financial initiatives towards water saving and responsible utilization at all consumer points.		No Direct Cost
19.	**Groundwater table and quality**	• Comprehensive study of the qualitative/ quantitative groundwater resources.	CWWDA, WRA and Kwale County Department of Water Services Kwale County Department of Agriculture	No Direct Cost
		• Monitoring programme for groundwater.		No Direct Cost
		• The use of pesticides and chemical fertilizers should be curtailed to the minimum. In order to combat pests, disease, weeds and to fortify the land, measures devoid of chemicals should be taken.		No Direct Cost
		• If the use of chemicals is necessary, the amount used must be controlled and excessive applications should be refrained from.		No Direct Cost
		• Technical environmental surveillance on chemicals is essential.		No Direct Cost
		• Biological combating with pests and utilizing the natural prayers of pests and parasites is encouraged as much as possible		No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
20.	**Soil erosion**	• Minimize soil exposure through intensive cropping patterns.	CWWDA, Kwale County Government, Department of Agriculture, Livestock & Fisheries Development, and Environment & Natural Resources	No Direct Cost
		• Application of conservation treatments such as land leveling, conservation tillage, and crop rotations to control erosion		No Direct Cost
		• The design of water supply systems will provide for conveying and distributing water without triggering soil erosion		No Direct Cost
		• Land use control in the basin, particularly in the conditions of change in the forest, being transformed into agricultural lands.		No Direct Cost
		• Preventing over-grazing in areas around the dam basin.		No Direct Cost
		• Ensure Water intake into the reservoir with a suitable speed in order to control erosion effects and decrease the probable collapsing of the walls.		No Direct Cost
21.	**Soil properties degradation in the area**	• Avoid waterlogged conditions within the adjacent land to the reservoir	CWWDA and Kwale county government department of Agriculture, Livestock & Fisheries Development	No Direct Cost
		• Management of chemical fertilizers and pesticides.		No Direct Cost
22.	**Health & disease**	• Sensitization of the community on boiling drinking water before consumption	CWWDA and Kwale County	No Direct Cost

No.	Potential Impact	Proposed Mitigation Measures	Responsibility	Cost (KES)
		• Provision of treated nets to the targeted communities especially for pregnant mothers	Government, Department of Medical and Public Health	80,000
		• Ensuring the existing health facilities are well equipped and stocked with medication and medical personnel		No Direct Cost
		• Public Health awareness campaigns and civic education		150,000
		• Health control of dam water through sampling and monitoring.		100,000
		• Monitoring of health and disease indices.		No Direct Cost

9.0 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

9.1 General Overview

Environmental and social monitoring provides feedback about the actual environmental and social impacts of a project. Monitoring results help judge the success of mitigation measures in protecting the environment. They are also used to ensure compliance with environmental standards, and to facilitate any needed project design or operational changes. A monitoring plan ensures corrective action and effective implementation of mitigation measures are undertaken when necessary. By tracking a project's actual impacts, monitoring reduces the environmental risks associated with the project, and allows for project modifications to be made where required.

9.2 Environmental and Social Monitoring Plan

With the commencement of the Makamini dam Project, construction and its side installations, the physical, ecological and socio-economic parameters, shall be subjected to change in the area. In this regard, the changes that have come into existence have to be continuously monitored throughout the construction and operation periods of the project.

Monitoring plans should take attention of the following:

- Control the survival of quality of environmental condition within a desirable level,
- Surveillance and monitoring the qualitative and quantitative transformations of indexes in comparison to the accepted standards and criterions,
- Assessing and continuous monitoring of predicted impacts in the construction and operation phases, and
- Monitoring plan to reduce the negative impacts, in order to determine the effects of the methods and several programmes to decrease the impacts, including the comparison of the activities with the environmental criteria and regulations.

Environmental and social monitoring plan will be carried out during the construction and operation phases of the project. Environmental parameters and indicators to be monitored, monitoring time frequency, estimated costs, responsible agency and location or stations of the monitoring is summarised in this section as below (Table 11 and 12).

Table 11: Environmental and Social Monitoring Plan during Construction Phase

Environmental Parameter	Process/Description	Measure	Frequency	Monitoring Location	Responsible Organization	
					Performance	**QA/QC**
Water Quality	River	1. Physico-Chemical parameters 2. Microbiological parameters	Monthly	1. Mulunguni and Vigurungani Rivers (near the dam site) Chigulu River (downstream)	WRA	Kwale County Department of Water Services & NEMA
	• Contamination by fuels and oils • Soil erosion	Heavy metals	Every 6 months			
Soil Erosion	• Soil erosion • Increased runoff	Erosion signs & River water quality (TSS, TDS, TH, EC)	Monthly	• Mulunguni and Vigurungani Rivers • Construction site • Chigulu River downstream	Environmental management unit of the project	NEMA
Soil Contamination	• Contamination by fuels and oils	Oil, grease, etc.	Monthly	Construction sites, access roads, river bank	Environmental management unit of the project	NEMA
Noise	Unhealthy conditions	Noise Intensity	Weekly (at the peak of activities)	construction sites, surrounding areas and affected villages	Contractor, EHS officer	NEMA

Air Quality and Dust	Unhealthy conditions - Dust emissions	Dust, HC, CO, SO2 CO2, NOx	Weekly (at the peak of activities)	construction sites, surrounding areas and affected villages	Contractor, EHS officer	NEMA
Health, Safety and Environment		Level of health & safety	Weekly	Construction sites and camps	Contractor, EHS officer	Ministry of Health & NEMA

Table 12: Environmental and Social Monitoring Plan during Operation Phase

General Aspect	**Environmental Parameter**	**Measure**	**Frequency**	**Monitoring Location**	**Responsible Organization**	
					Performance	**QA/QC**
Water Quality	River	1. Physico-Chemical parameters 2. Microbiological parameters	Monthly	Mulunguni and Vigurungani Rivers River: (near the dam site) Chigulu River (downstream)	WRA & Kwale Water and Sewerage Company	NEMA
		Heavy metals	Every 6 months			
	Reservoir	1. Physico-Chemical parameters 2. Microbiological parameters	Monthly	3 points at upstream of reservoir, amidst and at the dam axis	WRA & Kwale Water and Sewerage Company	NEMA
		3. Heavy metals	Annual			

General Aspect	Environmental Parameter	Measure	Frequency	Monitoring Location	Responsible Organization	
					Performance	QA/QC
Groundwater	Groundwater water table	Groundwater level	Seasonal	At least 5 wells, random and outspread in the project area	WRA	NEMA
	Groundwater quality	Groundwater Quality including all physicochemical, microbiological parameter	Twice in the year (in the maximum & minimum levels)	The same wells have been tested for groundwater table	WRA	NEMA
		Heavy metals	Annual			
Pollution	Wastewater of Agriculture Land (if for Irrigation)	PH, DO, BOD, NO2, NO3, PO4 & Pesticides	After irrigation	At least 3 pointes of discharges to the river	WRA, County Government Department of Agriculture, Livestock & Fisheries Development and Environment & Natural Resources	NEMA
Erosion and Sedimentation	Erosion and Sedimentation	Amount of sedimentation in the reservoir	Annual	• River in the upstream of the reservoir • Midst of the reservoir	WRA, Kwale County Government Department of Agriculture, Livestock &	NEMA

General Aspect	Environmental Parameter	Measure	Frequency	Monitoring Location	Responsible Organization	
					Performance	**QA/QC**
				• River in the downstream of the Dam	Fisheries Development and Environment & Natural Resources	
Vegetation	Flora	Flora species with emphasize on index and protected species	Annual	Reservoir surrounding areas, Mulunguni and Vigurungani Rivers, riparian & Chigulu River downstream	Kwale County Government Department of Environment & Natural Resources	NEMA
Public Health	Health & Disease	• COVID-19 disease • Waterborne diseases recorded • Clinics and health centres records of prevailing diseases • Sewage disposal system • Solid waste disposal system	Annual	Villages in the project area	Kinango Sub-County Public Health office	Kwale county government department of Medical and Public Health

10.0 CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion

The project location is an ASAL area with low and very unreliable rainfall. The water demand exceeds the little available supply from water pans and few scattered boreholes which retails the commodity at exorbitant prices. Considering the poverty levels in the area is high, the challenge of inadequate water supply coupled with overwhelming distances which have to be covered to access the few available sources robs local residents especially women time to engage in other meaningful economic activities.

The population comprises of hardworking residents who passionately engage in farming activities in a bid to make a living from the agricultural produces. However, the unreliable rainfall patterns in the region have inhibited crop production over the years subjecting the farmers to abject poverty due to low returns from the minimal produce. The rivers within the project area are all seasonal and therefore much of the water during rainy seasons end up not benefiting the farmers. With the proposed development of Makamini Dam, water will be harvested and retained for both domestic and farming purposes. The reservoir will harbour water which the locals can tap to promote their farming activities and thus promote food security within the region. The project further has a component of constructing a water treatment plant to ensure that water is treated and purified to render it fit for human consumption. Not only will the project supply water to the area abutting the dam reservoir but also will be a relief to the surrounding sub-locations undergoing through similar challenges which are earmarked for Phase 1 reticulation system

It is expected that the project will directly contribute in achieving vision 2030 through increased water supply. It will improve the economic development of the region through the availability of a good quality water supply, increased agricultural food production and creation of employment among other benefits. From public participation engagements, field assessments and professional judgement, the anticipated impacts of the project on the physical environment will be manageable, mostly short-term construction-related impacts, which will be mitigated. The report has outlined mitigation measures in the ESMP to be implemented during the various project phases in order to enhance the positive impacts and mitigate the negative ones.

Given that the Environmental Assessment undertaken under this Project, and considering the Project's strong economic justification, the Project satisfactorily meets environmental protection requirements provided that the mitigation, monitoring, and reporting programs are carried out. Based on field work and consultations with local community, administration, and other stakeholders, it was concluded that:

- It is unlikely that the Project will have significant adverse social and environmental impacts. Most adverse impacts will be of a temporary nature during the construction phase and can be managed to acceptable levels with implementation of the recommended mitigation measures for the Project such that the overall benefits from the Project will greatly outweigh the few adverse impacts.
- All the negative impacts will either be moderate or lesser in rating and could be easily mitigated.

10.2 Recommendations

The consultant recommended that the proposed project be implemented in compliance with all the relevant legislation and planning requirements of Kenya at all times. In line with this, the proponent and the contractor must take the legislative framework provided in this report into consideration, during and after the implementation of the project, as will be appropriate. Also, CWWDA should implement RAP report to the latter so as to mitigate the loss of land, fixed assets and other private properties by timely compensation and restoration of livelihoods. Ultimately, the proponent should ensure all the auxiliary projects in the construction of Makamini dam should undergo individual Environmental Impact Assessments.

REFERENCES

Agnew, Upland Kenya Wild Flower, 1999.

Alfred, A. knopf, Field Guide to African Wildlife, 2009.

Autin, B., 2014. Nile Crocodile (Crocodylus niloticus) Fact Sheet, 2014 [WWW Document]. San Diego Zoo Global Library. URL http://ielc.libguides.com/sdzg/factsheets/nile_crocodile (accessed 2.Feb.17).

Branch, B., A Photographic Guide to Snakes and other Reptiles of Southern Africa, 2001.

Channing, A., Howell, K.M., 2006. Amphibians of East Africa. Comstock Pub.Associates/Cornell University Press.

Chris & Stuart, T., Mammals of East Africa, 2009.

Chris & Stuart, T., Nature in General, A Field Guide to the Tracks & Signs of Southern and East African Wildlife, 1994.

Collins, H., Collins Field Guide: Birds of East Africa, 1995.

Collins, H., Collins Guide to African Wildlife, 1996.

Davies, F.G., Verdcourt, B., 1998. Flora of Tropical East Africa - Sapindaceae (1998). CRC Press. Froese, R., Pauly, D., 2016. FishBase. World Wide Web electronic publication, version 10/2016 [WWW Document]. URL http://www.fishbase.org (accessed 2.Feb.17).

Dharani, N., Field Guide to Common Trees & Shrubs of East Africa, 2002.

NEAP, (1994). Kenya National Environment Action Plan. Government Printers, Nairobi, Kenya.

Van Zuidam, R.A. (1973). *Terrain Analysis and Classification Using Aerial Photographs: A Geomorphological Approach*. International Institute for Aerial Survey and Earth Sciences (ITC).

Republic of Kenya, (1952). Water Act, Cap 372. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (1954). Traffic Act, Cap 403. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (1969). Explosive Act, Cap 116. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (1975). Wildlife Policy, Sessional Paper No.3 of 1975. Government Printers, Nairobi, Kenya.

Republic of Kenya, (1999a). Environmental and Development Policy, Sessional Paper No.6 of 1999. Government Printers, Nairobi, Kenya.

Republic of Kenya, (1999b). Environmental Management and Coordination Act. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (2000). Kenya National Gender and Development Policy. Government Printers, Nairobi, Kenya.

Republic of Kenya, (2006). Sexual Offences Act. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (2007). Occupational Safety and Health Act. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (2010a). Constitution of Kenya, 2010. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (2010b). National Climate Change Response Strategy. Government Printers, Nairobi, Kenya.

Republic of Kenya, (2012a). Land Act. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (2012b). National Land Commission Act. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (2012c). Land Registration Act. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (2012d). National Climate Change Action Plan 2013 - 2017. Government Printers, Nairobi, Kenya.

Republic of Kenya, (n.d.). Penal Code, Cap 63. National Council for Law Reporting, Nairobi, Kenya.

Republic of Kenya, (n.d.). Public Health Act, Cap 242. National Council for Law Reporting, Nairobi, Kenya.

APPENDICES

Appendix A: TORs Approved Letter

Appendix B: Project location Maps and Layout

Appendix C: Land Easement Agreement

Appendix D: Typical Cross Section of Proposed Makamini Dam

Appendix E: Public Participation and Stakeholders Minutes

Appendix F: Filled Sample Questionnaires

Appendix G: Lead Expert License

Appendix A: TORs Approved Letter

Appendix B: Project location Maps and Layout

Appendix C: Land Easement Agreement

Appendix D: Typical Cross Section of Proposed Makamini Dam

Appendix E: Public Participation and Stakeholders Minutes

Appendix F: Filled Sample Questionnaires

Appendix G: Lead Expert License