ATHI WATER WORKS DEVELOPMENT AGENCY

AFRICAN DEVELOPMENT BANK

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED MWANIA/MIWONGONI DAM WATER SUPPLY PROJECT, MACHAKOS COUNTY

Consultancy Services for Feasibility Study, Preliminary Design and Detailed Design of the Proposed Mwania/Miwongoni Dam and Water Supply Project in Tanathi Water Works Development Agency Area

ORIGINAL

JULY 2021

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DECLARATION

I Kibet Koech of CAS Consultants Limited, the 'Consultants' wishes to submit this Environmental & Social Impact Assessment (ESIA) Study Report. To our knowledge and believe, all information contained in this report is accurate and truthful representation of all findings as relating to the project.

Signed at Nairobi .../7/2021

Sign: .....

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NEMA Report Submission Details

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Signed .....Date.....2/7/2021

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Client:

Signed .....Date.....

ATHI WATER WORKS DEVELOPMENT AGENCY
CHIEF EXECUTIVE OFFICER

Disclaimer:

This Environmental Impact Assessment Study Report is based on literature review, preliminary Feasibility and Design Reports and findings from field assessment. It is strictly confidential and any materials thereof should strictly be used in accordance with agreement from the management of Athi Water Works Development Agency (AWWDA). It is however, subject to conditions in the Environmental Management and Coordination Act 2015 (Amendment), Environmental (Impact Assessment and Audit) Regulations, 2003 reviewed in 2009 and African Development Bank Operation Safeguards Policies 1,2,3,4,&,5.

Fact Sheet	
Contract No	AWSB/KTSWSSP/CS-09/2017
Assignment Name	Consultancy Services for Feasibility Study, Preliminary Design and Detailed Design of the Proposed Mwania/Miwongoni Dam and Water Supply Project in Tanathi Water Works Development Agency Area
Lead implementing agency	Athi Water Works Development Agency (AWWDA)
Area of Jurisdiction	TANATHI Water Works Development Agency (TAWWDA)
Funding Agencies	African Development Bank (AfDB) / Government of Kenya.
Consultants	CAS Consultants
Target County	Machakos
Target Sub County	Machakos
Target Wards	Mutituni, Mumbuni North, Machakos Centrall, Muvuti, Kalama, Kola, Mua and Kinanie.

Acronyms and Abbreviations

CBO	:	Community Based Organization
AWWDA		Athi Water Works Development Agency
CO		Chief Officer
CEC		County Executive Committee
CAPEX	:	Capital Expenditure
ESMF	:	Environmental and Social Management Framework
ESMP	:	Environmental and Social Management Plan
FGD	:	Focus Group Discussion
GoK	:	Government of Kenya
SDGs	:	Sustainable Development Goals
MoTIHUD	:	Ministry of Transport, Infrastructure, Lands, Housing and Urban Development
MoWI	:	Ministry of Water and Irrigation
MPCE	:	Monthly Per Capita Expenditure
TAWWDA		Tana and Athi Water Works Development Agency
NEMA	:	National Environment Management Authority
O&M	:	Operations and Maintenance
PAP	:	Project Affected People
RAP	:	Resettlement Action Plan
RPF	:	Resettlement Policy Framework
SCWO	:	Sub County Water Officers
SoK	:	Survey of Kenya
OPEX	:	Operating Expenditure
URTI		Upper Respiratory Tract Infection
WRA	:	Water Resources Authority
WSP	:	Water Service Provider

ESIA FOR MWANIA DAM PROJECT

CONTENTS

EXECUTIVE SUMMARY

Overview

Due to the growing population, the area of Machakos town and parts of lower Athi, located to the north of Machakos County headquarters have been faced with persistent water shortages. The growth of the satellite towns and lack of water infrastructure development has led to the increased water shortage.

The project area is faced with portable water shortfall, at this point, the existing water sources are already outstretched and obsolete. Water vending has become a booming business as the precious commodity gets scarce by the day. This water shortage will continue increasing because of the rapid expansion of these towns and their population.

The major source of water in the Project area is Maruba Dam. It contributes about 90% of the current water supply to the project area while a few operational boreholes augment the dam's supply. The Nol Turesh water supply project was also designed to contribute some water to the area but heavy abstraction along its pipeline route leaves no water to get to the area. All these sources are unable to meet the current demand. Their combined total production is only 3,400 m^3/d, which is far below the total current estimated demand of 22,315 m^3/d. As such, severe water shortages are regularly experienced. The total demand is expected to rise to approximately 25,226m^3/d by the initial year (2022), 31,115m^3/d by future year (2032) and 38,470 m^3/d by the ultimate year (2042).

Therefore, the objective of the proposed dam project is to supply clean drinking water demanded by the ever growing towns and to fill the water availability shortfall faced by these towns and their populace. Secondary objective is to provide irrigation water to farmers downstream of the dam.

This assignment is part of the 'Consultancy Services for Feasibility Study, Preliminary Design and Detailed Design of the Proposed Mwania/Miwongoni Dam and Water Supply Project in Tana Athi Water Works Development Agency Area', which aims at developing a Dam Reservoir, Water Treatment Works and bulk Water Supply System for the residents of Machakos town in Machakos County. The project is located approximately 60km south east of Nairobi, and is to be developed in two stages as follows:

Stage I Feasibility Study and Preliminary Design Report

Stage II Detailed Final Designs and preparation of tender documents.

This Environmental Impact Assessment findings presented in this report provides a critical examination of issues considered important in fulfilling the requirements of a clean, sustainable and healthy environment. This Report is primarily aimed at establishing the impacts of the proposed Mwania/Miwongoni Dam project on the environment; biodiversity, sustainability of resource utilization, resource use conflicts and socio-economic, socio- cultural and socio-political wellbeing of the nearby residents and the region. During the study, the ESIA team made consultations, interviews and field visits to the project area and offices of relevant stakeholders. The views and concerns of all relevant stakeholders were noted and considered when developing the Project and this study report.

The Proposed Project

Considering known site conditions as well as availability of construction materials within the vicinity of the dam reservoir area, an earthfill dam with a clay core was determined as the best alternative at the site. With the parameters obtained for above investigations, the consultant has thus undertaken the preliminary designs of a 33m high earthfill dam with a clay core at the site. The embankment will rise from 1539m to 1572m amsl.

The embankment has been designed with slopes of 1:3 and 1:2.5 for the upstream and down-stream respectively while the crest width is 6m. In order to control the seepage losses through the embankment, a central core constructed using impervious clay materials has been proposed. The core section will be compacted at optimum moisture content so as to achieve maximum dry density. The materials will be sourced from within the reservoir area. The core has side lopes of 1:0.3 both upstream and downstream. The width of the core is 23.2m at the base (el 1539masl) and built to elevation 1571m amsl. In order to arrest runoff particularly on the downstream slope resulting from precipitation, two berms have been incorporated on elevations of 1550m and 1561m. Then there will be 2m thick inclined filters with slopes of 1:0.3 for both upstream and downstream slopes. This satisfies the sizing criteria given in the USACE-EM-1110-2-2300 (2004). These inclined filters will be connected to a horizontal drainage blanket which will help evacuate the seepage losses to the toe of the dam.

The key project parameters of the proposed 33m high dam design are presented in the following project synoptic Table.

Project Name	Mwania Dam
Location	37M 305,119m E 9,827,081m S
County	Machakos
Sub County	Machakos Central
River Basin	Mwanial River Basin
River	Ikiwe / Mwania
Type of Dam	Zoned Earthfill Dam
Dam Crest Elevation (masl)	1,572
River Bed Elevation (masl)	1,539
Dam Height (m)	33
Upstream slope	1:3
Downstream slope	1:2.5
Crest Length (m)	513
Crest Width (m)	6
Mean Annual Evaporation (mm)	1800
Total Volume of the Embankment (CM)	484,797
Clay material for the core (CM)	51,178
Sediment yield rate in (m^3/km^2/year) arrived at using the NWMP of 1992	450
Site Suitability Index (SSI)	25
Hydrology	
Drainage Basin	3EA
Catchment area (km^2)	234

Mean annual rainfall	753mm
Mean annual rainfall runoff	55.6mm
Mean annual discharge	13MCM
$Q_{10,000}$	1200 m^3/sec
IDF (PMF)	1558 m^3/sec
Compensation flow	0.014 m^3/sec
Reservoir	
Normal Water Level (masl)	1568
Storage Capacity (CM) up to NWL	12,204,585
Submerged Area at the NWL (m^2)	1,298,434
Gross Freeboard (m)	4
Net Freeboard (m)	1
Reservoir Fetch (km)	2.4
Spillway	
Type of Control	Side channel Ogee
Spillway crest elevation	1568masl
Height of side channel ogee (m)	3
IDF - PMF	1,560m^3/s
$Q_{10,000}$	1,200m^3/s
Control section crest length	140m
Trough section	Trapezoid slopes 1 H: 2.5V
Trough bottom width	25m -33m
Water depth at chainage 0 (m)	10.184
Water depth at chainage 140 (m)	7.090
Wall height in trough including freeboard (m)	10.8
Elevation of second control section (m)	1556.915
Spillway Outflow Section	
Shape of section	Rectangular
Length (m)	350
Elevation at the entrance point masl	1556.915
Elevation at the terminal point (masl)	1544.89
Difference in elevation (m)	12.02
Section 1 Slope 0-210	0.0123
Base width of the channel (m)	35
Section 2 Slope 210-350	0.0683
Energy Dissipation	Flip bucket
Bucket Radius m	15
Lip angle	29.93^0
Horizontal distance, lip to impact area m	49.7
River Diversion System	
Diversion flow (CM/sec)	162m^3/sec
Height of upstream coffer dam	11
Culvert Invert level upstream (masl)	1539.2

Culvert Invert level downstream (masl)	1538.8
Culvert slope	0.068
Diversion culverts	2 No.
Dimensions (Height)	3m
Dimensions (Width)	3.5m
Length (m)	220
Stability and Seepage Analysis	
ks for upstream slope	2.223
ks for downstream slope	1.996
ks for full reservoir	2.176
ks for rapid draw down	2.125
ks considering seismic forces	1.187
Seepage loss (m3/day)	74

Scope of the Assignment

The Consultant is to undertake an Environmental Impact Assessment Studies for the proposed Mwania Dam Project. After selecting the dam site, the Consultant shall further carry out an Environmental Impact Assessment study of the project in accordance with the Environmental Impact and Audit Regulations 2003, and submit the EIA Report to NEMA for approval. The Consultant shall carry out a survey to collect, collate and present information on the baseline characteristics of the existing environment within and around the project area.

Approach and Methodology

The study assessed and quantified the potential impacts, both positive and negative from the proposed dam project. The baseline information collected was used to analyze the potential impacts of the proposed project. The ESIA study team embarked on various methodologies such as field visits, literature review, consultations with the stakeholders, among others. In order to generate adequate baseline information which served as a benchmark for analyzing potential impacts and generating an Environmental & Social Management Plan (ESMP); the fieldwork was extensive and included several activities: A reconnaissance visit was made to the project area by the ESIA team which helped the team to set out key areas of observation during the study. This was then followed by field visits to the project area and the neighbourhood, taking records of observations as well as interviewing community members.

The Constitution of Kenya 2010, Water Act 2016, Environmental Management and Coordination Act (2015 Amendment) and other relevant statutes that have direct significance to the proposed project were reviewed. Other reports and reference materials on physical and biological data on the study area were also studied including literature on dams and their impacts.

Consultation and Stakeholder Participation

Consultation and public participation was mainly achieved through direct interviews, observations, questionnaire administration, holding stakeholder and public meetings; there were 10 meetings targeting the communities within the project area of influence. Other stakeholders consulted included AWWDA/TAWWDA, National Government Administration, County Government of Machakos, WRA, KALRO, opinion leaders within the community. Local leadership; local members of the Provincial Administration consisting of the Sub county commissioners; Sub county administrators; area chiefs and their assistants.

Legal Framework

Kenya laws, regulations, financiers safeguard policies and guidelines pertinent to the various aspects and activities of the proposed Mwania Dam apply.

Land Ownership

The proposed land requirement of the dam and water treatment works is 406 acres of land. The land ownership at the proposed site is owned by County Government of Machakos (CGM)120acres, Kenya Agricultural and Livestock Research Organisation (KALRO) 64 acres and private land 226 acres. Land tenure in Kathekakai location, the proposed dam site is on title hold and the project will affect 183 households in Mikuyu sub location and 2 in Kimutwa sub location, the area for water treatment plant. Census conducted on the affected households shows that as many as 790 persons will be affected by the partial land take, of importance to note is the project will occasion minimal displacement of 11 households; TAWWDA and AWWDA have undertaken a Resettlement Action Plan (RAP) to mitigate on land take impacts. This project has been designed to minimize impact on land and communities living in the project area.

Potential Positive Impacts

The positive impacts associated with the proposed project include:

i. Improved access to safe drinking water;
ii. The project will attract more investment to the region hence leading to accelerated socio-economic growth;
iii. The project will ease the current water deficit/shortages in the Project area;
iv. The proposed project presents an opportunity for tourism, training and skills acquisition;
v. Support KaLRO Katumani performance by improving access to irrigation water;
vi. Improved food security;
vii. Materials and goods will be sourced from local suppliers thus creating a ready market leading to general economic growth;
viii. The dam will be used to regulate river flows downstream of the dam by temporarily storing the flood volume and releasing it later ensuring a sustainable supply of water to various users especially downstream community;
ix. Provision of employment opportunities during both construction and operation phases of the project. Impoundment itself may however be favourable to some fish species; and
x. Improved infrastructural services within the project area opening it up for development opportunities.

Potential Negative Impacts Associated with the Proposed Project.

The negative impacts identified which need to be focused on during the study are:

i. Economic displacements- loss of riverine cultivation;
ii. Disruption of community (roads, electricity and social networks)
iii. Loss of land and assets-riparian land;
iv. Loss of vegetation;
v. Effects on farming and traditional land uses;
vi. Soil erosion;
vii. Air pollution;
viii. Blasting and noise effects;
ix. Sanitation and health problems from construction camps;
x. Material Sources (quarries and borrow pits);

xi. Changes in downstream morphology of the riverbed and banks;
xii. Changes in the downstream water quality;
xiii. Reduction of biodiversity due to blocking of movement of organisms;
xiv. Spread of waterborne diseases; spread of malaria and bilharzia from stagnation of the watercourse;
xv. Exclusion of future land uses;
xvi. Danger of people drowning either intentionally or accidentally looms with the construction of this dam;
xvii. Occupational health and safety impacts
xviii. Work safety and security;
xix. Dam safety;
xx. Labour conflicts;
xxi. Socio cultural conflicts
xxii. Proliferation of squatters and vagrants within towns neighbouring the project area; and
xxiii. HIV/Aids, Gender and Moral decadence.

Proposed Mitigation Measures

i. Resettlement Action Planning;
ii. Benefit sharing for the PAPs and the Project beneficiaries;
iii. Controlled burning and use as biomass;
iv. Shoreline protection e.g. through riprap and gabions;
v. Compliance to pollution control regulations;
vi. Employing more local personnel;
vii. Compliance to OSHA 2007;
viii. Erosion control through conservation agriculture;
ix. Reservoir clearing, shoreline stabilization and removal and covering of organics so as to avoid greenhouse gas release;
x. Safety provision (e.g. fencing of the dam);
xi. Vector control, disease prophylaxis and treatment;
xii. Basin-wide integrated planning to avoid overuse, misuse, and conflicting uses of water and land resources;
xiii. Land use planning efforts, which include watershed areas above dam; and
xiv. Dam instrumentation.

The impacts listed above are considered potential project impacts and have been subjected to a systematic assessment through ESIA study. ESIA study has interrogated all the faucets of these potential impacts in detail so as to ensure that the project can be implemented to meet its overall objectives through development of an Environmental and Social Management Plan (ESMP) to mitigate on any of the potential impacts identified during ESIA study.

Impact Assessment Approach and Methodology

The purpose of impact assessment is to identify and evaluate the likely significance of the impacts on identified receptors and resources according to defined assessment criteria. As a general approach, the proposed methodology includes the processes of analysing, monitoring and managing the intended and unintended socioeconomic and environmental consequences, both positive and negative, of planned interventions and any social and environmental change processes invoked by those interventions.

The proposed methodology envisages the following phases:

i. scoping process;
ii. definition of impacts' characteristics;
iii. prediction of impacts' magnitude;
iv. evaluation of impacts' significance;
v. identification of mitigation options; and
vi. assessment of residual impacts.

Terms of reference for ESIA

Appendix II ESIA Terms of Reference for the proposed Mwania Dam Project development and provided the structure for the main contents assessed in the ESIA Study. Moreover, in this Section further activities are proposed, aimed at integrating the current scope of work to include the key strategic aspects of planning, along with the construction aspects part of the ESIA scope. A timeline to perform the ESIA activities is finally proposed considering the need to address the key issues identified during the scoping phase.

Conclusion

Based on the findings, it is evident that construction of the proposed dam will result in overall socio-economic growth and development as a result of improvements in the availability of safe drinking water and for irrigation use in Machakos Sub County Machakos County. The potential negative impacts can be mitigated with strict adherence to the ESMP and compensation for land take.

Recommendations

i. Implement the Resettlement Action Plan;
ii. Promote catchment conservation; and
iii. Continued stakeholder engagement.

1 INTRODUCTION

1.1 Background

The Government of Kenya (GoK) has received financing from the African Development Bank (AfDB) in the form of a loan and grant toward the cost of Kenya Towns Sustainable Water Supply and Sanitation Program. Athi Water Works Developemtn Agency (AWWDA), an implementing agency of the GoK and hereinafter referred to as the 'Client' has commissioned CAS Consultants (referred to hereafter as simply 'the Consultant') to carry out the Feasibility Study, Preliminary Design and Detailed Design of the Proposed Mwania/Miwongoni Dam and Water Supply Project in TAWWDA area. This is a Multi Donor Funded project, with AfDB and the GoK jointly financing the consultancy services.

In the project context, Mwania/Miwongoni Dam assumes the name by virtue of the fact that initial studies by the client had identified potential dam sites in the Mwania/Miwongoni River system. This however did not restrict the assignment to the said river system and the Consultant explored beyond these two Rivers in the area in search of potentially suitable dam sites.

1.2 Study Overview

In accordance with our work plan laid out in the Inception Report, the project has been divided into three phases:

Phase I	Inception Report, Feasibility Study and Conceptual Design
Phase II	Full Preliminary Design, ESIA and RAP Study
Phase III	Detailed Design and Tender Documentation

Following the signing of the contract, the consultant prepared and submitted the Inception Report.

1.3 Scope of Services

The primary task of the consultant is to support the activities of AWWDA & TAWWDA and other stakeholders in the preparation of Feasibility Studies and Detailed Studies for Mwania / Miwongoni dam Project as well as develop an Environmental and Social Management Framework to specify sufficient safeguard policy measures for effective mechanisms to ensure its implementation.

The consultant/s will be expected to undertake following tasks in order to prepare the detailed Design Study of Mwania / Miwongoni Water Supply Project:

i. Carry out preparatory studies including geotechnical, hydrological, and topological
ii. Perform analysis of alternatives
iii. Undertake additional preparatory studies for the chosen site
iv. Develop a preliminary design of the dam and water supply infrastructure.
v. Conduct preliminary economic and financial study
vi. Develop final studies for:
    a) Detailed Economics and Financial Study; and
    b) Technical Detailed Design and interrelating those parts in one process; and
vii. Finalize the TOR for consultancy services in Design Review and Supervision of Works in Consultation with AWSB, and Stakeholders, including holding public consultations/hearings.

The detailed scope of works shall include the following;

i. Detailed Feasibility Study and Conceptual Design,
ii. Preliminary Design

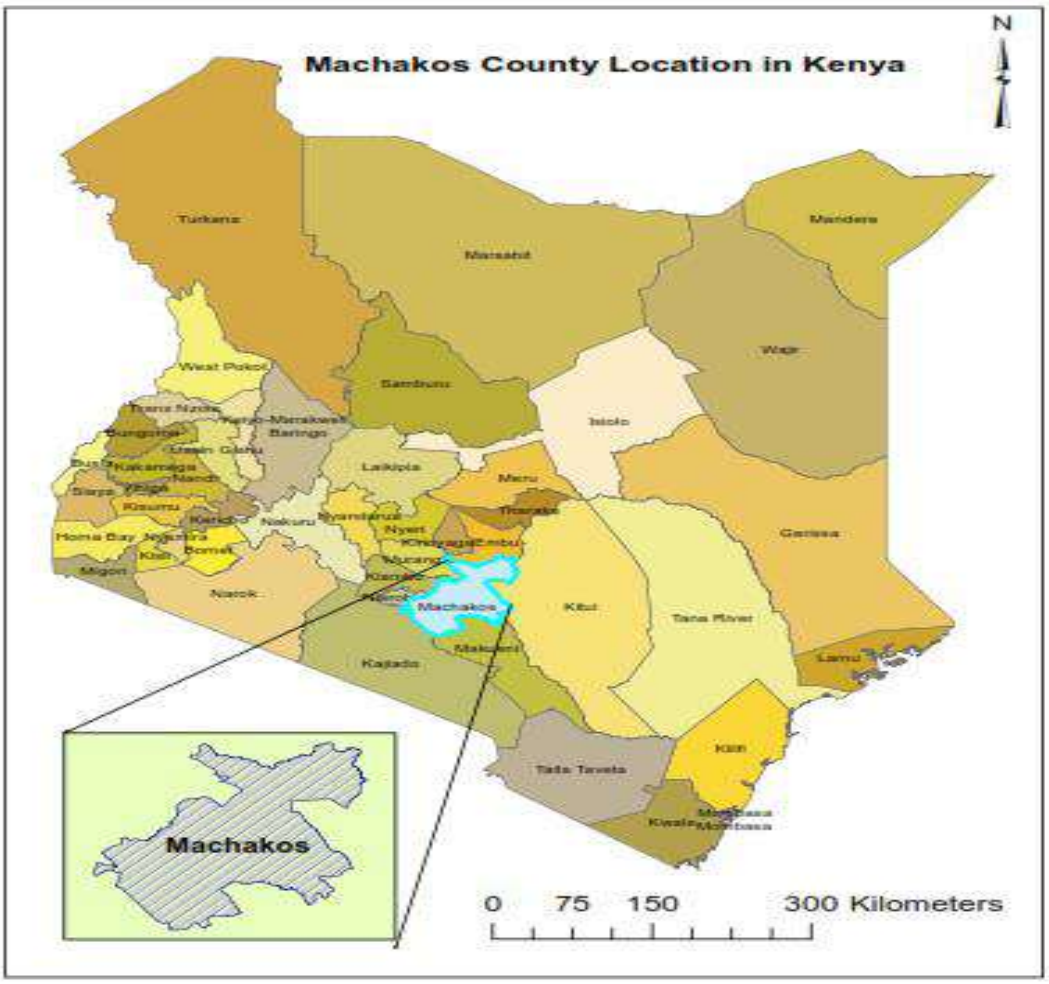
iii. Social and Environmental Impacts Assessment and Resettlement Action Plan for the selected dam site
iv. Detailed Design Reports

1.4 Project Area Machakos County

Machakos also known as Masaku is a town in Kenya, 63 kilometers southeast of Nairobi. The town serves as the capital of the County No 16, Machakos, Kenya. In the 2019 Population and Housing Census, the County population was recorded as 1,007,854. The town's population the town's, was recorded at 63,767. Historically, Machakos town was established in 1887, ten years before Nairobi. The town was the first administrative centre for the Kenyan British colony, but later on, the capital of Kenya was relocated to Nairobi in 1899 after Machakos was by-passed by the Uganda Railway that was under construction. The County borders Nairobi and Kiambu counties to the west, Embu to the north, Kitui to the east, Makueni to the south, Kajiado to the south west, and Muranga and Kirinyaga to the North West.

The town lies in a depression surrounded by hills, including Mua Hills to the West, Iveti on the Northern side and Kiima Kimwe on the southern side. With undulating terrain, the elevations vary from 1670 to 1620 meters above sea level (masl) and between coordinates (1° 33.099'S, 37° 15.375'E) to (1° 31.043'S, 37° 16.130'E).

Figure 1. Map of Machakos County showing the Project Area.



1.5 Project Location

The proposed project covers Machakos town and its environs with an estimated area of 567km^2 with Machakos town being the focal point of the project. The area includes the extents of Machakos town integrated spatial urban development plan (2015-2035), Makutano ya Kyumvi to the west of the town, up-to Kivandini to the east, Kyaani to the North and Muumandu to the south. Administratively, the area comprises of entire Machakos Central and Kalama divisions as well as Kinanie Ward in Athi River Division.

1.6 The Proponent (AWWDA/TAWWDA)

TANATHI Water works Development Agency (TAWWDA) & AWWDA transformed from Tanathi Water Works Development Agency (TAWWDA) and Athi Water Works Development Agency (TAWWDA) via Legal notice no.27 in the Kenya Gazette Supplement no.59 of 26th.April 2019

They are among the Eight Water Works Agencies serving various areas of jurisdiction in our Country. Tanathi Water Works Development Agency covers Kitui, Makueni,Kajiado and Machakos while AWWDA cover Nairobi, Kiambu and Muranga. It was created to provide bulk water and sewerage Infrastructure in its area of jurisdiction. TAWWDA & AWWDA draws its mandate from the Water Act of 2002 which includes;

a. Ownership and custodian of water and sewerage assets/infrastructure.
b. Planning, development, and expansion of water and sewerage services infrastructure.
c. Appoint viable and well managed Water Service Providers and ensure they have appropriate systems to among others:
    i. Enforce water quality monitoring,
    ii. Ensure effective and efficient maintenance systems and procedures to minimize interruptions to water supplies.
d. Build capacities of Water Service Providers to embrace efficiency, accountability and responsibility in service delivery
e. Monitoring and supervision of water and sewerage services provision by WSPs.
f. Following the enactment of the Water Act 2016, TAWWDA & AWWDA will transform into a Water Works Development Agency with the following responsibilities;
    1. Undertake the development, maintenance and management of National Public Waterworks,
    2. Operate the waterworks and provide water services as a water service provider, until such a time as responsibility for the operation and management of waterworks are handed over to a county government, joint committee, authority of county government or water services provider,
    3. Provide reserve capacity for purposes of providing water services where the Regulatory Board orders the transfer of water services functions from a defaulting water services provider to another licensee,
    4. Provide technical services and capacity building to such county government and water providers,
    5. Provide to the cabinet secretary technical support in discharging of his or her functions under the Water Act 2016.

1.7 Project Objectives

The rapid growth in population has left Kenyan urban centres with huge unmet demand for critical infrastructure and basic services. The Government of Kenya has received a loan/grant from the African Development Fund (ADF) for implementation of the Small Towns Rural Water Supply and Sanitation Project in Kenya. The objective of the project is to improve water supply, sanitation/ sewerage services in the urban, peri-urban and rural communities within the service area of the TAWWDA who is the Executing Agency. According to the Terms

of Reference, the objective of this project is to improve the water supply, sanitation/sewerage services in Machakos town.

The water sector in Kenya has been undergoing radical transformation driven by the new national policy, which separates water resources management and development from water services delivery. This conforms to the Poverty Reduction Strategy Paper (PRSP), the Economic Strategy for Wealth and Employment Creation and it is backed up by the Water Act of 2002. The Poverty Reduction Strategy Paper (PRSP) recognizes that water is a basic need and an important catalyst for both economic and social development of the country. It states that "access to water for human consumption, agriculture, and livestock use is a major problem in rural areas.

The water supply situation in rural areas has deteriorated over the years to a point where demand cannot be sustained with current systems. Access to piped water has not increased since 1989 and those accessing other water sources have increased during the same period." The PRSP seeks to provide affordable safe water and sanitation to majority of the poor at reasonable distances.

This is expected to enhance efforts to meet the Sustainable Development Goals (SDG) and realize the objectives of the Vision 2030. The country needs to provide water to an estimated 60% of the population (about 16 million people) who have no access to improved water sources, reduce uncounted for water that currently stands at over 50% and manage water provision in sustainable, business-like approach.

Provision of safe and adequate water is an effective and efficient intervention for fighting poverty, disease and social disparities. This intervention alone has positive impacts on all other SDGs and the attainment of the Vision 2030.

In the project area, provision of clean safe water will reduce costs of health care and child - mortality by reducing water - related infections which will ultimately contribute to attainment of SDGs: Universal Primary Education by freeing time for children, especially the girls, and by improving their nutritional status. The project will promote gender equity and empower women by releasing the time they now spend fetching water and seeking medication. Young people will have more time for formal and informal education and this will contribute to combating HIV / AIDS, and in line with the Kenyan constitution and the vision 2030.
It is against this background that the TAWWDA has proposed the development of the proposed water supply system to meet the water requirements for the entire area to enhance social-economic improvement leading to poverty reduction.

1.8 Project Justification

This major source of water for this region of Machakos County is Maruba Dam. It contributes about 90% of the current water supply to the area while a few operational boreholes augment the dam's supply. The Nol Turesh water supply project was also designed to contribute some water to the area but heavy abstraction along its pipeline route leaves no water to get to the area.

However due to reasons detailed in the later chapters, all these sources are unable to meet the current demand. Their combined total production is only 3,400 m^3/d, which is far below the total current estimated demand of 22,315 m^3/d. As such, severe water shortages are regularly experienced. The total demand is expected to rise to approximately 25,226m^3/d by the initial year (2022), 31,115m^3/d by future year (2032) and 38,470 m^3/d by the ultimate year (2042).

1.9 Proposed Project

Mwania Dam Water Supply Project has been projected for 20 years as stipulated by the Kenyan Water Design Manual of 2005. The current year was set at 2020 and that the project is expected to be constructed within two years, bringing the initial project year to 2022. This design further assumes that other ongoing water projects within the area, i.e the Miwongoni Dam Water Supply project and rehabilitation of the existing Maruba Dam Treatment Plants will help contribute about 15,000m^3/d by ultimate year 2042. This report therefore gives a design break down with the above considerations in mind.

From population and demand analysis, 10,226m^3/d of water is the additional requirement for initial year 2022, 16,115m^3/d for future year 2032 and 23,470m^3/d for ultimate year 2042. However, the Mwania River system through Mwania Dam project can only give a safe yield of 19,000m^3/d. The Mwania Dam Water supply Infrastructure interventions described in this report is therefore designed to have a production of 19,000 at ultimate year 2042. The Consultant thus advises that the 4,470 m^3/d water deficit be bridged through identification and development alternative water sources for the year 2042.

1.10 ESIA Objectives

The objective of the study is to carry out an Environmental and Social Impact Assessment (ESIA) of the project areas in accordance with the Environmental Impact and Audit Regulations 2003 and the international guidelines for ESIA and submit report to NEMA for approval. On the social impact assessment, it includes; carrying out a social-economic and social environmental status analysis through a base survey and prepare an Environmental and Social Management Plan (ESMP).
Under the Second Schedule of the EMCA, an ESIA is mandatory for a project that is outside the character of its surroundings. The purpose of an ESIA is to provide information to regulators, the public and other stakeholders to aid the decision-making process. The objectives of an ESIA are to:

- ✓ Define the scope of the project and the potential interactions of project activities with the environment (natural and social);
- ✓ Identify relevant national and international legislation, standards and guidelines and to ensure that they are considered at all stages of project development;
- ✓ Provide a description of the proposed project activities and the existing environmental and social conditions that the project activities may interact with;
- ✓ Predict, describe and assess impacts that may result from project activities and identify mitigation measures and management actions to avoid, reduce, remedy or compensate for significant adverse effects and, where practicable, to maximize potential positive impacts and opportunities; and
- ✓ Provide a plan for implementation of mitigation measures and management of residual impacts as well as methods for monitoring the effectiveness of the plan

1.11 ESIA Justification

Due to the unprecedented rate of environmental degradation in Kenya, the government realized the need to curb the same and this led to the enactment of the Environmental Management and Coordination Act, (Amendment 2015). The Act requires among other things that an Environmental Impact Assessment (EIA) study must be conducted on various categories of projects as outlined in the Second Schedule and section 58 of the Act. The Water Act 2016 gives the Water Resources Management Authority (WRA) specific mandates to develop instruments for surface water management. This is also related to Environmental Management and Coordination Act (Amendment 2015), the legislation that coordinates all

environmental issues in Kenya. The most significant environmental issues concerning water supply project include contamination of water sources related to poor land use planning, damage to water infrastructure, waste water disposal, downstream water users e.t.c EIA should be applied to all water abstraction projects particularly weirs and intakes since their scale of impacts require mitigation measures to be planned and implemented.

1.12 Purpose of the Report

The main purpose of this is to highlight the significance of the project's potential environmental impacts in order to determine the depth of EIA studies required. This is the initial phase in the EIA process. This report also provides registration of the proposed development with the National Environment Management Authority (NEMA) of Kenya. The term of reference for the consultancy is attached as Appendix III.

1.13 Scope of the EIA Study

The study was conducted to identify the proposed project implementation activities in order to identify the associated potential positive and negative impacts in order to formulate the necessary mitigation measures at an early stage. The negative and positive impacts of the project activities were assessed in form of benefits and losses to the community and in the light of the mitigation measures before the decision are made on the way forward. The decision to approve the project implementation or not lies with NEMA.

The EIA study included assessment of impacts of the project during construction, operation and decommissioning activities on the following:

i. Physical environment;
ii. Flora and Fauna;
iii. Land use;
iv. Social economic aspects; and
v. Public and occupational health and safety.
vi. The study assessed the impacts of the proposed development on the environment in accordance with EMCA (2015 Amendment) and covering the following:
vii. Baseline information;
viii. Activities of the project;
ix. Design of the project;
x. Materials to be used;
xi. Methodology;
xii. Assessment of potential environmental impacts of the project and mitigation measures;
xiii. Economic and social impacts to the local community and mitigation measures;
xiv. Health and safety measures; and
xv. Environmental management and monitoring plan.

1.14 EIA Guiding Principles

The guiding principles for Environmental Impact Assessment are:

- ✓ It requires that all environmental concerns must be accounted for in all development activities;
- ✓ It encourages public participation in all stages of proposed project development. It increases the ownership and sustainability;
- ✓ It also recognizes the role of social and cultural principles traditionally used in the management of the environment and natural resources;
- ✓ International cooperation in the use and wise management of shared resources.
- ✓ Intra-generation and inter-generation equality;
- ✓ Polluter-pays principle; and
- ✓ The precautionary principle.

1.15 Methodology

The impacts of the proposed project were assessed through project site visits and the following:

- ✓ Evaluation of the location, extent of the water supply pipelines, the treatment works and the current land use of the project area;
- ✓ Evaluation of the design and proposed construction materials and methodology and ;
- ✓ Stakeholders meetings and Public Barazas;

The assessment team used both primary and secondary data. Primary data was collected through site visits, personal interviews and public consultations. While at the site, the consultant used key informant interviews, semi-structured interviews, observations and focus group discussions. Secondary data was obtained through literature review.

1.15.1 Literature Review

Information obtained through literature review enabled us to know:

- ✓ Relevant laws and regulations;
- ✓ Socio-economic information;
- ✓ Water quality criteria to apply - potable, livestock etc.;
- ✓ Data gaps to be filled;
- ✓ Social, environment, community and land ownership criteria likely to influence the sitting and operation of the project;

1.15.2 Site Visits

The team visited the project site in order to:

- ✓ Develop a better understanding of the project area;
- ✓ Consult the local people about the proposed project and document their views; and
- ✓ Assess project impacts.

1.15.3 Public Consultations

Preliminary Consultation was also undertaken as part of the ESIA in order to sensitize the community, interested and affected groups within the Project area immediate area of influence. Public barazas were held in five locations of the Project area.

1.16 Terms of Reference

The environmental consultant was commissioned by the proponent through AWWDA & TAWWDA to undertake an Environmental Impact Assessment (EIA) study for the proposed water supply project and to prepare a report for consideration by the National Environment Management Authority (NEMA) and subsequent authorization to implement the proposed project. The guidelines to conducting an EIA as per Environmental (Impact and Audit) regulations 2003, applied in addition to terms of reference between the proponent and the environmental expert.

1.17 Constraints and Limitations

The information presented in this report is by and large consistent with the data and information gathered through the various sources and approaches outlined above. However the study experienced various constraints and as a result there could be gaps in information in the report as the consultants could not exhaust the collection of all primary data.

The findings and issues advanced in this report reflect the general views and perceptions of some selected people and stakeholders. They may not cover the specific issues from unique situations or individuals. Some of the information in the report was processed from secondary sources and it is therefore necessary to understand the report with the time reference beside the limitations.

1.18 The ESIA Team

The ESIA team comprised of the following:

Dr Eng. S. M Mwarania	Project Director
Eng Wainaina	Team Leader/Dam Expert
Eng George Muchugia	Civil Engineer
Kibet Koech	Environmentalist
Pauline Ikumi	Sociologist
James Waititu	Hydrologist
George Muhugu	Cordinator
Nick Abbeyi	Land Economist

2 DESCRIPTION OF THE PROJECT

2.1 Proposed Dam

The selection process of the dam axis location was driven by the topography which as captured by LiDAR survey of the site. Aside from the topographical consideration, the suitability of the axis was also found to be geologically suitable. The precision topographic layout map is projected in Arc1960 UTM Zone 37S geodetic system. Dam axis is 511.98m long and starts at X = 304962.22, Y = 9827276.22 (left side of the river flow) and ends at X = 305248.08, Y = 9826878 (right side of the river flow). The elevation of the dam crest is on 1,572m while the river bed is on 1,539m thereby giving a 33m high dam. A snapshot of the site is shown in the Figure 2-1.

The reservoir area generally consists of farmland, grazing land and scrubland with scattered vegetation of shrubs and trees or under cultivation some presence of human settlement although homesteads tend to be ridge tops.

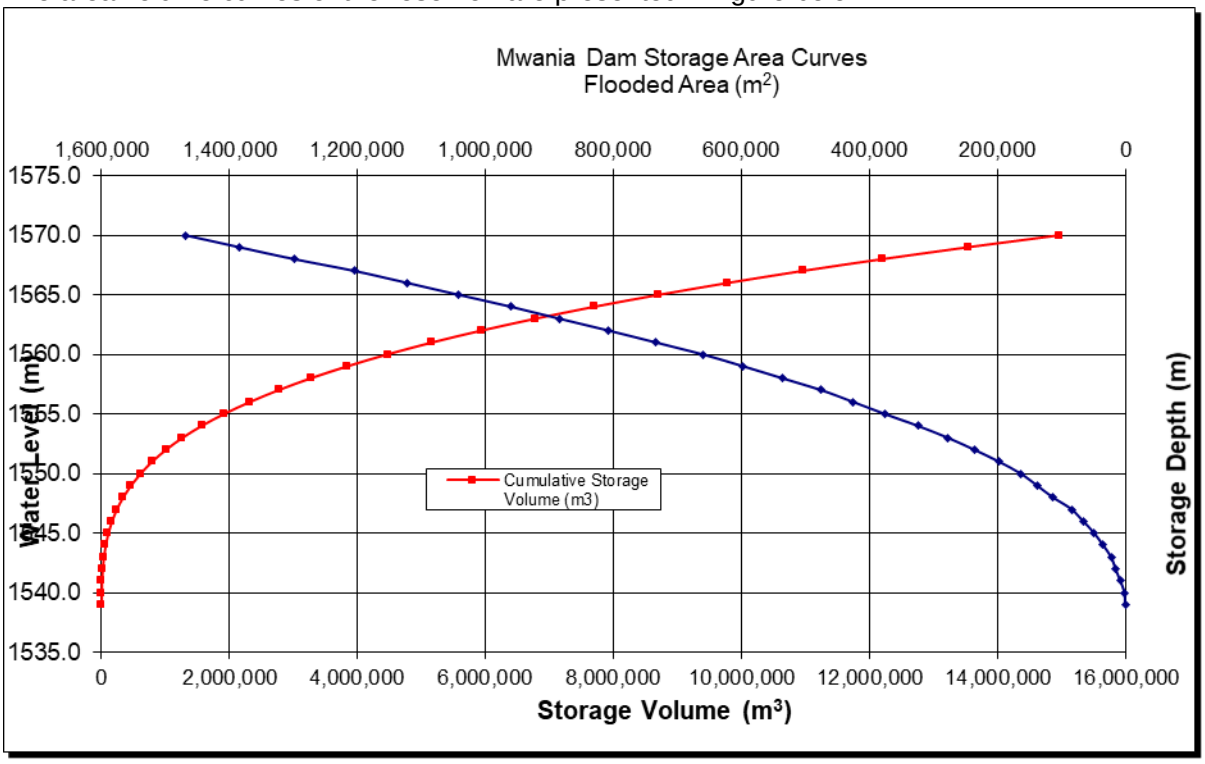
2.1.1 Reservoir Characteristics

The topographic survey base of the dam and reservoir area was derived by using LiDAR survey. Arising therefrom, topographic contours were derived and then used to estimate the water elevation – storage volume and water elevation – reservoir area relationships which are generally termed as the reservoir characteristics and they are presented in the following figure.

Elevation (m)	Depth (m)	Flooded Area (m^2)	Storage Volume (m^3)	Cumulative Storage Volume (m^3)
1,539.00	-	-	0.00	0.00
1,540.00	1.00	978.40	489.20	489.20
1,541.00	2.00	7,822.96	4,400.68	4,889.88
1,542.00	3.00	15,160.41	11,491.69	16,381.57
1,543.00	4.00	22,122.37	18,641.39	35,022.95
1,544.00	5.00	34,894.62	28,508.49	63,531.45
1,545.00	6.00	48,674.24	41,784.43	105,315.88
1,546.00	7.00	65,953.43	57,313.84	162,629.72
1,547.00	8.00	84,208.27	75,080.85	237,710.57
1,548.00	9.00	113,445.13	98,826.70	336,537.26
1,549.00	10.00	138,018.55	125,731.84	462,269.10
1,550.00	11.00	163,905.70	150,962.12	613,231.22
1,551.00	12.00	197,826.22	180,865.96	794,097.18
1,552.00	13.00	236,294.61	217,060.41	1,011,157.59
1,553.00	14.00	277,767.91	257,031.26	1,268,188.85
1,554.00	15.00	324,485.49	301,126.70	1,569,315.55
1,555.00	16.00	376,254.09	350,369.79	1,919,685.34
1,556.00	17.00	424,993.29	400,623.69	2,320,309.03
1,557.00	18.00	475,512.69	450,252.99	2,770,562.02
1,558.00	19.00	536,459.69	505,986.19	3,276,548.21
1,559.00	20.00	597,113.29	566,786.49	3,843,334.70
1,560.00	21.00	660,699.85	628,906.57	4,472,241.27
1,561.00	22.00	733,764.57	697,232.21	5,169,473.48
1,562.00	23.00	807,303.48	770,534.03	5,940,007.51
1,563.00	24.00	884,472.35	845,887.91	6,785,895.42

Elevation (m)	Depth (m)	Flooded Area (m^2)	Storage Volume (m^3)	Cumulative Storage Volume (m^3)
1,564.00	25.00	960,326.27	922,399.31	7,708,294.73
1,565.00	26.00	1,041,288.36	1,000,807.32	8,709,102.05
1,566.00	27.00	1,121,666.28	1,081,477.32	9,790,579.37
1,567.00	28.00	1,203,955.42	1,162,810.85	10,953,390.22
1,568.00	29.00	1,298,434.41	1,251,194.92	12,204,585.14
1,569.00	30.00	1,384,184.32	1,341,309.37	13,545,894.50
1,570.00	31.00	1,468,318.07	1,426,251.20	14,972,145.70
1,572.00	33.00	1,648,651.86	3,116,969.93	18,089,115.63

The area volume curves of the reservoir are presented in figure below.



2.1.2 Location of the Spillway

The spillway for Mwania dam is located on the left abutment of the natural valley cross section; a side channel ogee type is considered to be the best option. The control weir is 3m high and its crest is on level 1568masl while the toe is on level 1565masl. The outflow section is 307m long and the terminal point is on level 1541masl on river Mitheu, which further downstream joins the main Mwania River. In this case, the receiving water body will be trained so as to accommodate the assumed flood flow of 1,560m3/sec.

The choice of the spillway to be designed will be dependent on the topography of the site i.e. requiring a rather flat section for the open channel or side channel ogee spillway control structure and this is aimed at reducing the volumes of excavation. In the case of either type of spillway, the best location of the spillway for Mwania dam is on the left hand side where the contours demonstrate little excavations.

2.1.3 Determination of the NWL and the Crest Level of the Dam

The crest level of the dam as per the site topography is on level 1572masl. With a gross freeboard of 4.0m, then the Normal Water Level of the dam is on elevation 1568.0 masl. With the bed level of the dam being on 1539masl, the static depth of water is, therefore, 29m.

2.1.4 Spill Way

A side channel ogee spillway is selected as the best alternative. The spillway is 442.33m long and it falls from 1565m to 1539m at the terminal point where the energy dissipator will be constructed. The difference in elevation is 26m thereby generating a longitudinal slope of 0.04814.

2.1.5 Embankment Dam Design

The following factors have been taken into consideration during the preliminary design of the dam;

i. The slopes of the embankment should be stable under all conditions of construction and operation, including rapid drawdown of the reservoir.
ii. The foundation under the reservoir area must be water tight. The findings of the ERT and core drilling have been used to determine the need for pressure grouting as a way of foundation treatment.
iii. Seepage losses through the embankment will be controlled through proper compaction of the construction materials, foundation and abutments so that piping, sloughing or removal of material by solution does not occur. However, if seepage occurs, then it will be collected by the filters and be discharged into the toe of the dam through perforated pipes.
iv. Filters will be constructed to collect the seepage waters and hence lower the phreatic line especially on the downstream slope of the dam and, therefore, enhance stability of the slope.
v. The gross freeboard of the dam must be sufficient to prevent overtopping by the waves and include an allowance for settlement of the foundation and embankment after full consolidation will have taken place. The gross freeboard of the dam has already been determined to be 4.0m.

2.1.6 Dam Foundation

The foundation of the dam should be strong enough to withstand the stresses which will be exerted on it by the embankment wall and it should be water tight so as not to allow excessive seepage losses to the downstream end of the dam. Seepage losses will be prevented through grouting which entails creation of a grout curtain along the axis of the dam. This is achieved through injection under specified pressures of grouting materials which will comprise of sand and cement with additives. According to geological and geotechnical investigations, the overburden layer was observed to have a maximum depth of 12m below the surface. Excavation of this materials to such a depth would seem excessive. In this regard, it is proposed that a 5m deep core trench be excavated and then grout material injected from a grout cap which will be located at that point. In order to assess the spacing of the grout boreholes, trial grouting will be carried out and the information generated thereon will be used to prepare a grout program. The grout holes will comprise of primary and secondary and if need be tertiary which will all be in rows spaced at 2m intervals.

2.1.7 Clay Core

Seepage losses through the embankment wall are not desirable because they threaten the stability of the dam and they may result in draining the reservoir thereby causing piping and eventual dam failure. In order to control the seepage losses, the central clay core will be constructed using impervious clay materials which will be compacted at optimum moisture content so as to achieve maximum dry density. The materials will be sourced from within the reservoir area. The core has side lopes of 1:0.3 both upstream and downstream. The width of the core is 23.2m at the base (el 1539masl) and built to elevation 1571m amsl.

2.1.8 Embankment Zoning and Filters

The embankment will be constructed using clay materials which are available within the dam site. However, the materials will be zoned within the embankment and they will be properly

compacted at optimum moisture content so as to achieve the maximum dry density. Then there will be 2m thick inclined filters with slopes of 1:0.3 for both upstream and downstream slopes. This satisfies the sizing criteria given in the USACE-EM-1110-2-2300 (2004).
The inclined filters will be connected to a horizontal drainage blanket which will help evacuate the seepage losses to the toe of the dam.

2.1.9 Cutoff Trench and Cutoff Width (w)

The cutoff trench reduces loss of water through the foundation and the abutments and it also prevents sub-surface erosion by piping. The bottom width of the trench is fixed based on the following considerations;

i. Provision of sufficient working space for compaction
ii. Provision of sufficient space to carry out curtain grouting
iii. Provision of safety against piping

The base width (w) is 5m which is sufficient to accommodate the compaction equipment.

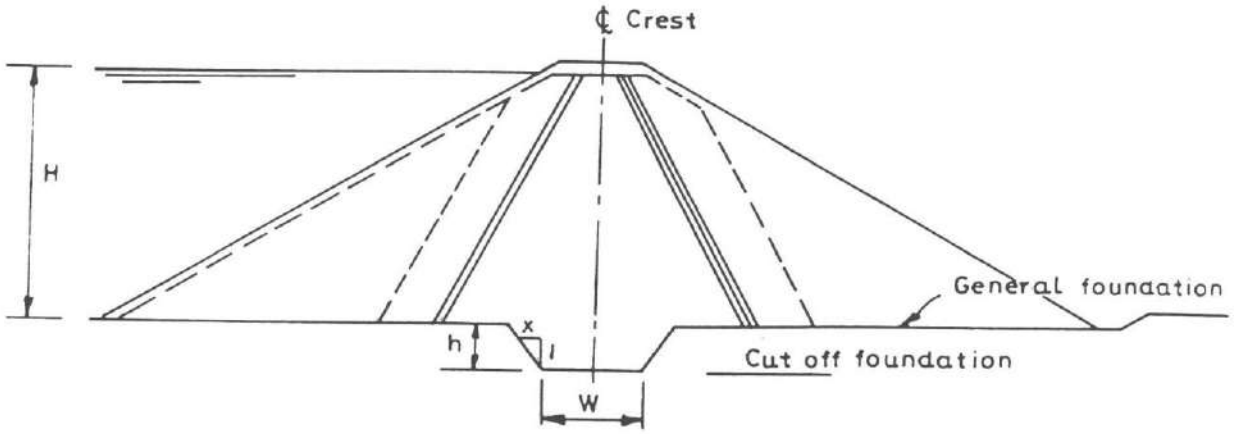


Figure 2-2; Cut off Trench Details

2.1.10 Batter Slopes of the Cutoff Trench

The selection of the batter slopes for the cutoff trench is based on the foundation material which is fractured rock. In the case of this dam, the batter slopes are 1V:1.5H which is adequate to allow compaction of the clay materials against the sides of the trench.

2.1.11 Volume of the Embankment Materials

As mentioned elsewhere in this report, the dam axis is located in a narrow gorge as shown in the book of drawings. The length of the dam crest is 786m while a crest width of 6m has been adopted for the dam height of 33m; the crest level being on 1,572m and the bed level being on 1,539m. Two berms are also included at elevations 1550masl and 1561masl.

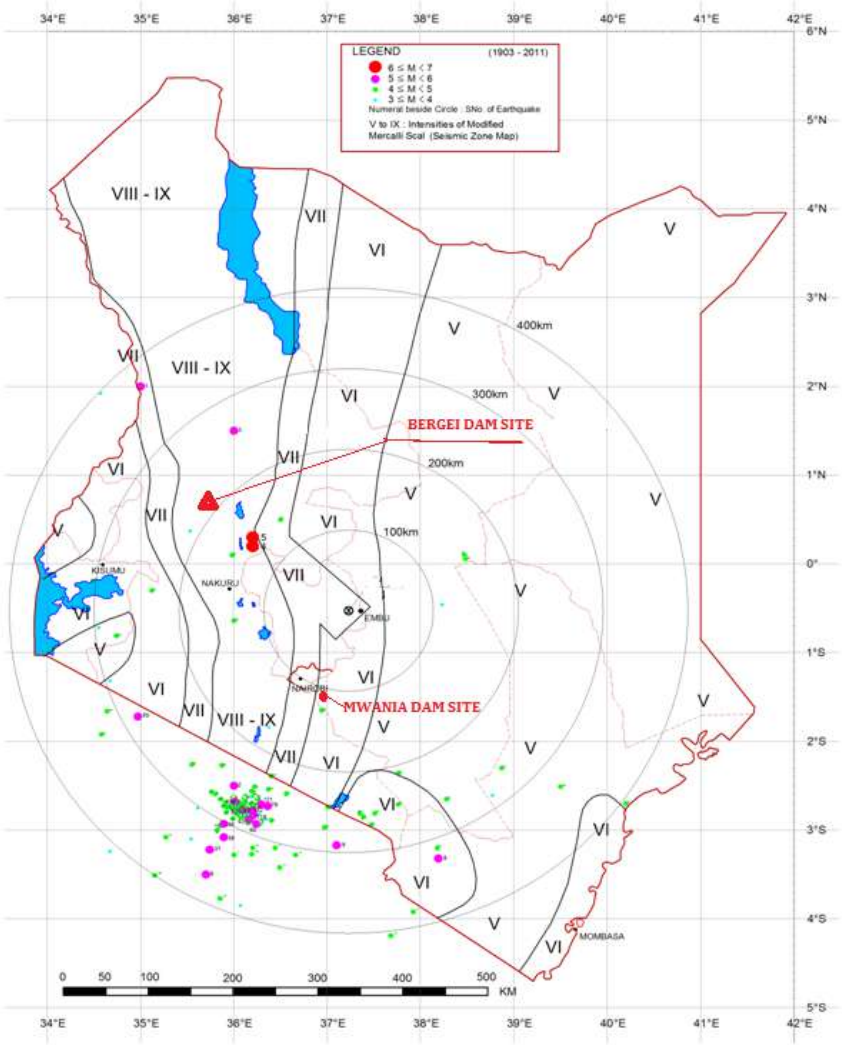
2.1.12 Dam Filter

In the case of Mwania dam, the filters will be inclined and will run across the entire river valley joining the two abutments and then finally be connected to a drainage blanket which will house a 4 No. 150 mm diameter perforated seepage drain pipes which will be connected to V notches for measuring the amount of seepage losses through the embankment wall. For ease of construction of inclined filters in large dams, 8- to 10-foot (2.4-3m) widths are commonly used so that over-the-road trucks and smaller dozers can be used as per USBR (2013) Design Standards No. 13, Embankment Dams, and Chapter 5: Protective Filters

2.1.13 Seismic Zoning Map of Kenya

The figure below shows the seismic distribution Map of Kenya and it was developed by Prof. S. I. Loupkine of the University of Nairobi in 1972. According to the map, Mwania Dam lies in zone VI

According to the map, the high-dense areas of the epicenter have a tendency to appear along the Great Rift Valley, but compared with seismic intensities of other countries, the seismic activity in Kenya is not so high as to cause serious consequences.



2.1.14 River Diversion

River diversion works will be constructed to divert the river flows during construction. This entails construction of an upstream coffer dam and a river diversion passage or culverts. The coffer dam diverts the water to the diversion culverts, which thereafter evacuate it to the downstream part of the dam and thus create a dry working environment. It is also necessary to construct a downstream coffer dam to prevent backflow of water to the area of construction.

The river diversion system for Mwania dam is designed against a flood flow of a return period of 25 years which is estimated to be 162m3/sec. The coffer dam will have its crest on

level 1550 masl so as to coincide with the lower berm. Assuming a freeboard of 2m, then the static depth of water in the pool is 9m.

2.1.15 Diversion Passages

Diversion passages for the dam are concrete culverts which will be built by cut, construct and cover methods. The cover method will be the final one to be applied once the actual construction of the culverts is completed. The axis of the diversion culvert as selected is through an area where foundation will be in rock. Tunneling may not be feasible on this side of the abutment because of the rather flat slopes.

The entrance points to the culverts will be fitted with thrashracks (screens) to arrest any debris which may enter into the culverts and further on into the culverts thereby reducing their conveyance capacity. Debris in the culvert would ultimately raise the head of water in the pool created by the cofferdam resulting in its possible overtopping. However, this will be averted by constructing three culverts which will also ease plugging during the impoundment of the reservoir.

2.1.16 Draw Off Tower

All the water abstracted from the dam will be treated at a Water treatment plant located 1.6km downstream of the reservoir, thus the outlet works have been conceptualized to cater for the following;

i. Raw Water Pipeline
ii. Compensation pipe for Environmental flow release (EFR)
iii. Rapid drawdown outlet for emergency evacuation of the reservoir

The outlet works for the dam comprises of a dry concrete intake tower, pipes and control valves. The pipes will be flanged steel pipes.

For abstracting raw water, the consultant considered two options consisting of a single draw off point at the lowest elevation of storage in the reservoir versus multiple intakes at alternate elevations. The criteria weighing the options included;

i. Assured reliability,
ii. capacity to enable the water to be drawn from any selected level in reservoir to obtain water of a desired quality and/or to draw from a stratum relatively free from silt or algae or other undesirable contents and;
iii. Ease of maintenance repair of alternate control valves without interruption of water supply service is also of primary importance.

Applying the above criteria, the consultant selected multi-level intakes tower due to the fact that the water is abstracted for domestic water supply where quality of abstracted water is of key importance.

Abstraction of water into the raw water pipeline shall therefore be through the draw off tower located at altitude 1,542m on the right hand side of the dam, the free standing outlet tower will be located over the diversion tunnel. The intake tower bell mouths will be equipped with trash racks and fine screens and will house a 500mm diameter pipe with 3 staggered intakes, each equipped with control valves (at elevations 1550m, 1555m and 1560m). The vertical intake pipe will be connected to a horizontal pipe laid in the diversion tunnel once the diversion tunnel is closed at its upstream end by a closure. The total length of the raw water pipeline is 1600m to the treatment plant.

In designing the tower location and layout, Functional and service requirements, component interrelationships and compatibility, economy, safety, reliability, and repair and maintenance requirements have all been considered. Site conditions considered include topography, geology with regard to foundation bearing capacity. Hydrology and minimum flow requirements were also important for determining the range of design release elevations.

Drawings AWWDA/MW/DT/001 in the book of drawings shows the features of a draw-off tower. Flow regulators and measuring devices will be put in place at the tower to control the water flow and quantify the amount of water into the pipe as required by WRA.

2.1.17 Compensation flows

Downstream water requirements (compensation flows) will be released during the closure and impoundment operations of the reservoir until such time that the permanent works (intake tower and water draw off system) will be operational so as to release the river flows according to the downstream water requirements.

When impounding the reservoir, a compensation flow equivalent to 95% of the base flow will be released for sustaining the ecosystem downstream of the dam. For this section of the river, this flow amounts to 0.014m3/sec.

The effective head through which the compensation flows will be discharged to the downstream end of the dam will be measured from the dead water level to the terminal point of discharge and it is equal to 33m measured from level of 1534masl to 1550masl at the terminal point. The diameter of the compensation flow pipe is calculated as follows:

A= 0.014/(0.92*4.43*4) m2
A = 0.014/16.3 m2
A = 0.0000859 m2
Diameter of the pipe D
D = (4*A / 3.14)^0.5
D = 0.034m
D = 34mm

The diameter of the pipe is rounded to a standard diameter of 50mm.

The compensation flow pipe will terminate at the embankment where it will discharge the water back into the river course for further flow into the downstream areas.

2.1.18 Reservoir Sedimentation

Storage reservoirs built across rivers or streams tend to lose their capacity progressively with the passage of time on account of sedimentation. After the designated life of a reservoir, sediment affects the regulating capacity of reservoir/dam as the functioning of water intakes may get affected. It is therefore necessary to make an assessment of reservoir sedimentation and plan for a specified full service time of the reservoir. Provisions should thus be made for sufficient sediment storage in the reservoir at the time of design so as not to impair the reservoir functions during the useful life of the project or during the period of economic analysis.

As a general observation, there is general lack of sediment data for Mwania River. The sediment records held by the Ministry of Water and Irrigation and the Water Resources Management Authority do not contain any sediment load sampling and analysis from Mwania River. However, "The Practice Manual for Water Supply Services in Kenya (2005)" provides some guidelines in estimating the sediment load as given in the table below:

Erosion Class	Sediment Load (m3/km2/year)
Low	500
Moderate	1000
Heavy	1500

In addition, under "The Study on the National Water Master Plan (July, 1992), sediment load studies were undertaken and suspended load rating curves developed for different watersheds in the country as follows;

Region	Erosion Rate (m3/km2/year
Upper Tana River	350
Upper Kerio River	47.66 * Ri - 3016
Machakos Area	10.00 * Ri - 550
Dams in the Forest	120
Others	10.89 * Ri - 465

Ri – Average probable 1-day rainfall in the dam catchment with 10-year probability

Identifying Mwania River Dam as being in Machakos area, the sediment load (SL) has been estimated as follows:
Ri = 100mm; (National Water Master Plan Study)
SL = 10.0 * Ri -550 m3/km2/year
SL = 450 m3/km2/year
Further, under the "Design Review, Detailed Design and Construction Supervision of Mwache Multi-Purpose Dam", an in-depth study on sediment yield in Mwache River sub catchment was undertaken by the contracted consultant. This study established established that the sediment yield in Mwache River sub catchment was in the region of 451m3/km2/year {541 tonnes/km3/year (Bulk density of sediments taken to be 1.2 tonnes/m3)}. The two catchments are similar, particularly on topography and land use. This further lends credence to the use of 450 m3/km2/year for Mwania River sub catchment.
With a sediment yield rate of 450 m3/km2/year and considering the catchment area of 234 km2, the total annual sediment yield is 105,300m3. In a 50 year economic lifespan, this would translate to a loss of 5,265,000m3 or 43.14% of the initial capacity. For a semi-arid, water scarce area like Machakos, such substantial loss loss of dependable storage resulting from sediment deposition would be unacceptable and this therefore calls for conservation or erosion control measures in the drainage area as an important step for reduction in the long-term sediment production.
The terms of reference (ToR) task the consultant to compute sediment loading and loss of storage capacity and provide estimates of dead storage both for the feasibility and detailed design design stages. The design of sediment control measures is not part of the ToR and the consultant therefore recommends actions by the client targeted at development of a sediment management plan for the catchment area upstream of the dam.
In order to manage sediments from the contributing catchment area, two principal alternatives are recommended for further consideration by the client and other stakeholders. These include;

a) Water shed management

The amount of sediment loads from the catchment area is fairly high considering its size, the fragile nature of the soils due to poor agricultural practices and land use practices. In order to reduce the amount of sediment generation, a multisectoral approach should be adopted and this will comprise of the following institutions:

i. Ministry of Agriculture
ii. Kenya Forestry Services
iii. Ministry of Infrastructure (Roads)

They will all work under the guidance of Water Resources Authority which is mandated to carry out water resources and catchment management countrywide. Such conservation measures will take time to realize reductions on sediment yields.

b) Upstream check structures

This more immediate measure involves construction of check dams at strategic areas along the river course. These areas will be selected or identified based on a well-defined criteria which encompasses topography and geology. The 234km2 catchment is made up of three sub basins which converge slightly upstream of the proposed dam site to give rise to Mwania main tributary. Of the three, Potha sub-basin is the largest covering about 134km2 and the Miwongoni and Maruba sub-basins covering about 100km2. Maruba limb has an existing dam while the works contract for construction of Miwongoni dam is already awarded. The sediments from these respective systems are summurized below;

River system	Area km^2	Sediment yield/year	50 year Sediment yield
Potha	134	60,300	3,015,000
Maruba	52.1	23,449	1,172,453

Miwongoni	47.9	21,551	1,077,547
Total	234	105,300	5,265,000

It can be seen that Potha will contribute the highest proportsion of sediments in the reservoir. It is thus realistic to assume that by the time proposed Mwania dam is implemented, the sediments from Maruba and Miwongoni limbs will be trapped in the upstream reservoirs in those rivers and priority should thus be given to installing a check dam on Potha River system. These can be in Mamikuyu, Kalua Uki and Wamua streams just upstream of the proposed dam.

2.1.19 Reservoir Emergency Evacuation

A low level outlet has also been provided to perform the functions of evacuation of the reservoir if emergency conditions occurs, or inspection, maintenance, and repair of the dam and appurtenant works that are normally submerged; and controlling the rate of reservoir rise as may be required by reservoir filling criteria. It is sized on based on dam net outflows of irrigation, hydropower and domestic supply.

The evacuation criteria considers the proposed dam a high risk downstream hazard as a significant population (more than 6 persons) lives adjacent to the river valley downstream. The dam area itself is considered a medium risk area as certain natural elements do not stand out such as;

i. Risk of earthquakes and earth movements
ii. High probability of hurricanes or flash floods
iii. Active faults in or near the dam embankment
iv. High potential for rock solutioning
v. High potential for piping

Nonetheless, it is not to be considered low risk as there may be unprecedented compromise in construction material, quality control during construction and deterioration of structural elements with age.

The initial reservoir water surface elevation to be used to perform evacuation computations is the top of active conservation capacity to the original streambed.

The guide overleaf by Department of the Interior, Bureau of Reclamation has been adopted to establish evacuation time in days

2.1.20 Sequence of Construction

The construction works of the project will commence after all the land has been acquired and compensated for as informed by the Resettlement Action Plan.

The first activity will be implementation of the activities as listed under the Preliminaries and General Items and in particular establishment of the camps for the RE and the contractor's staff, procurement of all the vehicles and mobilization of machinery and equipment to site and it will follow the critical path.

The other remaining activities will be executed as per the following description;

i. Setting out the works for the diversion culvert and the upstream and downstream cofferdams
ii. Start construction of the culverts in cut, construct and cover methods within the limits of the embankment wall.
iii. Construct the open inlet and outlet sections of the diversion channel. The inlet section of the channel should be left closed until the entire culvert is completed after which this particular section will be open to allow water flow through the culvert and thus pave way for the commencement of the construction of the cofferdam.
iv. Fix and anchor the outlet pipes in the culverts; all the water abstracted from the dam will first be used to generate hydropower and thus the outlet works will be designed to cater for the following; penstock, compensation flow and rapid draw down pipe.
v. Set out the axis of the upstream cofferdam and excavate the secondary core trench.

vi. Construct the upstream cofferdam up to a height of 11m which coincides with the lowest berm and which will provide safety of the dam works during the construction period. The upstream cofferdam will ultimately be incorporated into the main embankment wall.
vii. Construct the downstream cofferdam up to a height of 11m which coincides with the lowest berm and which will provide safety of the dam works during the construction period. The two cofferdams will ultimately be incorporated into the main embankment wall.
viii. Set out the dam axis and excavate the entire length of the primary core trench at the river bed and throughout the entire valley along the dam axis.
ix. Carry out grouting works under the core trench at the point of the dam axis as well as along the abutment walls of the dam
x. Embark on the construction of the earthfill embankment, the central clay core, the inclined filters and the horizontal drains.
xi. Set the point of the intake tower and start excavation works followed by subsequent construction of the same.
xii. Construct the side channel ogee spillway.
xiii. Construct the outflow section of the spillway which is 442m long.
xiv. Construct a flip bucket energy dissipater at the terminal point of the outflow section.
xv. Construct above the outflow channel a 6m wide bridge with a span of 10m.
xvi. Upon completion of the dam wall, construct a foot bridge to connect the dam crest to the intake tower.
xvii. After the completion of the construction works, plug the diversion culverts to pave way for the impoundment of the reservoir. Closure of the culverts may even start earlier to facilitate gradual impoundment of the reservoir.

Diverting the river into the temporary passages (diversion culverts) and ultimately closing or plugging them off to begin impoundment of the reservoir is usually the critical activity in this approach. The diversion passages should be ready as soon as the coffer dam is built for easy diversion of the river flows.

2.1.21 Closure or Plugging of the Diversion Culverts

The two diversion culverts and arrangements will be such that one of the culverts will be closed while the second one will be functional.

The physical method of closing the diversion passage includes the following;

i. Sliding steel and concrete bulkheads,
ii. Large timber or concrete balls,
iii. Two rows of concrete stoplogs with concrete poured between them,
iv. Semi-circular concrete stoplogs dropped in front of the upstream portal
v. Once these items are in place, the permanent concrete plug will be placed and the control gate will be removed

2.2 Dam Instrumentation

Instrumentation is an integral component of any dam and its insertion in a structure can entail design modifications. The formulation of its definitions is the responsibility of the project designer. However, other players involved in implementing dam monitoring systems include equipment manufacturers, personnel in charge of installing the equipment and data collectors, construction contractors, engineers and the project Client who will be using the results. Procedures outlined in the Quality Assurance Plans aim at the following specific objectives:

i. Operational system
ii. A reliable system
iii. Storage and interpretation of data

2.2.1 Instrument Selection

Through comparison of measured values with the values calculated in the design stage using a reference model, instrumentation enables the monitoring of the dam's safety level and the timely implementation of the corrective measures.

The criteria to be considered while selecting the instruments is as follows:

i. Reliability of instruments
ii. Longevity of the instruments
iii. Ease of automating the readings.

2.2.2 Quality

The equipment to be used in the dam body should be sturdy and stable since it will be permanently fixed in the dam body. This is especially critical for cells measuring pore pressure the knowledge of which takes precedence over that of all other factors. The sensors and cables that transmit the information to the outside of the dam need excellent reliability because of the significance of the data that will be collected as it will give the direction of the activities geared towards enhancing the dam safety.

2.2.3 General Layout

The general layout of the instruments is based on the vertical or horizontal sections which the designers consider to be of primary importance. The choice of instruments depends on the objectives designed to monitoring. The first objective is to monitor safety by verifying the hypothesis regarding the behavior of the dam in order to improve future projects. However, the major difficulty is to prioritize the parameters considering the overall configuration of the dam including the specific structural elements and the heterogeneity of its foundation.

2.2.4 Types of Instruments

Survey monuments

Concrete pillars square base (1.2m x 1.2m) embedded into natural ground 0.6m followed by a concrete column 0.5m x 0.5m. The top of the column shall be equipped with a brass survey plot cast in the concrete and it will bear the GPS coordinates and the geodetic level of the position. The monuments will be far from the dam axis such that they will not be destroyed during construction. All other measurements will be taken relative to the monument.

Surface Displacement Measurements

This targets for direct topographic measurements and they will be tied with bench marks.

Measurements of Displacement within the Dam

These are settlement stand pipes which give a discontinuous reading of displacement along a vertical line.

Inclinometers

Inclinometers usually consisting of a metal or plastic casing inserted in a drill hole and a sensitive monitor either lowered into the casing or fixed within the casing. They give a discontinuous reading of horizontal displacement along a vertical line. The system may be used to measure settlement.

V- Notch

The V Notch will be installed at the end of the downstream slope and it will measure seepage water through the concrete face and the rock fill material. The seepage water will be collected in 150mm diameter perforated PVC pipes surrounded in geotextile polyfelt material to avoid entry into the pipes of fine materials which may be washed away from the embankment wall. The angle of the V notch is 900 and the notch will be calibrated accordingly.

Calibration of the V Notch

This type of V notch is suitable for measuring flows which are less than 200 l/sec. The notch will be calibrated using the equation expressed below;

$$Q = C_d x \frac{8}{15}\sqrt{2g}\, x \tan\frac{\theta}{2} h_e^{5/2}$$

$$C_d = disch\arg ecoefficient = 0.585$$

$$For an angle of 90^0, the formula assumes the following form$$

$$Q = C_d x \frac{8}{15} x \sqrt{2g}\, x h_e^{5/2}$$

Accelerometer / Seismograph

To measure the behavior of the embankment during and immediately after an earthquake if it occurs, one number strong motion accelerograph (SMA) will be installed at the lower berm on the downstream slope of the dam on level 1,550masl.

The accelerograph will register the movement of the dam crest and the background movement of the surrounding materials.

Instrument House

The instrument house has been conceptualized on the left hand side of the dam and it will be on level 1550masl which coincides with the level of the lower berm. The dimensions of the house will be 4m long x 3m wide and 2.3m high. It shall be an RC house with a lockable steel door, two windows and all necessary holes for instrument tubings and it will partly be buried in the shell. The tubings shall be protected in uPVC pipes.

Cabling

Appropriate cable layout is an essential condition since the monitoring system is to last for many years. The layout takes into consideration the geometry of the embankment zones from the perspective of the lifespan of the dam as well the conditions in which it was built. The construction phase is one of the most critical phases in the life of any monitoring system

2.3 Water Supply

2.3.1 Existing water Supply & Sanitation

The major source of water for this region of Machakos County is Maruba Dam. It contributes about 90% of the current water supply to the area while a few operational boreholes augment the dam's supply. The Nol Turesh water supply project was also designed to contribute some water to the area but heavy abstraction along its pipeline route leaves no water to get to the area.

However due to reasons detailed in the later chapters, all these sources are unable to meet the current demand. Their combined total production is only 3,400 m^3/d, which is far below the total current estimated demand of 22,315 m^3/d. As such, severe water shortages are regularly experienced. The total demand is expected to rise to approximately 25,226m^3/d by the initial year (2022), 31,115m^3/d by future year (2032) and 38,470 m^3/d by the ultimate year (2042).

The existing distribution network within Machakos Town consists of Galvanized Iron (GI), uPVC and Asphaltic Concrete (AC) pipes of sizes varying from 150mm to 50mm. Many of these pipes are in poor condition and consultations with the WSP show that many bursts

occur whenever the level of water in the storage tanks is high, leading to high levels of unaccounted-for water (UFW) which currently stands at almost 45%.

2.3.2 Design Projections

Mwania Dam Water Supply Project has been projected for 20 years as stipulated by the Kenyan Water Design Manual of 2005. The current year was set at 2020 and that the project is expected to be constructed within two years, bringing the initial project year to 2022. This design further assumes that other ongoing water projects within the area, i.e the Miwongoni Dam Water Supply project and rehabilitation of the existing Maruba Dam Treatment Plants will help contribute about 15,000m^3/d by ultimate year 2042. This report therefore gives a design break down with the above considerations in mind.

From population and demand analysis, 10,226m^3/d of water is the additional requirement for initial year 2022, 16,115m^3/d for future year 2032 and 23,470m^3/d for ultimate year 2042. However, the Mwania River system through Mwania Dam project can only give a safe yield of 19,000m^3/d. The Mwania Dam Water supply Infrastructure interventions described in this report is therefore designed to have a production of 19,000 at ultimate year 2042. The Consultant thus advises that the 4,470 m^3/d water deficit be bridged through identification and development alternative water sources for the year 2042.

2.3.3 Development of Design Criteria

The Design Criteria is primarily based on the guidelines for design parameters are laid down by the Ministry of Water & Irrigation of the Republic of Kenya in the Practice Manual for Water Supply Services in Kenya, Published in October 2005 (MoWI, 2005). Where the design guideline is silent, other design standards, guidelines or previous experience of project specialists have been used in consultation with appropriate stakeholders. Where appropriate, adjustments to these other guidelines have been made to consider conditions in the project area. For other criteria relevant to detailed design (e.g. Sewer and structural criteria) the designs will conform to British Standards and other stated standards.

The chosen criteria emphasize functionality, cost effectiveness, environmental compatibility and long-term flexible operation and ease of construction bidding process with reduced maintenance costs. The objectives of this section are to establish the criteria necessary for a realistic Engineering design of the Project water supply and sanitation facilities and to present reasons behind their selection.

This section thus lists the necessary design criteria, describes system component evaluation and selection, and provides sufficient detail to allow the design and study of the Project element to proceed. The design criteria for the following items are included:

- ✓ Treatment plant
- ✓ Pipelines
- ✓ Pumping equipment
- ✓ Water storage facilities

This sub-section describes the criteria to which the project has been designed. This includes, minimum flows, and minimum diameters for pipe network design, the appropriate criteria for the design of the water treatment plants, costing and financial analysis and the criteria for the design of the treatment facilities. The design criteria applied in this project is based upon good international and engineering practice in water supply works and the MoWI, 2005 manual.

2.3.4 Water Supply Design Criteria

Design Parameter	Criteria
Design Standards and references	Kenya Practise Manual for Water Supply Services in Kenya, December 2005 WHO Guidelines for Drinking-Water Quality, 2006 Steel Pipe – A Guide for Design and Installation, AWWA Manual M11, Third Edition; Advanced Water Distribution Modelling and Management, by Haestad Methods. Kenya Practise Manual for Water Supply Services in Kenya, December 2005 WASREB Impact reports BS Codes & BS EN 1295-1-1998 Structural Design of Buried Pipelines.
Planning Horizons	2020 is the Current year 2022 is the Initial Year 2032 is the Future Year 2042 is the Ultimate Year
Population Projection	Assumed medium Variant of 1.5 for rural area and rural population and 3.0 for urban other areas.
Domestic Consumption	High Income: 150l/Capita/day Medium Income: 120l/capita/day Low Income 60l/capita/day
Non-Revenue Water	Non-revenue water (NRW) includes operational water demands and system losses This shall be assumed to be 20% of the treated water
Peak factors	Peak factors were used for establishing design capacities for dimensioning of facilities and pipelines. These peak factors comprise maximum day factor and peak hour factor. MOWI Design manual 2005 water demand values used and they include peak factors.
Fire Fighting Demand	No provision made for fire hydrants in the distribution system. However, 2% shall be reserved for firefighting in reservoirs.
Water Quality	The basic requirements for drinking water is as set by MoWI, 2005 design manual.
Desirable Aesthetic Quality	Common constituents that do not affect health in concentration in which they normally are present in water may however affect the aesthetic quality of the water. The following quality is desirable for water, which should be generally accepted for human consumption and for all usual domestic purposes (KS 150 and WHO Guidelines).
Water Treatment	The treatment shall be effective enough to: - 1. Achieve the bacteriological standards as set out in the chapter "Water Quality". 2. Achieve the chemical standard as set out in section "Constituents of health significance" and section "Desirable aesthetic quality" in

Design Parameter	Criteria
	chapter "Water quality". 3. Produce water that complies with the requirements set out in section "Substances and characteristics affecting Building and Pipe Materials "in chapter "Water Quality". **General Design Considerations** The following general principles shall be adhered to in the planning and design of treatment works: - • The works shall normally be designed for continuous operation i.e. 24 hours a day. • All major units (chemical feeders, flocculation, sedimentation, filters) which require frequent servicing or cleaning should be provided at least twos. Sedimentation tanks and filters should preferably be provided in threes to limit the temporary overloading to 50% when one unit is cleaned. • However, in treatment works designed for less than 500m^3/day it will not always be possible to have more than one unit as they then will be too small. • Besides the above criteria the optimal number of units shall be determined through an economic analysis. • As a general principle, all kinds of mechanical and automatic equipment shall be kept to an absolute minimum. • Even when the water analysis does not indicate immediate or future need for treatment, provision shall be made to incorporate full treatment at a later stage in case of deteriorating raw water quality or raised demand for high-quality clean water. • A suitable site for the treatment works should be identified and adequate gradients provided to allow for the additional head losses through the works. • When the design and construction of the treatment works is phased it shall be made sure that there is enough space for future extensions. • Units whose performance depends on the velocity of the water should be designed so that they will function also for flows smaller than the ultimate design flows.
Transmission and Distribution system	A gravity fed supply shall be preferred whenever technically, economically and financially feasible. **General Design Considerations** Balancing tanks shall be incorporated in the system to cut down peak flows. The position of and the capacity of each tank should be determined after economic analysis aiming at minimizing the system cost. A pipe traversing a supply area shall be designed for the peak flow of that

Design Parameter	Criteria
	area plus the mean flow of succeeding areas. The static pressure should be kept low by breaking the pressure preferably in the balancing tanks or in separate break-pressure tanks. The number of major high points and low points should be kept to a minimum where possible by trying to follow the contour lines of the terrain rather than only roads and tracks. This calls for active participation by the design Engineer in the survey of the pipeline routes. For large size pipes (150mm and above) alternative routes may have to be surveyed for an economic analysis to find the optimal alignment. The excavation depth should be varied to avoid local high and low points to minimize the number of air-valves and washouts. The pipeline should be set out by the Resident Engineer who also should check that the pipe levels are strictly in accordance with the drawings.
Pipes	The diameters considered in the analysis shall range from 90mm to 600mm for wide range of options and accurate choice of the optimal design. A specified minimum and maximum velocity of 0.7 and 2.0m/s respectively shall be adopted for this design. Low velocities shall not be allowed for hygienic reasons, while too high velocities shall be avoided to prevent exceptional head-losses. Standard design velocities shall be:(± 1 m/s, in distribution system (preferably between 0.7 to 1 m/s); ± 1.5m/s, in transmission lines pipes; 1 - 2 m/s, in pumping stations Trench designs shall be prepared using the method given in National Annex NA to BSEN 1295-1:1998, using the following limiting deflections: 2% for steel pipes with elastomeric joints or with mortar linings; 6% for welded steel pipes with flexible coatings and linings. The minimum cover over unprotected pipes in areas where motor traffic may occur shall be 0.9m. Pipelines in road reserves should be located, whenever possible 1.5m from the edge of the road way. Pipelines below road surfaces should be laid as instructed by Ministry of Roads and Public Works. Water pipelines are located 3.00m to the right or left of a right of way centreline, or, where possible, in a dedicated utility corridor. Water pipelines located in a right of way will be designed in the location authorized by a water county council/municipal Engineer or planner, unless the location is precluded by the existence of other extenuating circumstances. The following factors are used to determine the pipeline location. Pipelines in road reserves are located whenever possible 1.5m from the edge of the road way.

Design Parameter	Criteria
Pipe Material	**Pipe Material Selection – General** The selection of pipe material was based on the analysis of Steel pipe, Glass Reinforced Plastic (GRP) and High-Density Polyethylene (HDPE). Steel has been preferred for higher pressure ratings. However, the internal surface of steel pipes must be protected with a centrifugally applied cement mortar or epoxy lining. Steel pipes used in the project shall therefore have both internal protection i.e. cement coating and external protection i.e. epoxy coating.
Pressure	The minimum pressure at design flow should be 1 bar (10-meter water head) in pipe sections to which there may be made consumer connections and 0.4 bar (4m) in other cases. The levels of the surrounding areas to be served form the pipeline must be considered when determining the minimum pressure. The static pressure in pipes with consumer connections should be not more than 0.6 bar (60m) unless the terrain makes higher pressures unavoidable. Higher pressure than 0.6 bars may require special fittings, ball valves, stop valves etc. for the consumer connections.
Water Hammer	Water hammer is a phenomenon, which may be caused by the sudden closing, or opening a valve, all pipelines are checked against water hammer.
Air-Release Valves	They are provided to permit release of air, which accumulates at high points, and to prevent negative pressures from building up when lines are drained. Two types of air valves are specified, namely Double-Orifice Air Valves: is an air and vacuum release valve, it releases air from the pipeline during the filling process and allows air to enter the pipeline to prevent vacuum to occur. Single Orifice Air Valves: To release air from the pipeline during the normal operation of the water supply Double air valves shall be placed at all high points relative to the horizontal on pipes with inside diameter of 80mm or larger. On smaller pipes air valves should be placed only at accentuate high points and then if air cannot be released through consumer connections. In this context it may be considered that a high point is accentuate if it is situated 10m higher than the low points preceding or succeeding it. Single air valves shall be positioned at points if significant vertical grade change in pipelines of diameter 80mm or larger at distance of about 1 km. All air-release valves should be equipped with isolating valves for easy removal and repair of the air valves.
Washouts	Washouts shall be placed only at accentuated low points on raw water and clear water mains of inside diameter 80mm or larger. In this context, it may be considered that a low point is accentuated if the succeeding major

Design Parameter	Criteria
	high point is situated on a 10m higher level. All dead-end pipelines will have a blow-off valve assembly type flushing device. There shall be an open drain leading the water from the washout to a suitable steam or discharge point nearby. There shall be a valve only on the washout pipe and not on the main pipeline unless the valve can be combined with a section valve
Section Valves	Section valves shall be located at between 2 and 3km for rural areas and about 0.5km for urban areas. All branch lines shall have valves at the connection. Whenever possible the section valves should be placed in a joint valve chamber with air valves or washouts and upstream of these valves.
Marker Posts	Marker posts shall be provided along pipelines at every 200m, except where they follow permanent roads. Markers shall be placed at all bends, river and road crossings that cannot be easily found otherwise. The marker shall be square 100 x 100mm; height 700mm lettered "MAJI". The post shall be blue with white lettering.
Valve Chambers	Valve chambers shall be at least 1200 x 1200mm internally (or larger for larger pipes). The cover shall be lockable. The chamber shall be well drained through the floor or through a drain pipe
Anchor and Thrust Blocks	Anchor or thrust blocks of appropriate detail as shown on the MoWI, 2005 Water Design Manual, shall be provided for horizontal and vertical bends, capped ends, change of size and tees and for pipes laid in steep slopes (>1:6).
Flow measurement	Provision should be made of zonal bulk meters
Water Storage	The purpose of storing water is to balance the variation in the water consumption during the day and for emergency storage to ensure the steady water supply during break-downs Balancing tanks shall be provided to reduce the peak flows in the transmission and distribution lines. The number and location of the tanks should be decided after an economic analysis aiming at minimizing the cost of the whole system of tanks and pipelines. Generally, the tank for the balancing of the daily peak demands will have a capacity of 50% of the daily water demand of the area served by the tank. It is often economical to phase the balancing tanks as the required balancing capacity is generally low during the first few years after a supply has been taken into operation. The need for balancing shall therefore be analysed for different years.
Tanks	Tanks should: Be covered and have a lockable manhole cover, universal type. Be equipped with internal and external ladder or steps. Have a level indicator which can be read from outside.

Design Parameter	Criteria
	Have inlet pipe that ends not more than 0.5m above the floor to prevent air entrainment. Have an outlet at a level at least 0.2m above the floor. Have a scour pipe that allows complete emptying. Have an overflow placed at least 50mm above the normal top water level that allows the overflowing water to be seen when in operation. Be designed so that the ball valve (if any) is above the highest water level and is easily accessible from the manhole. Have ventilation pipes covered with nylon nets. Have outside walkway and handrail (only elevated steel tanks). not usually have any partitioning
Electro-mechanical works	This constitutes both recirculation pumps and backwash water pumps at the water treatment works. A generator set will also be provided as a power back-up system There are two (3) types of pumps in the project; re-circulation pumps backwash pumps at the water treatment works and booster pumps along the pipelines. The pumps will be cast iron horizontal centrifugal volute casing pumps with appropriately sized 3hp, 50Hz motors to run at 2900rpm. The pumps are sized to deliver flow required at a particular head and will be operated via a wall mounted control panel Because there are fluctuations in electrical power supply, it is a good practice to provide a standby generator at the water treatment works. A direct diesel driven generator shall be provided for in the project. The selection of a generator shall be made after consultations with the manufacturers.

2.3.5 Design of Water Treatment Works

The Review of the Water Treatment Plant was based on Water Analysis report. Full - Conventional treatment process has been recommended that includes the following processes:

i. Mixing Chamber adding Coagulation aiding chemicals
ii. Flocculation
iii. Sedimentation
iv. Filtration and
v. Disinfection

It should be noted that there is no phasing of the treatment plant capacity contrary to recommendations by the guidelines of the MoWI Design Manual 2005. The Water Treatment Woks have been designed to ultimate year 2042 and implemented as one contract.

The initial demand at year 2022 is 44% of ultimate demand and future demand at Year 2032 is 67% of ultimate demand, therefore the treatment works is provided as a system with parallel and independent treatment units capable of handling the required proportions of the ultimate water demand. A small number of these units will be operated simultaneously during the initial periods of lower flows while additional units will be operated as demand increases. Since each unit is designed to operate independently, any of the required number of units will be selected from the total number of units during operation. However, the safe yield from the dam is only 19,000m^3/d. Therefore, the treatment works are only designed for

this capacity which amounts to 81% of the Ultimate year water demand. As indicated above, the additional 19% will be augmented from other alternative sources.

(a) Coagulants

Selection of coagulants has been made in consideration of the amount, quality and turbidity of the raw water while considering the filtration method and sludge disposal system. The chemical commonly used in Kenya for coagulation is Alum, Aluminum Sulphate (A12 (SO4)3.14H20).

$$AL_2(SO_4)_3 + 6H_2O = 2AL(OH)_3 + 6H^+ + 3SO_4$$

Aluminum Sulphate is briefly called Alum and produced in either solid or liquid state. This agent proves effective against most of the turbids, and will be still more so when, at the time of high turbidity, used conjointly with coagulant aid chemicals. Among the chemicals in use at present, Aluminium salts are predominant.

The Chemical solutions shall be fed into the raw water through 50mm diameter pipes by means of calibrated and adjustable electromechanical dosing pumps, dosing rates will be adjusted from time to time from 0 to 2m3/hr.
Gravity dosers will be provided as standby to be used only when dosing pumps are undergoing repairs.

(b) Mixing Chamber

The 0.6m diameter raw water pipeline enters the water treatment plant from the proposed dam at the mixing chamber. The mixing chamber and inlet chamber are designed to regulate flow into the treatment plant and as well as ensure mixing of raw water and dosing chemicals.
The entire dose of chemicals has to be dispersed throughout the mass of raw water within a few seconds. Detention time before entering the flocculation chamber is calculated at 40 seconds. Rectangular Broad Crested Weir has been proposed for measurement of flow and mixing can be achieved by feeding the chemical into a baffle chamber, an overflow weir or a hydraulic jump. The mixing chamber dimensions will be 34 x 4m x 1.5m with a standard parshall flume for a flow rate of $0.22m^3/s$. Chemical dosing using dosing pumps is considered and provided for gravitational dosers.

(c) Flocculation

The gravitational flocculation method is one of the types of flocculators in the MoWI, 2005-design manual, and has been adopted in the design of this project.
In conclusion, the chemically dosed water will be split equally into three flocculation tanks which are designed for round the bend flow mixing. This is formed by 15 consecutive channels turned at 180o at each end to provide 19 minutes retention time at design flow of 6,333m3/day per unit. 3 (three) No. shallow reinforced concrete tanks 8.9m width, 11.5m length, 1.0m wetted depth and 0.5m freeboard will be constructed. Each tank will be divided into 15 channels by using 100mm wide reinforced concrete walls. Each channel will be 500mm wide.
Some deposition of the flocs may occur in the flocculation basins and these will have to be removed manually. The 500mm wide spacing between the baffle walls will allow for cleaning the channels manually. Sludge from the flocculation basin to be drained out periodically through a 200mm pipe into the common sludge channel.

(d) Sedimentation

The general design criteria for sedimentation based on MoWI, 2005 design manual provides two options, namely Horizontal Flow Settling Tanks and Vertical Flow Settling Tanks of Sludge Blanket. The design has adopted horizontal flow settling tanks.

3 (three) No. reinforced concrete tanks of 10.5m width, 31.5m length, 3m wetted depth and 0.5m freeboard will be constructed. The floor will slope 0.025% towards the center, where effluent water or sludge will be washed out through a 500mm deep gulley trap into a 200mm diameter washout pipe to a scour drain.

(e) Settled Water inlet

The water will flow into a channel from the three flocculation tanks. The Channel will distribute the water into the sedimentation tanks through influent openings of diameter 100mm spaced at 300mm centers

(f) Settled Water Outlet

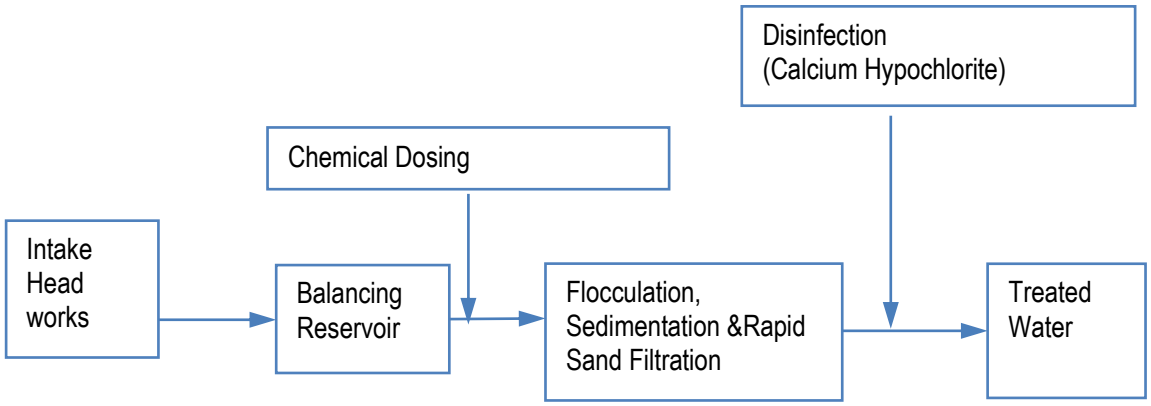
The draw-off is made possible by outlets composed of collection water channels. Flow of water out of the tanks and into the channels is controlled by V-Notches launder weirs skimming settled water from the surface of the sedimentation tank. The V-Notch level is made adjustable by about 250mm.

Therefore provide 4 No. collection channels of 8m length and cross sectional dimensions 0.25m x 0.25m per sedimentation tank. Collection channels will have V-Notches to skim the water from the sedimentation tank. The V-Notches shall be made on a minimum 8mm thick and 500mm wide stainless steel strip/plate, the steel plate will have adjustable bolting slots capable of allowing a 0-250mm variation of the water skimming height see

(g) Filtration

The MoWI, 2005 design manual provides two options, namely Rapid Gravity Sand Filtration and Slow Sand Filtration. The design has adopted the rapid gravity sand filtration. 6No. Rapid Sand Filters with total area 225m2 (37.5m2 each). The minimum tank height is 2.3m, consisting of filter bed of sand and 4 layers of gravel, free height board of 500mm

The treatment process proposed is summarized in the chart below;



(h) Power source

The power for the facility shall be from the national grid.

(i) Access road

Access and service roads have been proposed from existing main roads to scheme infrastructure. The access roads have been designed to be at least 6m wide and meet the Kenyan code for similar classes of roads.

(j) Auxiliary Building

A number of buildings have been proposed to be constructed under this design. These include;

(k) Pump House

Guard houses at all treatment sites and pumping stations. Guard houses will also have sanitation facilities in form of a water closet and septic tank. Office, laboratory and storage buildings for the functioning of the water treatment plants. Staff Houses will be located at at the treatment plant.

2.3.6 Water Supply

(a) Design Criteria for Gravity Main Pipeline

Three (3) types of pipe material were considered during design, which is Glass Reinforced Plastic Pipes (GRP), Cement Lined/epoxy coated Steel pipes and High-Density Polyethylene Pipes (HDPE). For the Main conveyance and Rising mains, epoxy or cement lined / epoxy coated steel pipes were used while HDPE was used for the distribution lines.

(b) Six transmission mains have been proposed

Transmission Mains	Type of Flow	Length	Q
Rising Main to Kiima Kimwe Hills	Pumping	3,580	0.2094m^3/s
Main line to Kyanda	Gravity	14,320	0.209m^3/s
Rising Main to Mua	Pumping	3,200	0.0807m^3/s
Rising Main to Iveti	Pumping	3,100	0.0691 m^3/s
Kitanga line	Gravity	10,120	0.0209m^3/s
Kivandini Line	Gravity	7.140	0.0211m^3/s

(c) Four distribution mains have been proposed.

Distribution Mains	Type of Flow	Length	Q
Kimutwa Line	Gravity	11,100	0.0175m^3/s
Kaathi to Kyanzasu Line	Gravity	15,420	0.0078m^3/s
Mua Hills to Kivutini Line	Gravity	7,140	0.0070m^3/s
Mua Hills to Makutano Line	Gravity	7,400	0.0184m^3/s

(d) Storage tanks

S.No	Size/capacity	Location	Easting	Northing	Elevation (m)	Type
1	3000 M^3	KIIMA KIMWE	306541.799	9829825.373	1528.20	Reinforced concrete tank
2	500M^3	KIMUTWA	305718.859	9823759.826	1528.20	Reinforced concrete tank
3	2000M^3	KYANDA	299476.528	9836907.986		Reinforced concrete tank
4	225M^3	NGIINI	305719.17	9823760.12	1844.85	Elevated Steel tank
5	500M^3	KIVANDINI	312527.487	9831249.943	1901.55	Reinforced concrete tank
6	225M^3	MAKAVETI	312369.289	9825731.988	1321.39	Reinforced concrete tank
7	500M^3	KITANGA	297666.276	9830139.053	1282.43	Reinforced concrete tank
8	2000m^3	IVETI	309128.579	9836247.259	1095.75	Reinforced concrete tank
9	500m^3	MUA HILLS	298699.632	9837144.957	1277.83	Reinforced concrete tank

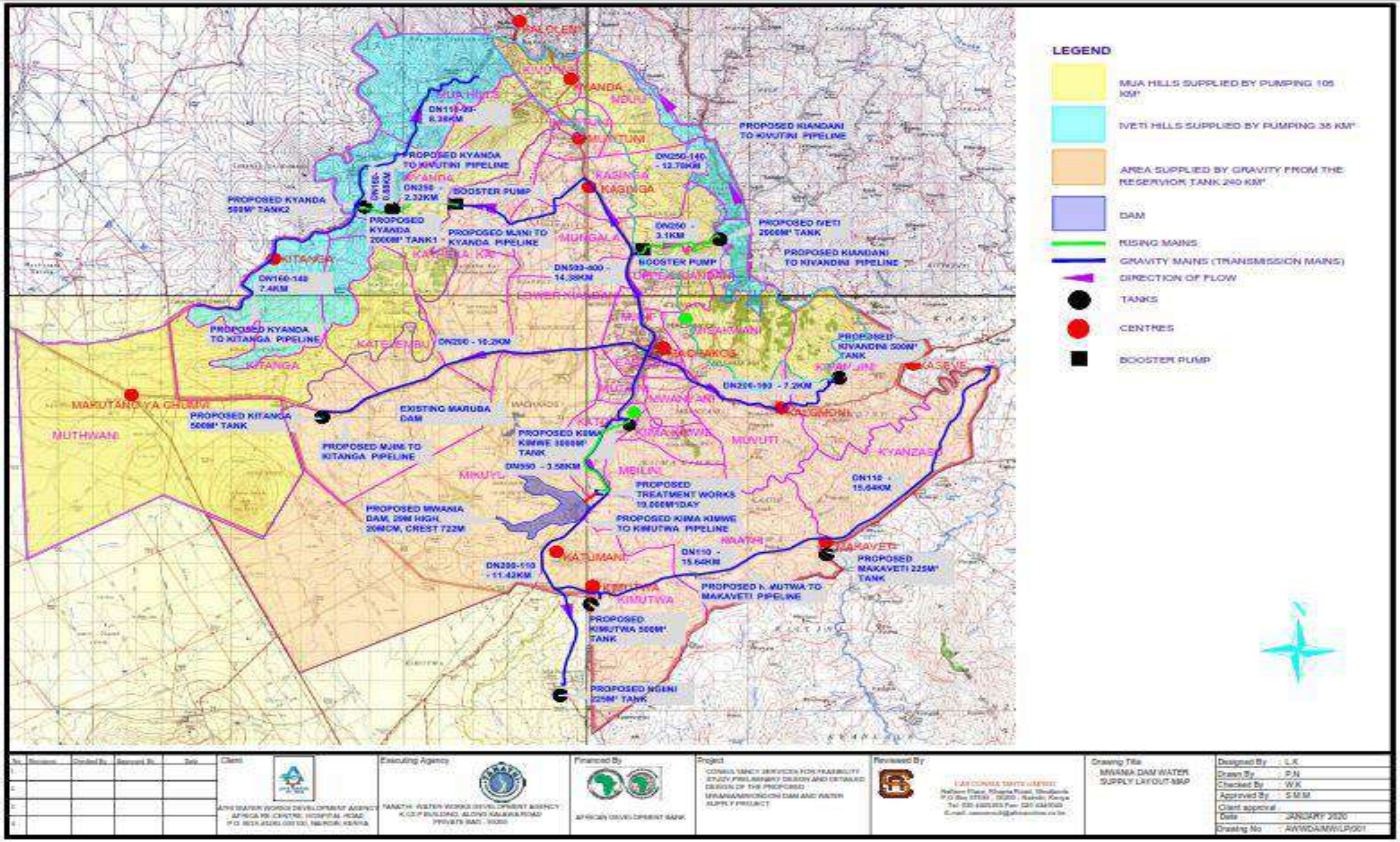
(e) Pumping stations

S.No	Station	Deascription	Units
1	Kiima Kimwe Hill	Q(Demand)	0.2094m^3/s
		Head	175m
		Length	3580m
		Efficiency	70%
		Power Required	620.6 Kwh
		Cost of Power	20 Kshs/Kwh
		Cost of Power per Year	Kshs. 100,908,719.74
2	Iveti Hills	Q(Demand)	0.0691m^3/s
		Head	295m
		Length	3100m
		Efficiency	70%

		Power Required	367.12 Kwh
		Cost of Power	20 Kshs/Kwh
		Cost of Power per Year	Kshs. 59,693,318,565
3	Mua Hills 1st Lift	Q(Demand)	0.0807m³/s
		Head	152m
		Length	2320m
		Efficiency	70%
		Power Required	239.139 Kwh
		Cost of Power	20 Kshs/Kwh
		Cost of Power per Year	Kshs. 38,883,227.46
4	Mua Hills 2nd Lift	Q(Demand)	0.0248m³/s
		Head	262m
		Length	80m
		Efficiency	70%
		Power Required	111.085 Kwh
		Cost of Power	20 Kshs/Kwh
		Cost of Power per Year	Kshs. 18,062,059.91

(f) Water kiosks

Public/ Kiosks are usually located within a walking distance of 500 metres to the consumers with each Kiosks serving between 150 to 200 households. The target rural community for the project are practice nomadic pastoralism. Thus proposing water kiosks according to the MoWI standards cannot be applied. A provisional sum for a number of water kiosks and stand pipes has been proposed. The location of the water kiosks shall be determined by the local administration and stakeholders during the time of implementation. However all public facilities such as hospitals, defined market centres, schools have been provided with water kiosks and livestock watering points.


LEGEND
MUA HILLS SUPPLIED BY PUMPING 105 KM²
IVETI HILLS SUPPLIED BY PUMPING 38 KM²
AREA SUPPLIED BY GRAVITY FROM THE RESERVIOR TANK 240 KM²
DAM
RISING MAINS
GRAVITY MAINS (TRANSMISSION MAINS)
DIRECTION OF FLOW
TANKS
CENTRES
BOOSTER PUMP
PROPOSED KYANDA TO KIVUTINI PIPELINE
PROPOSED KIANDANI TO KIVUTINI PIPELINE
PROPOSED KYANDA 500M³ TANK2
PROPOSED KYANDA 2000M³ TANK1
BOOSTER PUMP
PROPOSED MUIMI TO KYANDA PIPELINE
PROPOSED IVETI 2000M³ TANK
PROPOSED KIANDANI TO KIVANDINI PIPELINE
PROPOSED KYANDA TO KITANGA PIPELINE
PROPOSED KIVANDINI 500M³ TANK
PROPOSED KITANGA 500M³ TANK
EXISTING MARUBA DAM
PROPOSED MUIMI TO KITANGA PIPELINE
PROPOSED TREATMENT WORKS
PROPOSED MWANIA DAM, 20M HIGH, 20MCM, CREST 722M
PROPOSED KIMA KIMWE TO KIMUTWA PIPELINE
PROPOSED MAKAVETI 225M³ TANK
PROPOSED KIMUTWA 500M³ TANK
PROPOSED NGENI 225M³ TANK
MACHAKOS
KITANGA
MUTHWANI
KATUMANI
KIMUTWA
MAKAVETI
KALAMA
Drawing Title
MWANIA DAM WATER SUPPLY LAYOUT MAP
Designed By : L.K
Drawn By : P.N
Checked By : W.K
Approved By : S.M.M
Date : JANUARY 2020
Drawing No : AWWDA/MW/LP/001
AFRICAN DEVELOPMENT BANK

(g) Flow measurements

Bulk water meters will be installed at all key points of the distribution network. This will ensure that proper management of the system can be carried out such as early detection / assessment of leaks.

(h) Control valves

All throttling valves will be gate valves. Isolating valves up to and including DN 300 will be gate valves, and valves larger than DN 300 will be butterfly valves except where otherwise specifically required. "n-1" Gate valves will be provided at junctions, where n is the number of junction lines.

All valves will be designed for a maximum permissible differential working pressure of 16 Bar except where higher pressures are necessary.

(i) Air valves

Double action air valves will be fitted at all high points and at significant changes in downward slope. Distance between air valves will not exceed 1000m for long transmission mains, and will not exceed 600m for transmission mains of minimum slope in flat areas. At pump stations and crossing where this valve is required, it has been recommended.

(j) Wash -outs

Washouts will be fitted at all low points. Minimum spacing of 2000 m for washout chambers shall be observed

Table **2-1**). For large diameter mains the washout tee will be an invert tee to evacuate water and any settled deposits from the pipeline. The table below presents criteria for minimum washout branch diameters of washouts (from Tanzanian Design Manual).

Table 2-1: Minimum Washout Sizes

Main Pipeline Diameter	Washout Branch Diameter
Up to 300 mm	80 mm
400 - 600 mm	100 mm
700 - 1000 mm	150 mm
1100 - 1400 mm	200 mm
1600 mm & greater	250 mm

3 ALTERNATIVES TO THE PROJECT

Consideration of alternatives is one of the most critical elements of the environmental assessment process. Its role is to provide a framework for sound decision-making based on the principles of sustainable development. Alternatives should be identified as early as possible in the project cycle. The search for alternatives should be well documented and should take into account the views of stakeholders. Key criteria for consideration when identifying alternatives are that they should be "practicable", "feasible", "relevant", "reasonable" and "viable". A range of alternatives exists, not all of which are necessarily appropriate for each project under consideration.

3.1 Project Alternatives

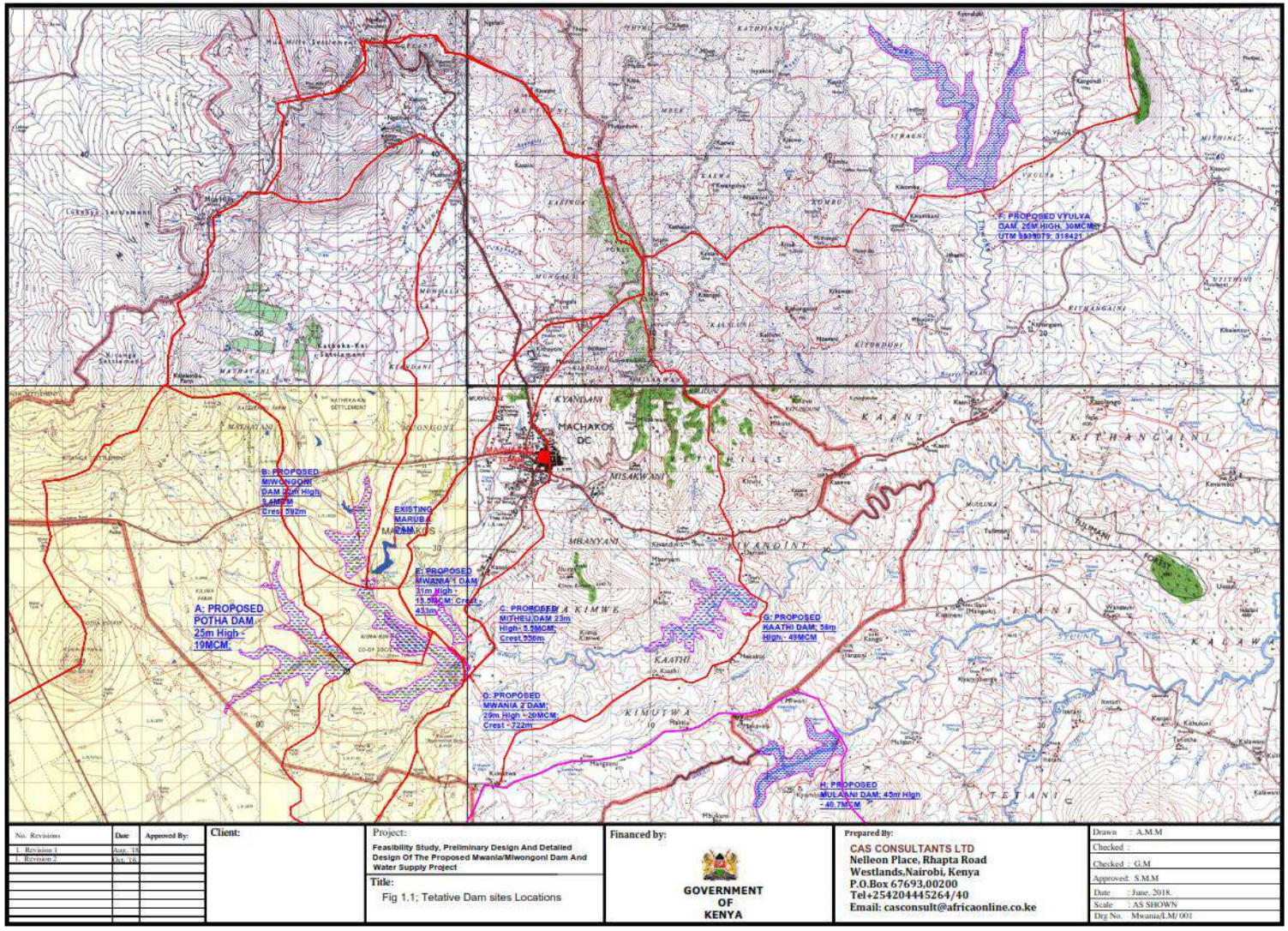
During the site exploration exercise, the Consultant was guided by the following factors;

i. Dam sites, elevation of the dam with respect to the Supply Area
ii. Treatment Works
iii. Conveyance System
iv. Storage Tanks
v. Pipeline Routes
vi. Multipurpose use of the dam
vii. Socio - Economic and Environmental Considerations

3.1.1 Dam sites, elevation of the dam with respect to the Supply Area

Using contours generated using the SRTM, the Consultant identified 8 potential dam sites. Based on topography at the axis, the site properties i.e. the volume-inundation area against the height for successive 2m increase in height to highest possible ground levels. It must be noted that the height and the crest length of a dam are the main factors determining the volume of fill materials for the embankment wall.

The locations and attributes of the sites are presented below;


A: PROPOSED POTHA DAM - 25m High - 19MCM;
B: PROPOSED MIWONGONI DAM 22m High; 5.4MCM Crest 592m
EXISTING MARUBA DAM
E: PROPOSED MWANIA 1 DAM 31m High - 13.5MCM; Crest - 453m
C: PROPOSED MITHEU DAM 23m High- 5.5MCM; Crest 556m
D: PROPOSED MWANIA 2 DAM; 29m High - 20MCM; Crest - 722m
F: PROPOSED VYULYA DAM, 26M HIGH, 30MCM; UTM 9939079; 318421
G: PROPOSED KAATHI DAM; 58m High - 49MCM
H: PROPOSED MULANNI DAM; 45m High - 40.7MCM
MACHAKOS DC
KYANDANI
MISAKWANI
MBANYANI
KIVANDINI
KAATHI
KIMUTWA
KITHANGAINI
KALAWA
ITETIANI
No. Revisions
Date
Approved By:
1. Revision 1
Aug. 18
1. Revision 2
Oct. 18
Client:
Project:
Feasibility Study, Preliminary Design And Detailed Design Of The Proposed Mwania/Miwongoni Dam And Water Supply Project
Title:
Fig 1.1; Tetative Dam sites Locations
Financed by:
GOVERNMENT OF KENYA
Prepared By:
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Drawn : A.M.M
Checked :
Checked : G.M
Approved: S.M.M
Date : June, 2018.
Scale : AS SHOWN
Drg No. Mwania/LM/ 001

Table 3-1; Summary-Storage-Elevation Capacities

Site	Location	Realistic Dam Height from site characteristics	Elevation	Catchment area sq. km	Achievable storage / Average Annual Volume of run off	Reservoir Area (ha)
A	Potha	22	1588	121	6,050,000	170
B	Miwongoni-1	18	1590	45	2,250,000	66
C	Mitheu	14	1544	13.5	675,000	29
D	Mwania	24	1552	232	7,100,000	138
E	Miwongoni-2	25	1563	99	4,950,000	80
F	Vyulya	24	1336	375	18,750,000	405
G	Kaathi	37	1395	342	12,700,000	118
H	Mulaani	23	1431	113	5,650,000	108

i. All sites are below Machakos town elevation of 1600 m amasl, as such none guarantee gravity command of supply area and pumping scheme is conceptualized.
ii. **Site A: Potha:** The site is heavily settled up with a small catchment area
iii. **Site B: Miwongoni-1**-a dam is already set for construction under Machakos Water supply and Sanitation Project. A contractor and supervising consultant (SCET / Losai) are already procured for this site.
iv. **Site C: Mutheu** - effluent from Waste Water treatment Plant works discharges effluent into this river making it unsuitable for development of dam. In addition the annual runoff is of the order of 675,000CM which is too low to dent the demand. Further, the site would catch runoff from Machakos town itself which would contain increased variety and amount of pollutants carried into the dam. Some of the pollutants found in urban runoff are similar to pollutants found in rural runoff. These are the "conventional" pollutants — sediment, nutrients, oxygen demanding materials, and bacteria. However, urban areas on a per acre basis deliver as much or more of these conventional pollutants as rural areas.
v. **Site D: Mwania** - though part of the water is already allocated to Maruba dam and the proposed Miwongoni dam, there is still enough water mainly coming from the Potha system. This site has potential to be developed.
vi. **Site E**; at this point the runoff is already allocated to the existing Maruba dam and the proposed Miwongoni dam. There would hardly be any run off to catch and thus this site cannot be developed.
vii. **Site G: Kaathi**; Machakos Waste Water treatment Plant at Mutheu River discharges into Mwania River upstream of this location making it unsuitable for development of a dam for storing domestic water. Even with proposed relocation of WWTP, the trunk sewer line would be located in the valley. Similar to Mitheu, the site would also catch runoff from Machakos town itself which would be a point source of pollution.
viii. **Site H: Mulaani** - though this site offers a good storage potential, it is limited by the size of the catchment. In addition it very close to the boundary between Machakos and Makueni, while the embankment can be located in Machakos County, the treatment plant might have to be located in Makueni.

Taking cognizance of the project objectives and the multi criteria analysis of the sites, the consultant filtered out 6 sites and adopted Site D (Mwania).

3.1.2 Treatment Works

The type of treatment depends on the quality of the source of supply and the quality desired in the finished product. The sources of water can be classified into two general categories namely: Ground water sources, principally wells and Surface water sources such as rivers, lakes, and impoundments on rivers and streams. Treated water quality criteria to conform to requirements of the Ministry of Water and Irrigation Manual (2005). The method preferred must be suitable for surface water. Full - Conventional treatment process has been recommended.

3.1.3 Water Conveyance System

Invariably, conveyance from the treatment plants shall be by pumping which will deliver water from the treatment works to the existing and proposed storage tanks. The lengths of the mains have been optimized by keeping them as short as possible, utilizing where possible, existing rights of way. To optimize on the hydraulics no connections have been provided for along the mains.

3.1.4 Storage Tanks

This being bulk water supply project will mainly convey water to existing storage tank sites. Due to the expansiveness of delineated area, additional storage tanks will be provided at strategically high locations on lveti Hills, Mua Hills, Kimutwa, Ngiini, Ianzoni, Makaveti, Nziuni, and Kalama, to gravitate to surrounding areas. Additional storage capacity / tanks has also been proposed at Kiima Kimwe to augment town supply.

3.1.5 Pipeline Routes

The pipeline routes have been identified using the most recent road network maps, urban development plans, Google earth satellite imagery and walkover surveys. Where possible existing wayleaves have been used while in new pipelines have as much as possible been aligned along the reserves of the existing and proposed roads.

3.1.6 Multi purpose use of the dam

In order to meet the requirement of the Government's Big Four Agenda, the consultant explored the possibility of surplus water being allocated for irrigation, identified the area to be covered and provided for the an off take connection for Irrigation.

3.1.7 Environmental and Socio-economic Considerations

The eight potential dam sites were subjected to environmental and social screening to identify and select the dam with the most environmental and social payoffs. Mwania Dam at site D was the most desirable dam site as shown in Table 3.2 below

Table 3.2 Mwania Dam Selection Criteria

Criteria	Site A	Site A1	Site B	Site C	Site D	Site E	Site F
Impacts on Ecological values	-1	-1	-1	-1	-1	-2	-1
Impacts on wildlife & natural vegetation	-1	-1	-1	-1	-1	-2	-1
Land Use Systems (catchment)	-4	-4	-4	-2	-3	-3	-4
Impacts on livelihoods	-2	-3	-5	-5	-3	-3	-4
Impacts on infrastruc-ture	-5	-2	-1	-1	-1	-5	-2
Impacts on access to	1	1	-5	2	1	-5	2

public utilities							
Historical, archaeological & cultural sites	-1	-2	-1	-2	-2	-2	-2
Relocation of populations	-2	-2	-1	-4	-3	-5	-5
Land Tenure/Land conflicts	-2	-2	-4	-2	-2	-2	-2
Site Vulnerability to Natural Hazards	-3	-3	-3	-3	-1	-3	-3
Total	**-20**	**-19**	**-26**	**-19**	**-18**	**-32**	**-20**
Ranking	**3**	**2**	**4**	**2**	**1**	**5**	**3**

Scoring Criteria

Severity of Impact	**Rating**	**Scoring**
Insignificant / non harmful/less beneficial	-1/+1	Very Low
Small/ Potentially harmful / Potentially beneficial	-2/+2	Low
Significant / slightly harmful / significantly beneficial	-3/+3	Medium
Great/ harmful / beneficial	-4/+4	High
Disastrous/ extremely harmful / extremely beneficial	-5/+5	Very high

3.1.8 Do Nothing Option

The implication of this means the status quo remains i.e. the current water shortage in the three counties and the associated problems will persist. This option would mean that the local and regional/national benefits would not be realized. If the project does not proceed, there would not be any need to compensate project affected people. They would however also potentially miss out on development opportunities that the project could bring including access to water and power and economic opportunities through project construction and operation including employment and small business opportunities.

4 LEGAL AND REGULATORY FRAMEWORK

4.1 Background

Development of infrastructure projects is dealt with under several laws, By-laws, regulations and Acts of parliament, as well as policy documents and it is not possible to bring all those statutes under one heading. This section is therefore aimed at assessing the existing policies and legislative framework, economic tools and enforcement mechanisms for the management of infrastructure projects at different stages. In so doing, the discussion will be based on the following legislations and policy provision.

4.2 Policy Provision

4.2.1 Constitution of Kenya

Article 42 of Bill of Rights of the Kenyan Constitution provides that every Kenyan has a 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 legislation and other measures.

Part II of Chapter 5 of the Constitution (Environment and Natural Resources), (I) the State clearly undertakes to carry out the following:

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

Part (II) “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.

Chapter 5 on Land and Environment emphasizes on the following:

- Land use and management shall by law benefit local communities
- Community land is protected from encroachment by State.
- Law shall protect Rivers, forests and water bodies.
- Equitable access to land.
- All lawful land rights are secured; only someone who has stolen land needs to worry.
- County governments will manage land in trust of the people in accordance with the constitution.

Relevance

The constitution of Kenya provides for sound management and sustainable development of all of Kenya's projects, both public and private investments. It also calls for the duty given to the project proponent to cooperate with State organs and other persons to protect and conserve the environment as mentioned in Part II.

4.2.2 Kenya Vision 2030

Kenya Vision 2030 is the current national development blueprint for period 2008 to 2030 and was developed following on the successful implementation of the Economic Recovery Strategy of Wealth and Employment Creation which saw the country's economy back on the path to rapid growth since 2002. GDP growth rose from 0.6% to 7% in 2007, but dropped between 1.7% and 1.8% in 2008 and 2009 respectively.

The objective of the vision 2030 is to "transform Kenya into a middle income country with a consistent annual growth of 10% by the year 2030". One of this aims is to make Kenya to be a nation that has a clean, secure and sustainable environment by 2030. This will be achieved through promoting environmental conservation to better support the economic pillar.

Kenya's transformation in to a middle income country will be achieved by bringing and improving basic infrastructure and services namely: roads, street lights, storm water drains, footpaths, and water and sanitation facilities among others. This project aims at improving the Water supply services in Machakos Sub County through the construction of bulk water supply project.

4.2.3 National Environment Policy (NEP)

Sessional Paper No. 6 of 1999 on Environment and Development since adoption by parliament in 1999 has been in use and influenced the formation of EMCA in 1999 but has since been surpassed by time and is therefore under revision to comprehensively cover areas that were previously left out to augment it.

The revised draft of the National Environmental Policy, dated April 2012, sets out important provisions relating to the management of ecosystems and the sustainable use of natural resources, and recognizes that natural systems are under intense pressure from human activities particularly for critical ecosystems including forests, grasslands and arid and semi-arid lands. The objectives of the Policy include developing an integrated approach to Environmental management, strengthening the legal and institutional framework for effective coordination, promoting environmental management tools.

Relevance

The project shall implement the ESMP to mitigate the impacts of the resulting impacts during the construction and operational phases of the project, this will ensure that the sensitive ecosystems are not destabilized by the subsequent project activities.

4.2.4 National Land Policy

Chapter 2 of the policy is linked to constitutional reforms; regulation of property rights is vested in the government by the Constitution with powers to regulate how private land is

used in order to protect the public interest. The Government exercises these powers through compulsory acquisition and development control. Compulsory acquisition is the power of the State to take over land owned privately for a public purpose. However, the Government must make prompt payment of compensation.

Chapter 4 of the land policy under Environmental Management Principles, The policy provides actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution.

For the management of the urban environment it provides guidelines to prohibit the discharge of untreated waste into water sources by industries and local authorities; it also recommends for appropriate waste management systems and procedures, including waste and waste water treatment, reuse and recycling. This project in Machakos Sub County aims at improving the access to safe drinking water.

The policy goes further to advocate for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried out on all land developments that may degrade the environment and take appropriate actions to correct the situation. Public participation has been indicated as key in the monitoring and protection of the environment.

Chapter 4 further advocates for the Implementation of the polluter pays principle which ensures that polluters meet the cost of cleaning up the pollution they cause, and encourage industries to use cleaner production technologies.

4.3 Kenya Legislations

4.3.1 The Environmental Management and Coordination Act 2015 (Amendment)

The Act provides for the establishment of a legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. Just as in the new constitution, Part II of EMCA confers to every person the right to a clean and healthy environment and to its judicial enforcement.

The new Constitution and EMCA therefore obligates the project's Executing Agency and Contractor to work in a clean environment and not to contravene the right of any person within its zone of influence, to this entitlement. EMCA has provided for the development of several subsidiary legislations and guidelines which govern environmental management and are relevant to the project implementation.

These include:

4.3.1.1 The Environmental (Impact Assessment and Audit) Regulations, 2009 Legal Notice No. 101; The Environmental Impact Assessment and Audit Regulations state in Regulation 3 states 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 III of the Regulations indicates the procedures to be taken during preparation, submission and approval of the ESIA Study Report.

Relevance

Part 4(1) of the Regulation further states that: "no Proponent shall implement a project"

(a) Likely to have a negative environmental impact; or

(b) For which an environmental impact assessment is required under the Act or these Regulations, unless an environmental impact assessment has been concluded and approved in accordance with these Regulation.

4.3.1.2 The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121;- These Regulations were 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;
- 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, and
- 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 Environmental Impact Assessment license issued by NEMA.

Relevance

The proposed project, during construction phases will generate wastes which will need to be disposed of as per the guidelines in the regulations.

4.3.1.3 The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120; - These Regulations were published in the Kenya Gazette Supple-

ment No. 68, Legislative Supplement No. 36, and Legal Notice No. 120 of 29th September, 2006. The Regulations provides for sustainable management of water resources including prevention of water pollution and protection of water sources (lakes, rivers, streams, springs, wells and other water sources). It is an offence under Regulation No. 4 (2), for any person to throw or cause to 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.

4.3.1.4 The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61; -

These regulations were published as legal Notice No. 61 being a subsidiary legislation to the Environmental Management and Co-ordination Act, 1999. The regulations provide information on the following:

- Prohibition of excessive noise and vibration;
- Provisions relating to noise from certain sources;
- Provisions relating to licensing procedures for certain activities with a potential of emitting excessive noise and/or vibrations and
- Noise and excessive vibrations mapping.

According to regulation 3 (1), 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. Regulation 4 prohibits any person to (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 centimeters per second beyond any source property boundary or 30 metres from any moving source.

Regulation 5 further makes it an offence for any person to make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.

Regulation 12 (1) makes it an offence for any person to operate a motor vehicle which (a) produces any loud and unusual sound; and (b) exceeds 84 dB(A) when accelerating. According to sub-regulation 2 of this regulation, No person shall at any time sound the horn or other warning device of a vehicle except when necessary to prevent an accident or an incident. Regulation 13 (1) provides that except for the purposes specified in sub-Regulation (2) there under, 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.

Regulation 19 (1) prohibits any person to carry out activities relating to fireworks, demolitions, firing ranges or specific heavy industry without a valid permit issued by

the Authority. According to sub-regulation 4, such permit shall be valid for a period not exceeding three months.

Relevance

The contractor /sub-contractor for civil works will be required to ensure compliance with the above regulations in order to promote a healthy and safe working environment throughout the construction phase. This shall include regular inspection and maintenance of equipment and prohibition of unnecessary hooting of vehicles

4.3.1.5 The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160; - Part II of Regulations, section 4 states that no person shall engage in any activity that may have adverse impacts on ecosystems, lead to introduction of exotic species or lead to unsustainable use of natural resources without an EIA license. The regulation puts in place measures to control and regulate access and utilization of biological diversity that include among others banning and restricting access to threatened species for regeneration purposes. It also provides for protection of land, sea. Lake or river declared to be a protected natural environmental system in accordance to section 54 of EMCA, 1999.

4.3.2 Other relevant EMCA 2015 to be considered during construction and operation of the project are

- Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009.
- The Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations, 2006 Legal Notice No. 131;
- The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73.

Relevance to the Project

EMCA 2015 and above listed regulations shall form the main statutory instruments which will guide the implementation of the project so that any likely adverse impacts that could be caused by the project are promptly mitigated as recommended in this assessment. This report also in compliance with the requirement of the EIA/EA regulations

4.3.3 Water Act 2016

Water Act (2002 – amended in 2016). This Act provides the legal framework for the management, conservation, use and control of water resources and for the acquisition and regulation of right to use water in Kenya. It also provides for the regulation and management of water supply and sewerage services. In general, the Act gives provisions regarding ownership of water, institutional framework, national water resources, management strategy, and requirement for permits, state schemes and community projects. Part IV of the Act addresses the issues of water supply and sewerage.

After the passage of the Act, service provision are gradually decentralised to 91 local Water Service Providers (WSPs). These were linked to 8 regional Water Works Development Agencies in charge of asset management through Service Provision Agreements (SPAs) with the WSPs. The Act also created a national regulatory board that carries out performance benchmarking and is in charge of approving SPAs and tariff adjustments.

It should be noted that new Water Institutions are being established by the Kenya's 2014 Water Bill, as illustrated in the figure below

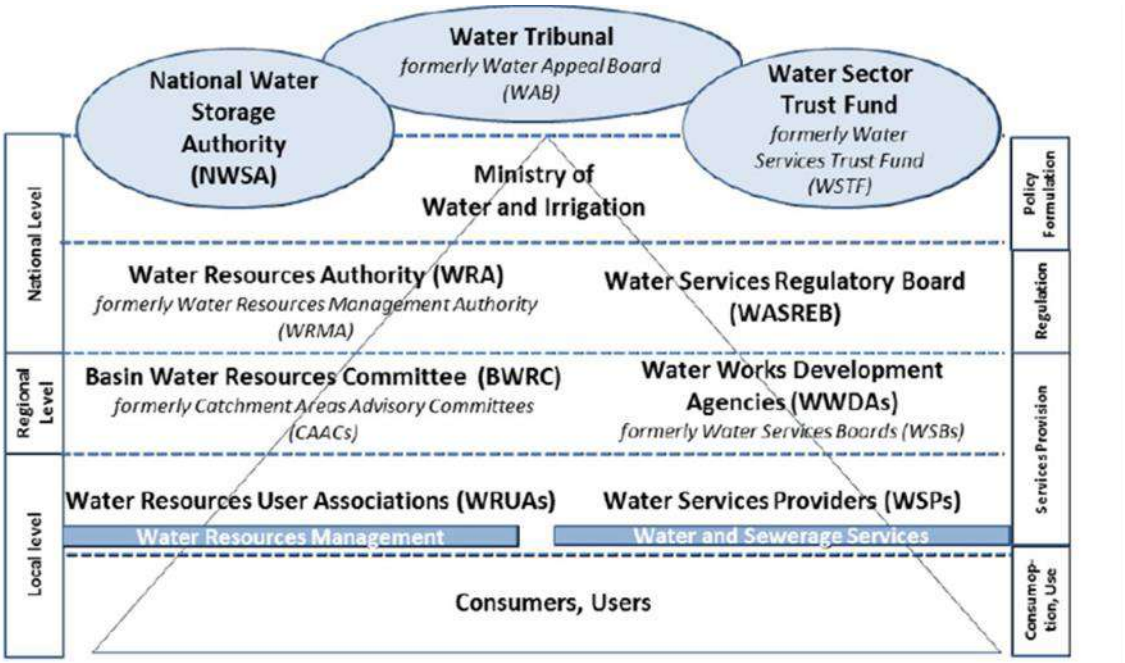


Figure 4.1. Redefined Roles and Responsibilities under Kenya's 2014 Water Bill (source: Understanding the Kenya 2016 Water Act)

Relevance to the Project

This Act shall be relevant during both construction operation phases of the project whereby the contractor and proponent shall ensure that all relevant water resources are not polluted from both liquid and solid wastes. TAWWDA shall also obtain authorization by WRA before abstracting water from Mwania River.

Water Rules 2007

One of the outcomes of the water sector reforms has been improved regulatory framework for water resource management and use. In addition to the Water Act 2002, the main document outlining the regulations is the Water Resource Management Rules 2007. The rules set out the procedures for obtaining water use permits and the conditions placed on permit holders. Sections 54 to 69 of the Water Resources Management Rules 2007 impose certain statutory requirements on dam owners and users in this regard.

Other sections within the rules imply that WRA can impose water quality sampling requirements from the water sources and impacts to the hydrology, water chemistry and river morphology downstream basin. Section 16 of the Water Rules requires approval from the Water Resources Management Authority (WRA) for a variety of activities that affect the water resources, including the storage of water in dams and pans. Approval by WRA is conferred through a Water Permit. A permit is valid for five years and must be renewed.

Section 104 of the Water Resource Management Rules requires certain water permit holders to pay water use charges. The intention of the water use charges was to raise revenue

for water resource management, raise revenue for catchment conservation activities, improve efficiency of water resource abstraction and provide a system of data collection on water resource usage.

4.3.4 County Government Act No. 17 of 2012

Part II of the Act empowers the county government to be in charge of function described in Article 186 of the constitution, (county roads, water and Sanitation, Health), Part XI of the Act vest the responsibility of planning and development facilitation to the county government with collaboration with national government, this arrangement has been adopted for interventions in order not to conflict with provisions of the Kenyan Constitution.

Relevance to the Project

The project once commissioned shall be handed over to Machakos Water and Sanitation Company which is a water utility company, wholly owned by Machakos County Government for operation and maintenance in accordance to the Act.

4.3.5 Physical Planning Act 1996 (286)

Section 29 of the said Act empowers the local Authorities (now county governments) to reserve and maintain all land planned for open spaces, parks, urban forests and green belts as well as land assigned for public social amenities. The same section allows for prohibition or control of the use and development of an area.

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

Relevance to the Project

Thus the Act directs, regulates and harmonizes development and use of land over the Country, the entire pipeline route has been designed within the reserve land and Kenya Power way leave stipulated reserve land under this Act, this was in an effort to avoid cases of acquisition of private property and resettlement complications.

4.3.6 Occupational Health and Safety Act (OSHA 2007)

This legislation provides for protection of workers during construction and operation phases. It is tailored at implementation of the EHS plan in compliance with the relevant sections of this Act. The EMP prepared under this assessment has provided for specific health and safety aspects to be complied with during implementation of the project.

Relevance to the Project

The Act provides Occupational Health and Safety guidelines which shall be followed by both the contractor and supervising consultant during implementation of the project in order to avoid injuries and even loss of life to workers and neighbouring community.

4.3.7 The Public Health Act (Cap.242)

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 to the Project

The Act provides guideline to the contractor on how he shall manage all wastes (Liquid and Solid Wastes) emanating from the project in a way not to cause nuisance to the community, this Act during construction shall be read alongside the waste management regulations of EMCA 2015 for utmost compliance. The Act also shall be applied to ensure that the food that is provided to the workers during construction of the project meets the safety requirements.

4.3.8 Eviction Wayleave and Rehabilitation Bill (2014)

Once passed by the parliament, it will be an Act of Parliament to provide for procedures for the evictions of unauthorized occupants from private or public land and the resettlement of displaced persons coerced or involuntary displacement and for matters incidental and related thereto.

The Bill main objective is to set out appropriate procedures applicable to evictions and resettlement, the bill also has outlined principles that are intended to guide the resettlement and eviction procedures including:

Every person shall be protected from arbitrary eviction;

i. the persons, affected by an eviction should not suffer detriment to their human rights;
ii. the Sate while carrying out eviction and resettlement, must observe the human dignity, equity, social justice, human rights, non-discrimination and protection of the marginalized and vulnerable groups; and
iii. every person has the right to administrative action that is expeditious, efficient, reasonable and procedurally fair

Part (111) section (17) of the bill elaborates of the process to the undertaken when the government intends to evict persons from their land to create room for project, the bill gives power to the cabinet secretary based on the Environmental and Social Impact Assessment Report prepared, prepare a plan for the resettlement of the affected persons after consultation with the representatives of the affected persons.

Relevance to the Project

The project route is entirely a government road reserve which implies that no person shall claim ownership of land for the pipeline to be constructed; the proposed sites for water treatment plant is located within government land.

This bill in reference to Operation Safeguards (OS 2): Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation, shall be used as reference during preparation and implementation of project in case private assets and sources of livelihood are impacted.

4.4 Institutional Structure of the Water Sector

The National Policy on Water Resources Management and Development and the Water Act 2002, presently guides water resources management. The Water Act 2016 has realigned this arrangement slightly to comply with the requirements of the new constitution 2010.

The overall goal of the National Water Development Policy is to facilitate the provision of water in sufficient quantity and quality and within a reasonable distance to meet all competing uses in a sustainable, rational and economical way.

The Ministry of Environment, Water and Natural Resources is responsible for policy development, sector co-ordination, monitoring and supervision to ensure effective Water and Sewerage Services in the Country, sustainability of Water Resources and development of Water resources for irrigation, commercial, industrial, power generation and other uses. The Ministry executes its mandate through the following sector institutions:

4.4.1 Water Services Regulatory Board (WASREB)

The regulatory Board is responsible for the regulation of the water and sewerage services in partnership with the people of Kenya. The mandate of the regulator covers the following key areas:

i. Regulating the provision of water and sewerage services including licensing, quality assurance, and issuance of guidelines for tariffs, prices and disputes resolution.
ii. Overseeing the implementation of policies and strategies relating to provision of water services of Water Works Development Agencies and approving their Water Services Providers,
iii. Monitoring the performance of the Water Works Development Agency and Water Services Providers,
iv. Establish the procedure of customer complaints,
v. Inform the public on the sector performance,
vi. Gives advice to the Minister in charge of water affairs.

4.4.2 Water Resources Authority (WRA)

The authority is responsible for sustainable management of the Nations Water Resources:

i. Implementation of policies and strategies relating to management of water resources,
ii. Develop principles, guidelines and procedures for the allocation of water,
iii. Development of Catchments level management strategies including appointment of catchments area advisory committees,
iv. Regulate and protect water resources quality from adverse impact
v. Classify, monitor and allocate water resources.

4.4.3 Water Services Trust Fund (WSTF)

This body assists in the financing of the provision of Water Services to areas of Kenya which are without adequate water services. This shall include providing financing support to improved water services towards:

i. Capital investment to community water schemes in underserved areas
ii. Capacity building activities and initiative among communities
iii. Water services activities outlined in the Water Services Strategic Plan as prioritized by the Government
iv. Awareness creation and information dissemination regarding community management of water services
v. Active community participation in the management of water service

4.4.4 Water Works Development Agencies (WWDA)

The WWDAs are responsible for the efficient and economical provision of water and sewerage services in their areas of jurisdiction. TAWWDA is among the seven catchment Agencies established under the Water Act, 2016 and is mandated to:

Develop the facilities, prepare business plans and performance targets
Planning for efficient and economical provision of Water and sewerage services within their areas of jurisdiction;

The water services Agency relevant to this project is the Tanathi Water Works Development Agency

4.4.5 Water Services Providers

Water Service Providers are the utilities or water companies. They are state owned but have been commercialized to improve performance and run like business within a context of efficiency, operational and financial autonomy, accountability and strategic, but minor investment.

4.4.6 NEMA Compliance

The government established the National Environmental Management Authority (NEMA) as the supreme regulatory and advisory bodies on environmental management in Kenya under EMCA 2015. NEMA is charged with the responsibility of coordinating and supervising the various environmental management activities being undertaken by other statutory organs. NEMA also ensures that environmental management is integrated into development policies, programmes, plans and projects.

4.5 Sectoral Integration

This integration encourages provision of sustainable development and a healthy environment to all Kenyans. The key functions of NEMA through the NEC include policy direction, setting national goals and objectives and determining policies and priorities for the protection of the environment, promotion of cooperation among public departments, local authorities, private sector, non- governmental organizations and such other organizations engaged in environmental protection programmes and performing such other functions as contained in the act.

Other stakeholder authorities include Ministry of Water and Irrigation, Ministry of Environment and Natural Resources, Ministry of Health and Sanitation, Ministry of Lands and Physical Planning, Ministry of Social and Cultural Services as well as the County Administration. Others are the Machakos County Government and Machakos Water and Sewerage Company as well as key groups working with the beneficiary communities in the respective areas.

4.6 Project Implementation Institutional Structure

Rift Valley Water Works Development Agency has established implementation units for project with project engineers in charge for various county projects, the Agency hires on case by case basis the services of environment specialist to oversee implementation of the EMSP developed for projects.

4.6.1 The Contractor

The contractor will be required to establish an environmental office to continuously advise on environmental components of the project implementation. Elements in the environmental and social management plan are expected to be integrated in the project with appropriate consultations with TAWWDA through the supervising environmental expert. The environmental officer of the contractor is also expected to fully understand the engineering and management aspects of the project for effective coordination of relevant issues.

4.6.2 The Supervisor

The supervisor will be engaged by TAWWDA (as the project proponent) to ensure effective implementation of the environmental management plan. It is expected that supervisor engages the services of an environmental expert who should in return understand the details of the recommendations on environment management and especially the proposed action plans, timeframes and expected targets of the management plan. The environmental supervisor expert should also be the liaison person between the contractor and TAWWDA on the implementation of environmental concerns as well as issues of social nature associated with the Project.

4.7 African Development Bank Integrated Safeguards Systems (ISS)

The African Development Bank Group (AfDB) presents its Integrated Safeguards System, a cornerstone of its strategy to promote growth that is socially inclusive and environmentally sustainable. Safeguards are a powerful tool for identifying risks, reducing development costs and improving project sustainability, thus benefiting affected communities and helping to preserve the environment.

Operational Safeguards (OSs) – are a set of five safeguard requirements that Bank clients are expected to meet when addressing social and environmental impacts and risks. Bank staff use due diligence, review and supervision to ensure that clients comply with these requirements during project preparation and implementation. Over time the Bank may adopt additional safeguard requirements or update existing requirements to enhance effectiveness, respond to changing needs, and reflect evolving best practices.

4.7.1 OS 1: Environmental and Social Assessment.

This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements: the scope of application; categorisation; use of a SESA and ESIA, where appropriate; Environmental and Social Management Plans; climate change vulnerability assessment; public consultation; community impacts; appraisal and treatment of vulnerable groups; and grievance procedures. It updates and consolidates the policy commitments set out in the Bank's policy on the environment.. This Study Report addresses issues of OS1, and the Project compliance to Environmental sustainability.

4.7.2 OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.

This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and it incorporates refinements designed to improve the operational effectiveness of those requirements. In particular, it embraces comprehensive and forward-looking notions of livelihood and assets, accounting for their social, cultural, and economic dimensions. It also adopts a definition of community and common property that emphasises the need to maintain social cohesion, community structures, and the social interlinkages that common property provides. The safeguard retains the requirement to provide compensation at full replacement cost; reiterates the importance of a resettlement that improves standards of living, income earning capacity, and overall means of livelihood; and emphasises the need to ensure that social considerations, such as gender, age, and stakes in the project outcome, do not disenfranchise particular project-affected people. The project triggers OS2 and Resettlement Action Plan shall be part of this Consultancy.

4.7.3 OS 3: Biodiversity and Ecosystem Services.

The overarching objective of this safeguard is to conserve biological diversity and promote the sustainable use of natural resources. It translates into OS requirements the Bank's commitments in its policy on integrated water resources management and the UN Convention on Biological Diversity. The safeguard reflects the importance of biodiversity on the African continent and the value of key ecosystems to the population, emphasising the need to "respect, conserve and maintain [the] knowledge, innovations and practices of indigenous and local communities… [and] to protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements3 . OS3 is not triggered as the proposed project area is modified by anthropogenic factors.

4.7.4 OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency.

This safeguard covers the range of impacts of pollution, waste, and hazardous materials for which there are agreed international conventions and comprehensive industry-specific standards that other multilateral development banks follow. It also introduces vulnerability analysis and monitoring of greenhouse gas emissions levels and provides a detailed analysis of the possible reduction or compensatory measures framework . The project will not utilize any hazardous materials, as such OS4 will not be triggered.

4.7.5 OS 5: Labour Conditions, Health and Safety.

This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It covers working conditions, workers' organisations, occupational health and safety, and avoidance of child or forced labour. This report and national legislations shall prevail in managing and guiding compliance to OS5.

Relevance

The Project is being financed by AfDB, was therefore checked against the above listed operation safeguards and appropriate mitigation measures of likely to be triggered under each policy was summarized in the EMSP and presented in table 13 below

Table 5-1: Project Activities Triggering AfDB Operational Safeguards

Policy	Triggered by the project?	Discussions
OS 1: Environmental and Social Assessment.	Yes	The project components will trigger EA safeguards and is Category A due to the interaction with the physical, biological and social setting within the immediate surroundings. This report is a part of Environmental & Social Assessment.
OS 2: Involuntary Resettlement: Land Acquisition, Population Displacement and Compensation.	Yes	The project shall be developed on private lands and RAP shall be undertaken to mitigate on impacts of loss of land.
OS 3: Biodiversity and Ecosystem Services.	No	Project activities have direct linkages to biological diversity and ecosystem services OS 1 shall be applied in isolated minor cases of biodiversity and ecosystem services. Also its important to note that the project is not in a protected area, the area is modified due to anthropogenic activities.
OS 4: Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency.	Yes	The project shall utilize raw materials both during construction and operation phase that could result to pollution of biophysical environment if not handled appropriately. Project activities shall not result to significant amount of greenhouse gases, EMSP has proposed measures of ensuring that methane gas generated from the anaerobic ponds is collected and flared appropriately. The project design has ensured that the both clean water and sewer flows through the distribution lines by gravity hence reducing the need for pumping.

OS 5: Labour Conditions, Health and Safety.	yes	The project shall involve workers both during construction and operation phases of the project. this policy read together with OSHA 2007 and IFC Performance Standards 2 on Labour and Working Conditions shall form integral instruments to be used in ensuring that health, safety and working conditions of both works and community is safeguards

4.8 Relevant International Conventions

The following international conventions will be relevant to the project as they are concerned with the protection of the ozone layer.

4.8.1 The 1985 Vienna Convention for the protection of the Ozone Layer

The Vienna Convention for the Protection of the Ozone Layer, 1985 was adopted after consensus was reached on 22nd March 1985. The overall objective of the Vienna Convention is to protect human health and the environment against the effects of ozone depletion.

4.8.2 The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol on Substances that Deplete the Ozone Layer is a significant milestone in international environmental law. It establishes firm targets for reducing and eventually eliminating consumption and production of a range of ozone depleting substances. These substances are enumerated in Annexes A-E to the Protocol and are to be phased out within the schedule given in article 2A-2I.

4.8.3 The United Nations Convention on Climate Change ("1992 UNFCCC")

The objective of the 1992 UNFCCC is to tackle the negative effects of climate change. The Conventions' stated aim is to stabilize greenhouse gas concentrations at a level that allows ecosystems to adapt naturally to climate change so that food production is not threatened, while enabling economic development to proceed in a sustainable manner (article 2).

4.8.4 The Kyoto Protocol

The Kyoto Protocol was adopted in December 1997 at the Third Conference of the Parties held in Kyoto. The Kyoto Protocol requires stronger commitments from parties to achieve quantified emission reductions within a specific timeframe. These commitments cover the six greenhouse gases listed in Annex A of the Kyoto Protocol (Carbon dioxide, Methane, Nitrous oxide, Hydrochlorocarbons, Perfluorocarbons and Sulphur hexafluoride).

Relevance

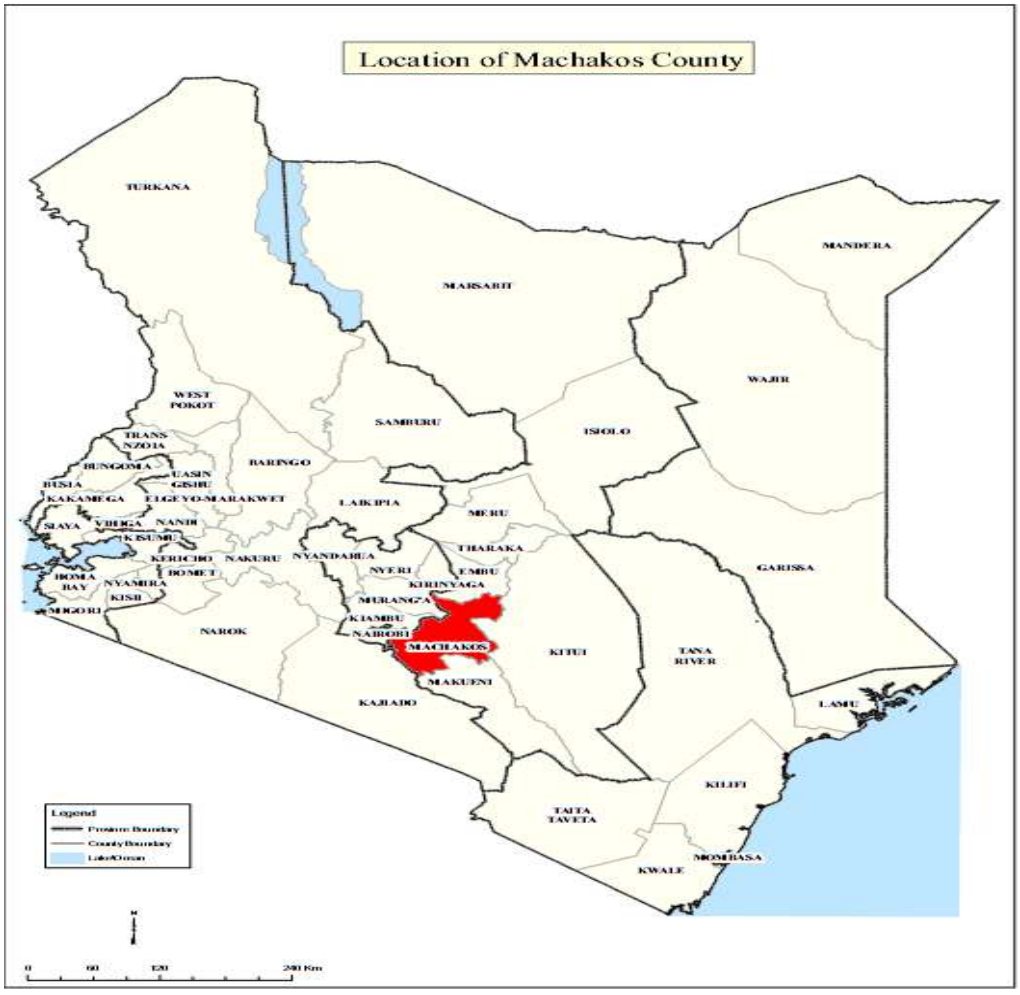
Rift Valley Water Works Development Agency and the contractor will be required to carry out regular inspection and maintenance of construction equipment in order to reduce the levels of green house gas emissions into the atmosphere, the design of the sewer ponds should ensure that the anaerobic ponds are covered to trap the methane gas which should be cleaned and used appropriately as renewable energy.

5 DESCRIPTION OF THE PROJECT ENVIRONMENT

5.1 Machakos County[1]

Machakos County is strategically located as it borders seven counties. To the north it is bordered by Embu, Muranga and Kiambu Counties, to the west Nairobi and Kajiado counties, to the south Makueni County and to the East Kitui County. Figure 2.1 below shows the larger Machakos County and Figure 2.2 shows the project target area; the eight wards of Machakos Sub County;-Mutituni, Mumbuni North, Machakos Centrall, Muvuti, Kalama, Kola, Mua and Kinanie. In terms of latitude and longitude it lies between latitudes 0º45´South and 1º31´South and longitudes 36º45´East and 37º45´East.

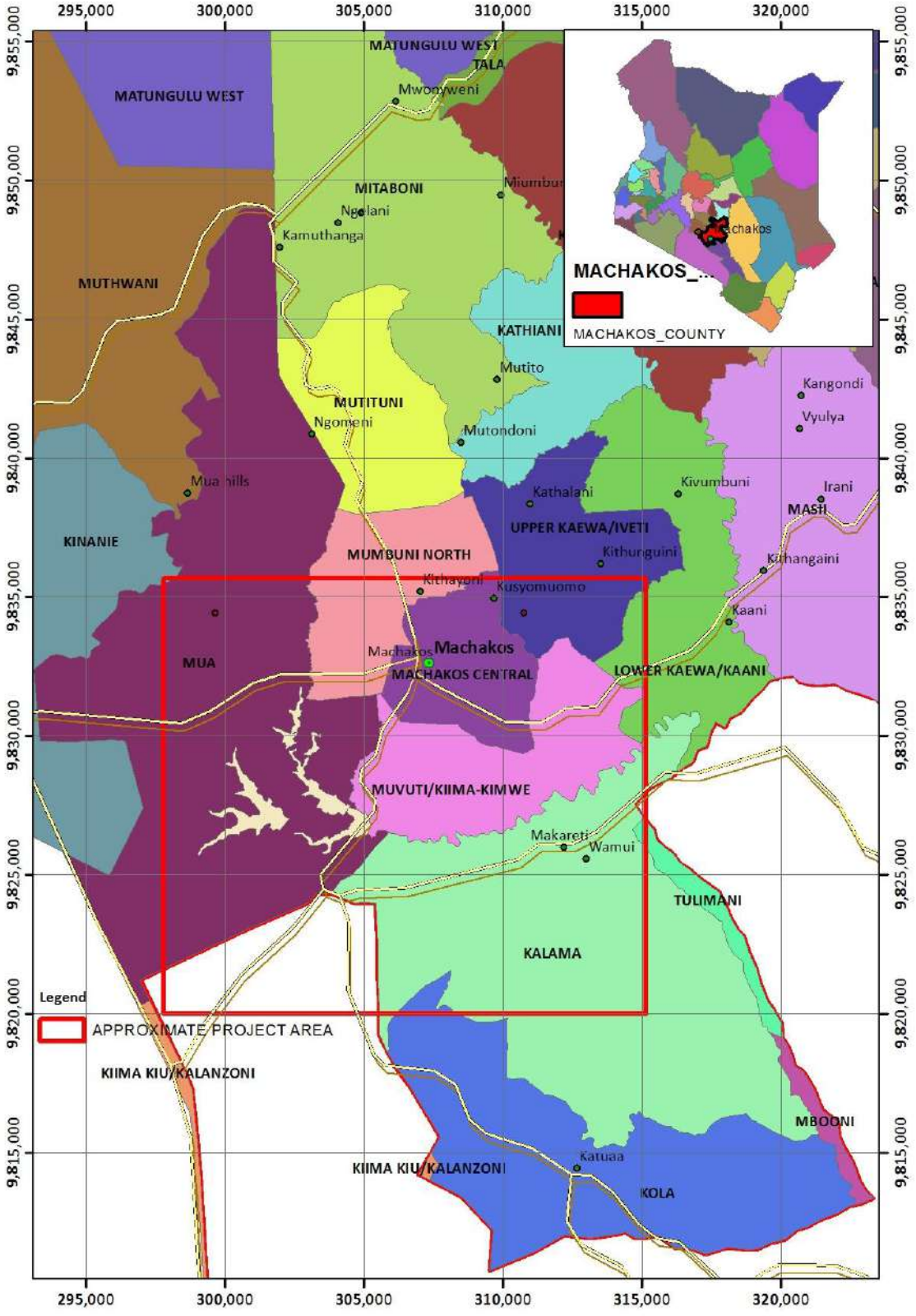
The County covers an area of 6208.2 Km^2 with Machakos covering 925.2 Km^2, Kangundo covers 177.2 Km^2, Kathiani covering 207.1 Km^2, Athi River covers 843.2 Km^2, Yatta covering 1,057.3 Km^2, Masinga covering 1,402.8 Km^2, Matungulu covering 577.5 Km^2 andMwala covering 1,017.9 Km^2.



Source: Kenya National Bureau of Statistics, 2013

(5.1.1.a.i.1 Figure 2.1 Location of Machakos County.

[1] The information is based on the Machakos County Integrated Development Plan, 2015



(5.1.1.a.i.2 Figure 2.2. Project target area.

5.2 Project Area of Influence

Administratively, the area comprises of entire Machakos Central and Kalama divisions as well as Kinanie Ward in Athi River Division.

Table 5-1 Administrative Divisions Areas Covered

Division	Locations
Machakos Central	Township, Mumbuni, Mua Hills, Katheka Kai, Muvuti, Kiima Kimwe, Ngelani, Mutituni and Kimutwa.
Kalama	Kalama, Lumbwa, Kyangala and Kola.
Kinanie	Lukenya (Kyumvi).

Machakos town and specifically the target project area has a linear settlement pattern discernible along the main transit corridors of machakos town i.e. along the Machakos – Nairobi, Machakos – Kangundo, Machakos –Konza/Wote and Machakos – Kitui roads. Along these main roads are found such centres as Kenya-Israel, Miwani; Mumbuni/St. Valentine; Katoloni, Kwa Kyumvi and; California, respectively. Accessibility to Machakos town is the main factor that has influenced the rise of these settlements.

5.3 Physical and Topographic Features

Machakos County has very unique physical and topographical features. Hills and a small plateau rising to 1800-2100m above sea level constitute the Central part of the County. To the West, the County has a large plateau elevated to about 1700m which is southeast sloping. The County rises from 790 to 1594 m above sea level. In the North West the County has stand-alone hills.

The soils are well drained shallow, dark red clay soils particularly in the plains. However the vegetation across the entire County depends on the altitude of any given area/location. The rainfall distribution in the County depends on the topography of the areas. Since some areas of the County are arid while others have hills and volcanic soils and other areas are plains, the rainfall is widely distributed. For instance the plains receives less amounts of rainfall as such the dominate vegetation is grasslands and some sparse acacia trees. The areas within the County are predominately plains include Mutituni, Mwala, Mua, Iveti Hills and Kathiani.

5.3.1 Climatic Conditions

Generally the annual rainfall of the County is unevenly distributed and unreliable. The average rainfall is between 500 mm and 1300 mm. The short rains are expected in October and December while the long rains are expected in March to May. The highland areas within the County such as Mua, Iveti and Kangundo receive an average of 1000mm while the lowland areas receive about 500mm; ideally the rainfall within the County is influence by the latitude. In terms of temperature, July is the coldest month while October and March are the warmest. Temperature varies between 180C and 29°C throughout the year. Since the County does not experience rain throughout the year it then means that there are moths that experience dry spells. These months are mainly February to March and August to September.

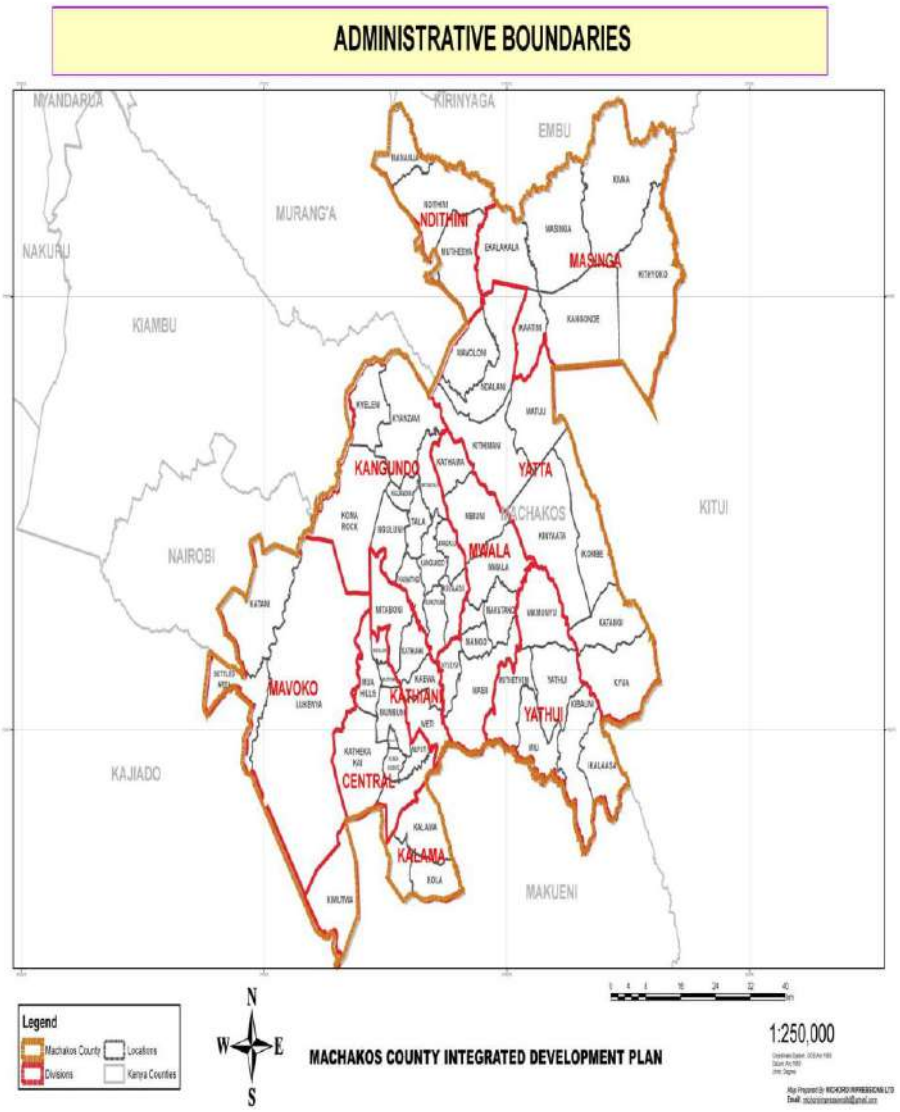
5.4 Administrative Units

The total land mass of Machakos County is divided into eight sub-counties/ constituencies, namely; Mavoko, Kathiani, Machakos, Matungulu, Yatta, Masinga, Mwala, and Kangundo as shown in Table 2.1 below. The populatin for Machakos County is 1,421,932, the male population is 710,707 and female 711,191and average households size is 3.5 (KNBS 2019) persons.

Sub-County/ Constituency	Area (Km^2)	(2009 Census)		2019 Census	
		Popn	Den (KM^2)	Popn	Den (KM^2)
Machakos	**925.2**	**199,211**	**215**	**170,606**	**243**
Kangundo	177.2	94,367	532	97,917	600
Kathiani	207.1	104,217	503	111,890	568
Mwala	843.2	163,032	160	181,896	181
Yatta	1,057.3	147,579	140	172,583	157
Masinga	1,402.8	125,940	90	148,522	101
Matungulu	577.5	124,736	216	161,557	244
Mavoko	1,017.9	139,502	165	157,288	187

(i) Table 2.1 Population of Machakos Sub Counties

These eight sub-counties/ constituencies are further subdivided into twenty two divisions, seventy five locations and two hundred and thirty nine sub locations respectively as shown in the in Table 1 and Figure 2.3 below.



(5.4.1.a.i.1 Figure 2.3 Machakos County Divisions and locational boundaries

5.5 Road, Rail Network, Ports and Airports, Airstrips and Jetties

The County has a total road network of 12152.5 Km of which 375 Km is bitumen surface, 10,628Km is gravel surface, and 1149.5 Km is earth surface. Some are good roads including the Nairobi - Mombasa road, Machakos - Kitui road, Machakos - Wote road and Nairobi- Kangundo road. Since majority of the roads within the County are earth and inaccessible during the rainy season; the County has prioritized the upgrading of the roads within the county.

5.6 Posts and Telecommunications

The mobile network coverage within the County is of 85 per cent of the total area. However, areas such as Kibauni and Yathui in Mwala, and Kalama in Machakos have a poor network coverage. The number of land line connection is 327 and its use is on the decline particularly because the use of internet as the main source of communica-

tion is on the rise and with the availability of fibre optic then the reliance on the land-lines is on the decrease. .

There are 14 post offices and 20 sub-post offices which are fairly distributed within the County. Radio ownership is 96 per cent which is attributed to low cost of purchase and maintenance while Television coverage is 58 per cent.

5.7 Educational Institutions

The County has 1,736 Early Childhood Development (ECD) centres, 688 primary schools and 190 secondary schools. The introduction of the free primary education increase the enrolment of children into primary school. This has led to a strain on the infrastructure of the primary schools particularly the classrooms, toilets and laboratories. Though primary education, secondary education and universities has not been devolved to the County government, the County is keen on cooperation with the National government to ensure that the infrastructure mentioned above takes into account the growing enrolment rates. Since the ECD and the village polytechnics have been devolved, the County government has set aside a budget to ensure that the number and quality of ECD centres increases.

The County has one medical training institution (MTC) located in Machakos town and two private universities Daystar University and Scotts Christian University which are situated in Mavoko and Machakos Town constituencies respectively. Other universities such as Nairobi University, Kenyatta University, Nazarene University St. Pauls University and Jomo Kenyatta University of Agriculture and Technology have also opened various campuses in the County. Most of the campuses are situated in Machakos town. The institutions have created opportunities for the youth to acquire skills and knowledge.

5.8 Energy Access

Masinga dam is one of the seven forks dams which produces hydroelectricity for the National Electricity Grid and it is located within the County. The connection to the national grid across the County is commendable since, 77 per cent of all trading centres have power. Though connection to individual homes is low and there is need for up scaling the rural electrification programme, the County is keen on cooperating with the Rural Electrifications Authority to ensure that there is energy access across the County. The department responsible for energy has also set aside a budget with respect to the distribution of power across the County.

Wood, paraffin, charcoal, solar, gas and electricity are the main sources of energy across the County. Though wood is the main source of cooking energy accounting for 81.6 per cent, while the main source of lighting energy is paraffin accounting for 88.1 per cent. From the foregoing it is apparent that diminishing forest coverage within the County can be attributed to the high use of wood as the main source of fuel.

5.9 Markets and Urban Centers

The main urban centres in the County are Machakos, Kangundo-Tala, Athi River, Kathiani Masii and Matuu, however the major urban centres are Machakos and Athi River. Other trading centres include Mlolongo, Kyumbi, Mwala, Mbiuni, Kaewa, Mitaboni and Kithimani among others. For purposes of categorizing markets, the County Finance Act has identified seven (7) urban centres and twenty three (23) peri urban

centres.

5.10 Housing: Types, Building Materials, Structure Quality and Distribution

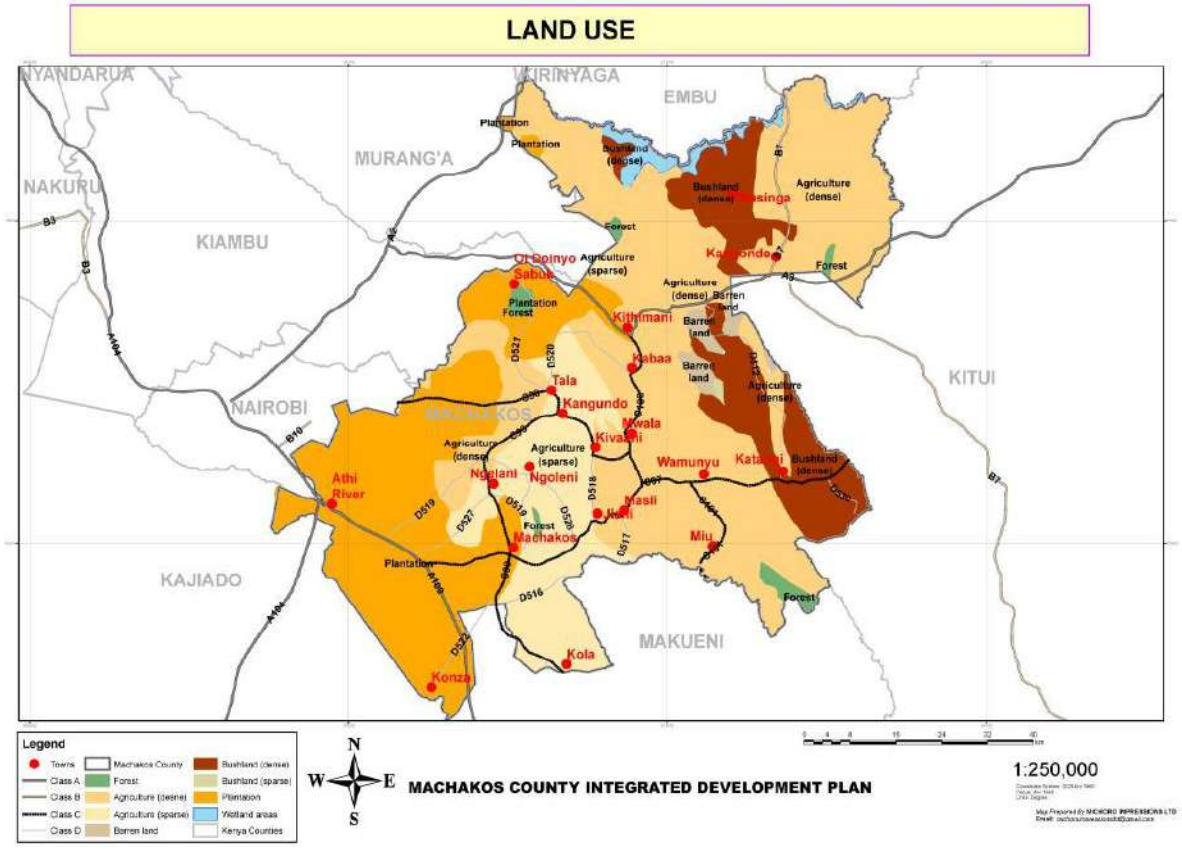
Houses in the County are both permanent and semi-permanent. 59.2 per cent of all the homes have brick/block walls, 23.9 per cent stone walled and 12.3 per cent mud / wood walls. Other houses have 1.5 per cent, 2.7 per cent wood wall and corrugated walls respectively. The highest number of houses has earth floor which accounts for 62.4 per cent, others have cement floors accounting for 46.6 per cent. Only 0.4 per cent of the housing have floor tiles. The main roofing materials in the County is corrugated iron sheets which represents 82 per cent of the total houses. Other houses are roofed using grass, tiles, concrete and asbestos sheets which accounts for 14.5 per cent, 1 per cent, 1.2 per cent and 0.5 per cent respectively.

5.11 Land and Land Use

Land has aesthetic, cultural and traditional values and is a vital factor of production in the economy. Land in the County is broadly used for Forest, Government Reserve, Townships, Game Reserves, Agriculture, Ranches, Industrialization, mining and livestock keeping. The absence of the national land use policy has led to the proliferation of informal settlement, inadequate infrastructure services, congestion environmental degradation, unplanned urban centres, pressure on agricultural land and conflicts. Below is a map showing the land use

Out of the 6,028 Km2 covered by the County, approximately 3,720.2 Km2 is arable land while approximately 2,436 Km2 is non arable land and approximately 124 Km2 is under water mass. Masinga Sub County has the highest water mass since it is the home of Masinga dam and the Seven Folks dam.

According to the available data, the proportion of land with title deeds stands at 28.5per cent with the most affected area without title deeds issued being Athi River, Machakos and Kathiani. The impact of the lack of title deeds in these areas has resulted in the reduced investments despite the investment potentials vested in these areas.



(5.11.1.a.i.1 Figure 2.4 Machakos County Land Uses

5.12 Public Benefit Organizations (PBOs)

There are 199 registered cooperative societies engaging in various activities such as agricultural, retail, urban, rural and multipurpose societies. However 62 of these societies are dormant and 17 have collapsed due to poor management and lack of funds. The County has various registered community based organisations. They are estimated to be 1,777 self-help groups, 965 active women groups and 1310 youth groups.

Non-governmental Organizations are very vital in the development of the County. There are about 150 registered NGOs with only 42 active focused mainly in fight against HIV and Aids education, youth empowerment, provision of water and poverty eradication.

5.13 Number of Ranches

There are thirty (30) ranches in the County categorized on basis of ownership of which two are company owned, three are group ranches while twenty five are individual ranches. Most of the ranches are in Machakos and Mavoko constituencies. The wildlife found here include; giraffe, lions, zebras, hyenas, buffaloes and antelopes.

5.14 Agriculture

Agriculture is the main activity carried out in a number of sub counties. Agriculture is a main source of job creation. From available statistics, the main cash crops are coffee, French Beans, pineapples and Sorghum which are mainly grown in Kangundo Matungulu, Kathiani, Yatta and Mwala. The main food crops are maize, beans, Pigeon peas

and cassava which are normally grown in small scale. Most of the crops are rain fed and due to the unreliability of the rain there is low production leading to food insecurity.

The total arable land in the County is 372,020 Ha but only 248,333 Ha has been put under crop production. Total acreage of land under food crops in the County is 161,695 Ha while the total acreage under cash crops 86,638 Ha.

5.15 Water Resources, Quality and Sanitation

Water resources in the County are under pressure from agricultural chemicals and urban and industrial wastes, as well as from use for hydroelectric power. The County has two permanent rivers namely Athi and Tana. Tana River is mainly used for hydroelectricity generation while Athi River is used for domestic and industrial uses. There are also several dams that serve as water resources and springs which are found in the hilly areas. Underground water sources supplement surface water sources.

There are established water supply schemes in every sub-County of the County. There are three water supply schemes in the County, Kayata in Matungulu, Yatta, and Kabaa in Mwala. There are various community management committees in various water catchments areas in the County.

The County has only two sewer lines; in Athi River and Machakos. Machakos is partially connected to the sewer systems. Parts of Kariobangi and Mjini are not connected and as high as 78.3 per cent of households use pit latrines. Other households use covered pit latrines, uncovered pit latrines, VIP latrine and flush toilets accounting for 47.8 per cent, 30.5 per cent, 6.2 per cent and 5.9 per cent use respectively. Garbage disposal in the County is mainly by farm garden which accounts for 48.4 per cent. Communities use other means such as local authority, private firms, garbage pit and burning and public garbage heaps.

5.16 Morbidity: Five Most Common Diseases in Order of Prevalence

The most prevalent disease is malaria which accounts for 40 per cent of the total cases reported. Respiratory complications account for as high as 24 per cent. Other diseases are flu accounting for 15.9 per cent stomach-ache and Diarrhoea accounting for 5.2 per cent and 3.1 per cent respectively.

5.17 Socio economic Baseline

5.17.1 Household size, age and gender profile

The households interviewed in the study consisted of (35.48%) male and (64.52%) female respondents. Households had a mean size of (4.3) members (Table 4.1). The median household size for the entire sample is (4.31) members. This is higher than the national average of 4 and Machakos County average of 3.6 (KIHBS 2015/16). The higher household size could be attributed to urban and peri-urban nature of the project area and climatic zonation of Machakos County.

1. Table 5-5: Composition of sample households

Statistics			
	Household Total	Males	Females
Mean	4.31	2.18	2.42
Median	4.00	2.00	2.00
Mode	3	2	2
50	4.00	2.00	2.00
75	6.00	3.00	3.00
90	7.00	4.00	4.00

Female headed households comprised (56.68%) of the population which indicates elevated levels of vulnerability in the project area. The average age of household head is 41.77 years as shown in the cumulative curve in Figure 4.1 below.

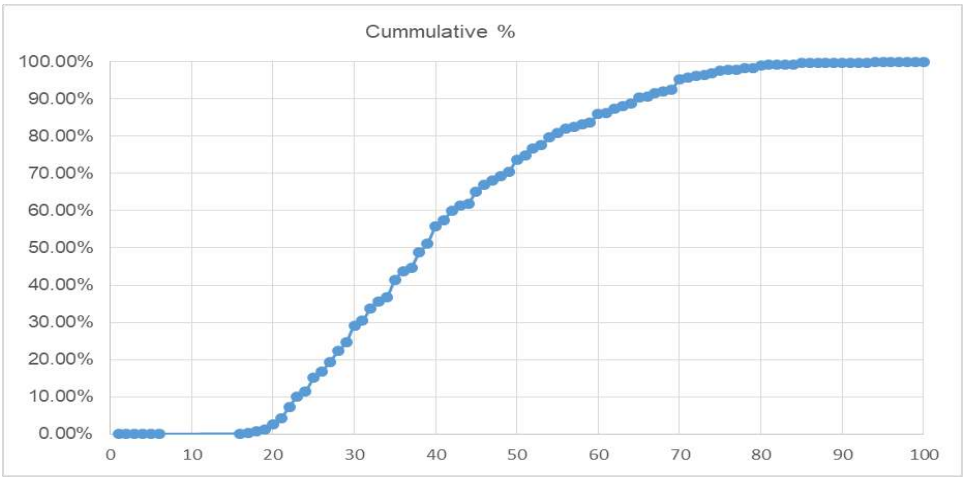


Figure 5-1: Age of Household head

Gender profiles In terms of gender, (56.68%) of the household heads are male and (33.32%) female. This is quite a departure from the findings of KIHBS 2015/16 which shows a breakdown of (63.6%) and (36.4%) male and female headed households respectively.

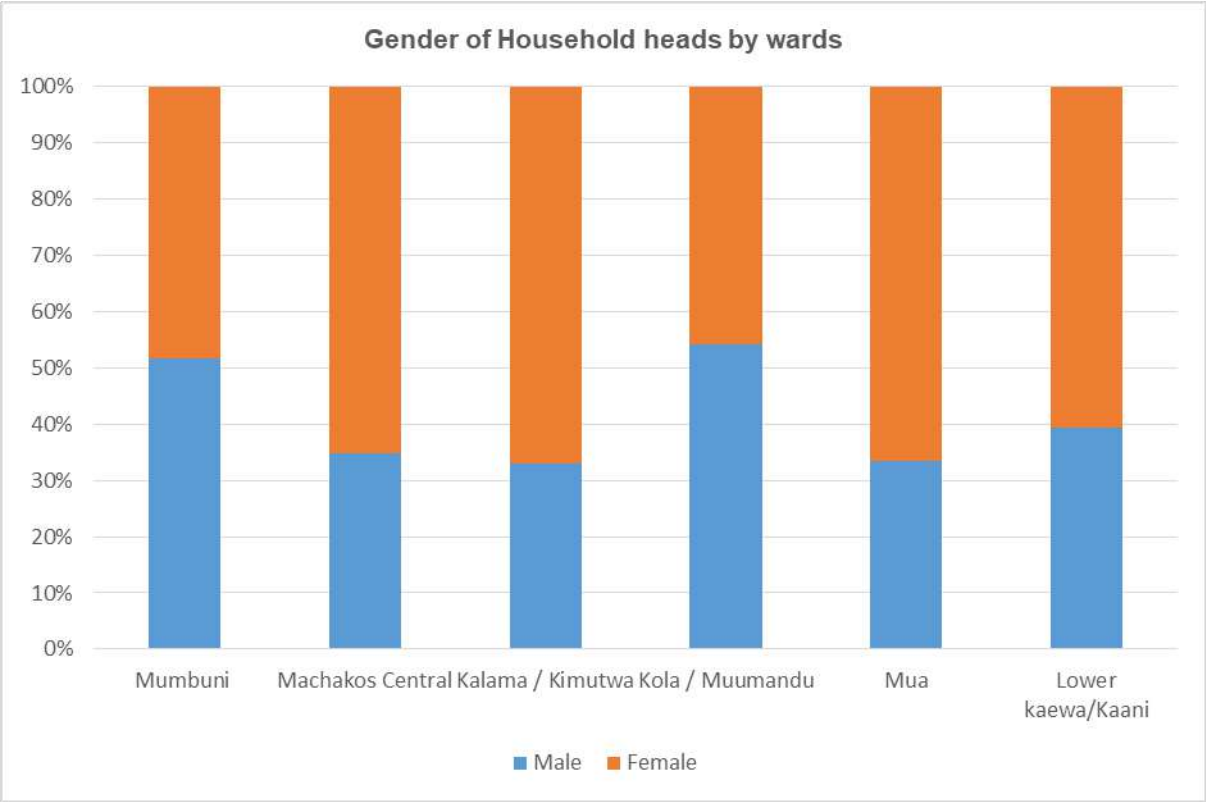


Figure 4.2: Gender of household head per ward

5.17.2 Gender Disparities and Vulnerability

As noted earlier, significant disparity has been noticed in terms of gender of the household head (only 29% of the households are female-headed; see (Figure 4.2). In addition, gender disparity is also observed in monthly household income with the average household income being Kshs13,013 and Kshs19,986 for the female and male headed households respectively. Whereas the low income in female headed households is expected since its attributed to earnings of only one person as opposed to two persons in the male headed household, this gender disparity is a socio-economic issue which needs to be addressed for inclusive growth.

2. Table 4.2: Gender disparity in terms of household income

Combined Household Income		
Female Headed Household	Mean	13,013
	Median	10,000
	Mode	10,000
	25th Percentile	5,000
	50th Percentile	10,000
	75th Percentile	15,000
	90th Percentile	30,000
Male Headed Household	Mean	16,987
	Median	10,000

Combined Household Income		
	Mode	10,000
	25th Percentile	7,000
	50th Percentile	10,000
	75th Percentile	20,000
	90th Percentile	40,000

Kenya has an overall Gender Inequality Index GII of 0.549 (Human Development Indices and Indicators: 2018 Statistical Update). The 2010 HDR introduced the GII, which reflects gender-based inequalities in three dimensions – reproductive health, empowerment, and economic activity. Reproductive health is measured by maternal mortality and adolescent birth rates; empowerment is measured by the share of parliamentary seats held by women and attainment in secondary and higher education by each gender; and economic activity is measured by the labour market participation rate for women and men. The GII can be interpreted as the loss in human development due to inequality between female and male achievements in the three GII dimensions.

However the GII value is not uniform across country as there are regional disparities with counties located in Arid and Semi-Arid Lands (ASALS) having high Gender Inequality Indices. In addition, there are other portions of population which are more likely to experience poverty. These vulnerable groups include children living in poor households, the disabled and the youth. Vulnerable groups in the project area are part of a significant proportion of the population. Generally, households with children under 5 constitute (43.38%) of the sample, (1.89%) had disabled individuals while (81.76%) had at least one member who is over 55 years. Moreover (19.06%) of households are headed by individuals over 55 years old while (9.67%) of household heads are over 65 years .

Improving equity in gender issues and reducing gender disparities will benefit all sectors and thus contribute to sustainable economic growth, poverty reduction and social injustices. Social protection of vulnerable groups is also very important to ensure posterity through elimination or reduction of causes of vulnerability by provision of safe clean water, healthcare, infrastructure and equitable resource allocation and use.

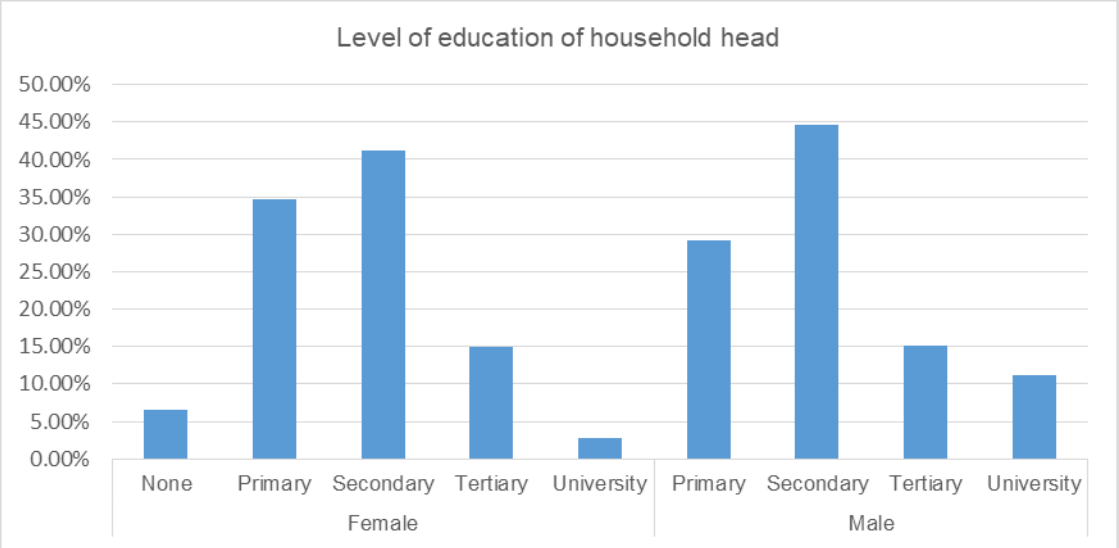
3. Table 4.3: Vulnerable Groups

Vulnerable persons	Percent
Households with Children Under 5	43.38%
Households with Disabled Persons	1.89%
Households with Elderly (over 55)	81.76%

5.17.3 Education Profile of HH

Perhaps due to the urban and peri urban nature of the study area, only (3.98%) while national level is (6.8 %) KIHB 2015/16 of household heads had no formal education, (31.69%) had have primary education, secondary (42.94%), (14.81%) had post-secondary education with (6.58%) of the sampled household heads with having attained university education. Disaggregated education levels by gender is as shown in Figure 4.3, male household heads on the overall have higher literacy levels of up to (93.52%).

4. Figure 4.3: Level of education by gender of HH



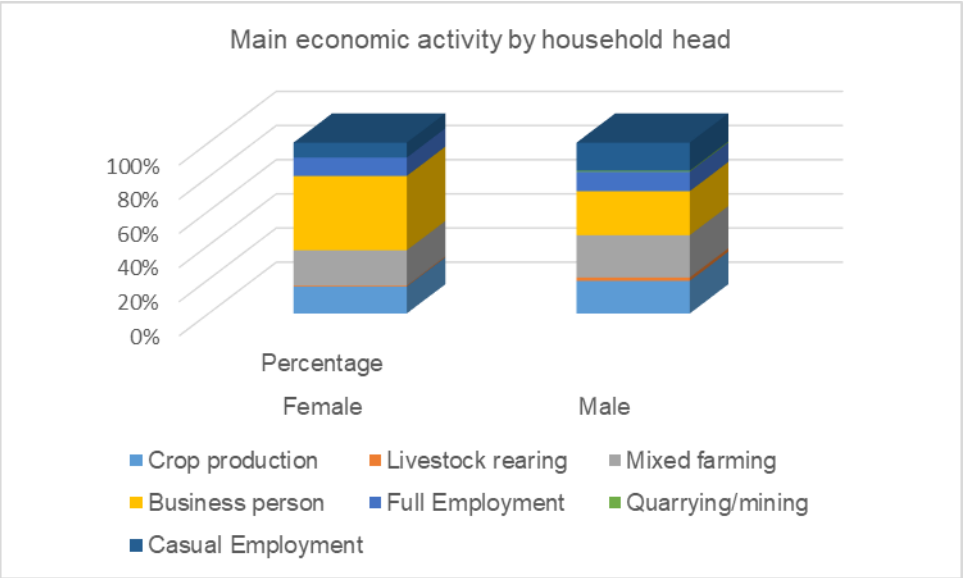
5.17.4 Economic Profile of Households

About (36.48%) of the households have their main economic activity being business, (10.96%) in formal employment, less than (1%) in quarrying/mining, (11.79%) are engaged as casuals while (40.5%) are involved in farming consisting of crop production, livestock rearing and mixed farming as shown in (Table 4.4). The average income per month is KShs 16,986.6 for the male headed households while female headed households average at KShs 13,013 per month. Only (44.72%) of households in this study had income over US$ 1 per person per day, and only (35.39%) had income over US$ 1.25 per day. These are the values commonly used as international thresholds for absolute poverty.

5. Table 4.4: Household head main occupation

Primary occupation of HH	
	Percent
Crop production	16.64%
Livestock rearing	1.25%
Mixed farming	22.61%
Business person	36.48%
Full Employment	10.96%
Quarrying/mining	0.28%
Casual Employment	11.79%
Total	**100.00%**

The target project area being predominantly urban and peri urban fringes of Machakos County shows a significant number of its population engage in business followed by formal employment either in the National or County Governments.



6. **Figure 4.4 shows main occupation**

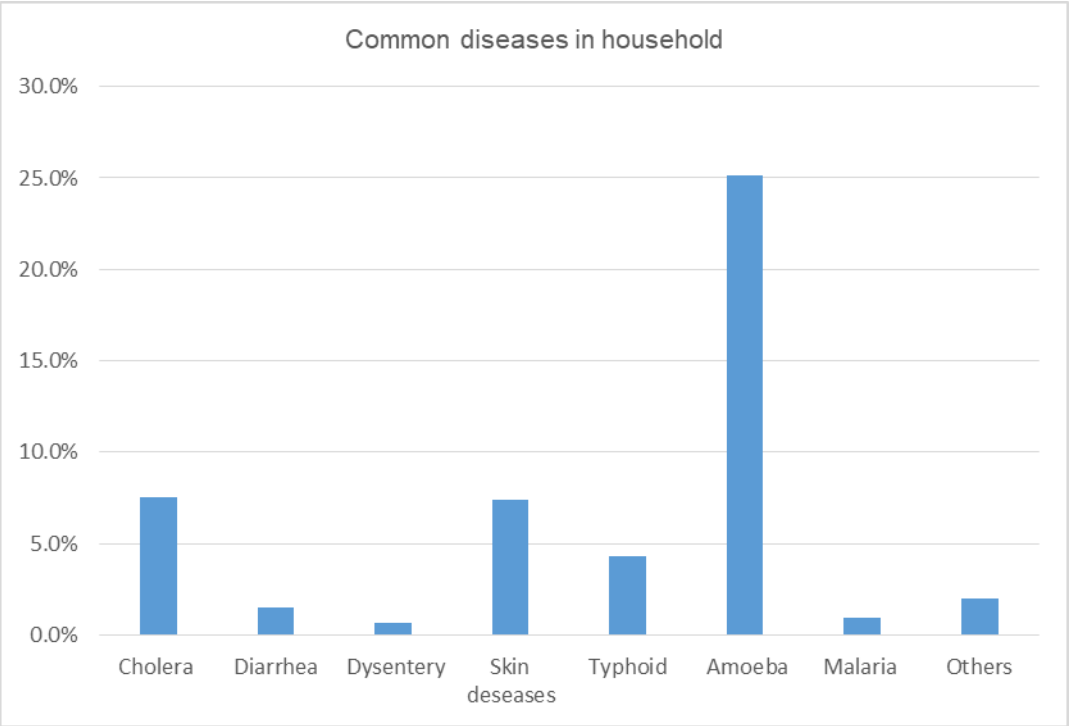
Expenditure: Analysis of household expenditure data shows that average Monthly Per Capita Expenditures (MPCE) is KShs. 8,556 per household. The expenditure on water is as shown in table (Table 4.5) of this amount, an average of Kshs 1,101 is spent on water bills while only (15.3%) of the population in the project area have access to piped water.

7. **Table 4.5: Household Water Expenditures**

Household Water Expenditure Statistics KShs/Month/Family			
	Household Expenditure	**Household Water Bill**	**Savings per house hold**
Mean	8,556	1,101	2,726
Median	5,000	600	1,000
Mode	3,000	-	-
25th percentile	3,000	200	-
50th percentile	5,000	600	1,000
75th percentile	10,000	1,200	3,000
90th percentile	19,800	2,400	7,300

5.17.5 Health

The main causes of morbidity as recorded in the project area are amoeba (25.1%), Cholera and diarrhoea at (9.1%), typhoid at (4.3%) and skin diseases at (7.4%) as shown in figure 4.5 below. Water borne diseases included diarrhoea, cholera and dysentery that descending. The number of episodes per household for water borne diseases in the last year is on average 1.51 times with (22.3%) reported as caused by contaminated water, (1.1%) of the cases caused by contaminated meals and (3%) caused by sewerage / undisposed excreta. Households affected by waterborne diseases spend on average KShs 6,184.30 per year. These consumes HH incomes, potential savings and productive hours by locking out economically active individuals from working.

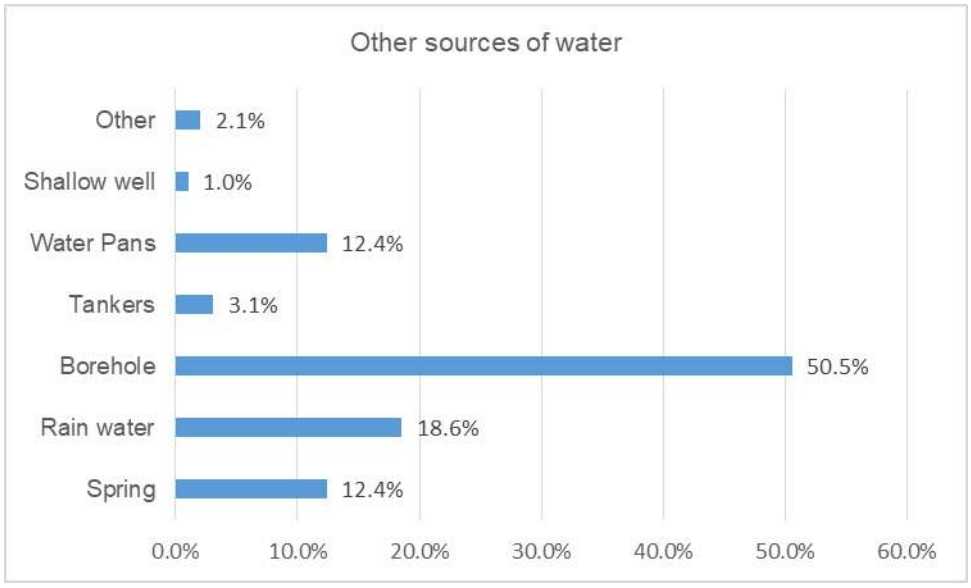


8. **Figure 4.5. Most prevalent diseases**

All households polled had access to sanitation facilities with (15.2%) using flush toilets while the rest had pit latrines and open pit latrines, this is consistent with the findings of D M Kavoo et al 2016 which found availability of functional pit latrines at (98%). The challenge in regard to sanitation in Machakos is treatment and disposal of waste water.

5.17.6 Water Supply

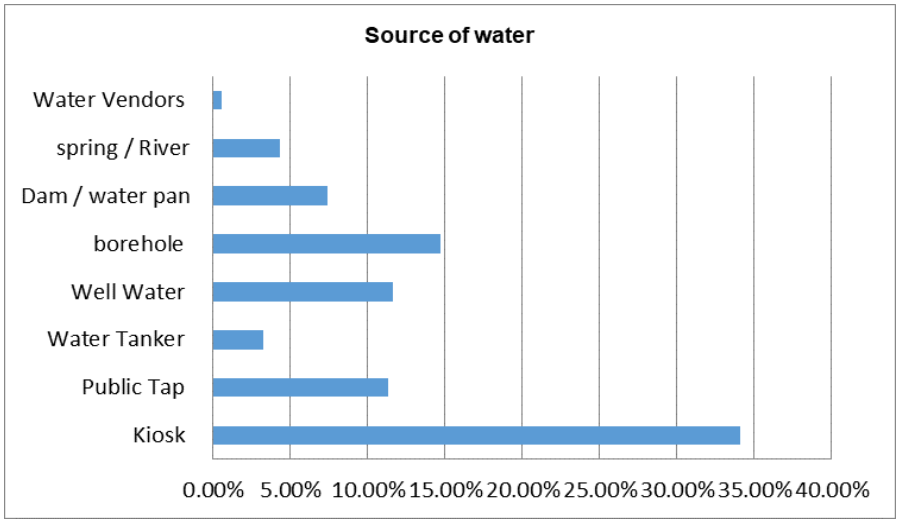
As per the polled households, access to piped water in the project area stands at (15.5%) while (84.5%) of the population have no access to pipe water/own connection. A summary of other water sources in the two project area indicates that boreholes supply (50.5%), surface water (24.80%), rain water accounts for (18.6%) while other sources supply (2.1%) as shown in Figure 4.8. The primary use of water is (98.8%) domestic purposes while (5%) and (2%) account for agricultural and business uses respectively. Figure 4.6 gives a summary of main sources of water in the project area.



9. Figure 4.6: Main sources of water in the project area

Households with piped water is (15.5%) of which (88.5%) were individual water connections while (11.5%) on shared piped water sources. The main service provider in the area is Machakos Water & Sewerage Company (Machwasco) while some boreholes are run privately. Despite the low penetration of individual connections, a majority (72.5%) of these connections are metred and (89.2%) of the meters are in good working order. The stated HH average monthly bill is Kshs 533 for those with connections. The households were asked to rate the quality of water about (77.7%) of the households rated water quality as 'good', (32.3%) found water quality poor. Majority of them (45.8%) aren't satisfied with the water services provided due to rationing, quality, cost and availability. For those that accessed piped water by the 20l jerry can, the average cost was ksh 7.8; this translates to Kshs 390 per cubic metre.

Households with no access to individual connections, most of the water needs are met through water kiosks, public taps and boreholes as shown in Figure 4.7.



10. Figure 4.7: Sources of water for No access HH.

Only (37.36%) of the households fetch water within 100m while close to (70%) access water within 500m. Another (30.3%) travel more than the recommended 500m to a water source. The tables below show the time and distance to water access points.

11. Table 4.6 Time taken to collect water/day (Minutes)

Time taken to collect Water per day min	
Mean	69.45
Median	60.00
Mode	60
25th percentile	30.00
50th percentile	60.00
75th percentile	100.00
90th percentile	120.00

12. Table 4.7 Approximate distance from the water source to the HH

Approximate Distance from the Water Source to house		
	Frequency	Percent
Within 50m	128	20.09%
100m	110	17.27%
500m	206	32.34%
1km	89	13.97%
more than 1 KM	104	16.33%
Total	637	100.00%

The average water use for the unconnected households is 114.62 litres per day translating to a per capita consumption of 32.14 l/p/d. The average time taken to fill a 20l jerry can is 7.38 minutes. A majority of HH with no access to water service are willing to connect (99.1%). The only reason cited for the tiny proportion unwilling to connect was available reliable water services already.

5.17.7 Water Storage and perceptions of the water source safety

Due to unreliability of supply and lack of connection for over (85%) of the households, water storage in containers at household level is inevitable. While this is a good measure to ensure availability when mains supply is not available, storage and handling of domestic water presents a window for potential source of contamination of potable drinking water at the household level.

5.17.8 Attitude and Perceptions of the Proposed Project.

At the time of undertaking the household survey, (41.4%) are aware of the project. That notwithstanding, the consultant has embarked on an extensive consultation program to create and raise awareness about the proposed project, initial key stakeholder consultations and stakeholder sensitization was undertaken and the Key Stakeholders Consultation log is attached as Appendix 5 and Project Sensitization Meetings attendance lists . The main objective is to sensitize the community more on the project so as to gain acceptance and ownership by the community. At the proposed dam, treatment plant and major transmission routes the communities have been sensitized more to ensure smooth delivery of the project considering the role of such

stakeholders in a water supply projects. The sources of information to the residents was from friends and neighbours – (19.1%); through chiefs' baraza (17.4%) and (3.2%) from media.

The survey also sought to assess the willingness to pay for improved water services in which (91.5%) are willing to pay take up and pay for better water services. Table 4.8 shows the levels of willingness to pay as expressed in the polled sample households.

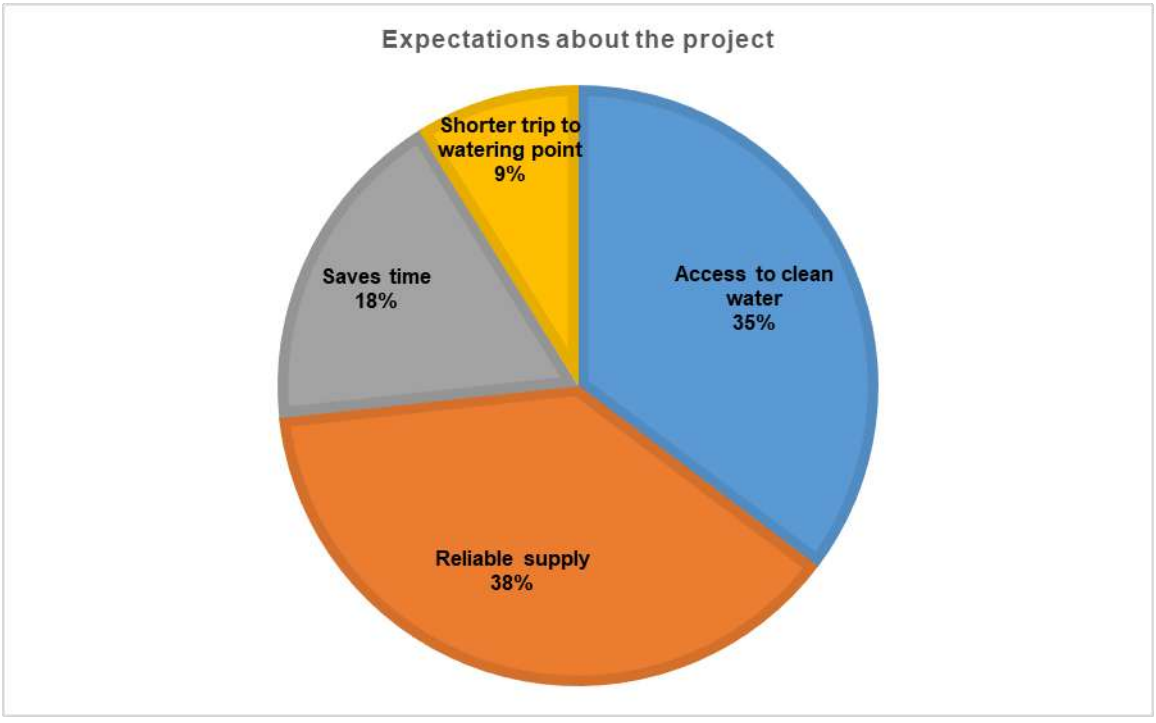
13. Table 4.8 Willingness to Pay

How much are you willing to pay per month per family	
Mean	564.88
Median	300.00
Mode	500
25th Percentile	200.00
50th Percentile	300.00
75th Percentile	500.00
90th Percentile	1,000.00

Table 4.13: Willingness to Pay

The amount each household is willing to pay is Kshs 564 per month on average. However this amounts seems on the lower side considering that the proposed scheme will deliver water largely by pumping.

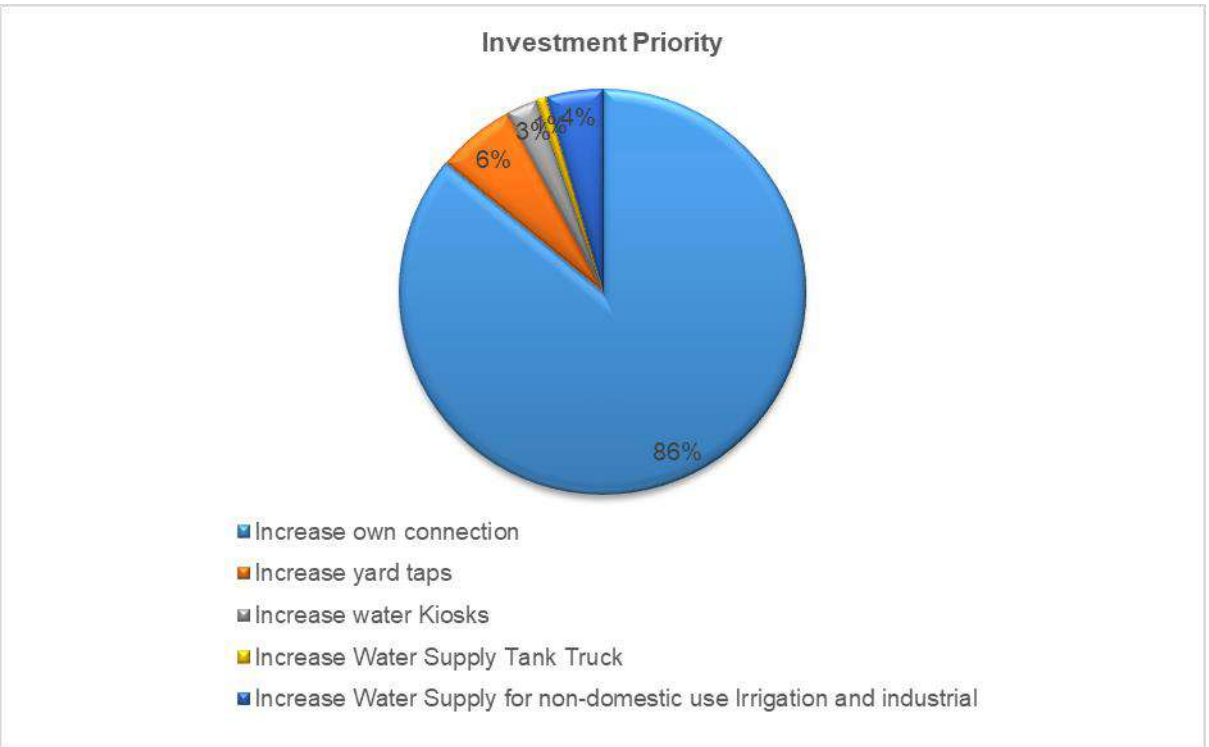
The community expectations of the proposed project is mainly centred on improved reliability of supply (38%) and access to clean water – (35%) Close to a quarter of the respondents expect savings in time and less toil as a result of shorter trip to the watering point. Figure 4.8 shows the community expectations of the project when implemented.



14. Figure 4.8: Community expectations on completion for the project

5.17.9 Investment Priorities

The residents in the projects area were again asked to prioritize the type of investment or type of access to water supply upon completion of the project and (86%) preferred increase in individual connections, (6%) yard taps, (3%) water kiosks amongst other as shown in in figure 4.9.



15. Figure Priority investments for the proposed water supply interventions

Community members also identified investment priorities through the FGD undertaken. The list included in order of priority the following: own connections; water kiosks; yard taps; and finally industrial and irrigation uses as shown in (Table 4.9). The recommendations made by the FGD also indicate that there is need for a storage of water by construction of big water reservoirs (dam) so as to guarantee across the seasons supply of good quality water. A schedule of FGD discussions is attached as Appendix 3. The current situation now poses a threat to the socio-economic growth of Machakos County; an intervening measure is urgently required to ensure equitable access to safe water.

16. Table 4.9: List of investment priorities based on FGD

Service	Works required
Own Connection	Construction of a dam, treatment works, storage tanks, transmission pipeline, tanks and distribution network.
Yard Taps	
Water Kiosks	
Water for Industrial and Irrigation Uses	

Majority, (98.1%) support the project as it will improve their livelihoods. These high levels has been attributed to knowledge of importance of safe water and high costs incurred by households in provision of water and to treat water borne diseases. The few households that have reserva-

tions on the project fear that the project will occasion resettlement. This can be overcome by supplying ensuring a wide reach of water supply system and community sensitizations.

5.17.10 Anticipated Project Impacts

From the household survey, (1.9%) indicated the presence of sites of cultural significance within the project area. The sites mentioned included fruit trees plantations, Kititi shrine and Kyakavulu Shrine. These mentions give a pointer to the ESIA scoping process, this shall also be interrogated further during the project detailed ESIA studies. An overwhelming majority of (99.2%) support the proposed Mwania Dam Water Supply Project. The polled respondents expected the following benefits from the project upon implementation:-

i. Access to clean, affordable and reliable water supply
ii. Creation of job opportunities and technology transfer
iii. Gender equity in economic contribution
iv. Reduction of water borne diseases and improved HH savings
v. Irrigation and improved food security

Residents (78.6%) agree that the project will affect their operations in one way or the other. The major effects are both environmental and social which will be subjected to ESIA study by the consultant to determine their significance, and propose mitigation measures for the identified impacts. The potential impacts identified include:-

i. Disruption of existing water supply services;
ii. Cutting out of roads;
iii. Deforestation;
iv. Displacement of people;
v. Dam failure floods;
vi. Soil erosion during construction;
vii. Moral decadence;
viii. Mosquitos and water borne diseases at reservoir area;
ix. Employment conflicts;
x. Family break down;
xi. Loss of vegetation due to clearing;
xii. Land take for weir and pipeline;
xiii. Noise Pollution;
xiv. Spoil roads at points of crossing;
xv. Safety, health and security and; and
xvi. Waste water disposal challenges.

The main problem affecting the area is (50.8%) lack of access to safe water, unemployment 27.6%, insecurity for 6.9%, irrigation water for 9.7% and poor infrastructure 11.6%. What is evident is the desire by the community to access safe water supply service which will enhance the household incomes in the project area

6 PUBLIC CONSULTATION

6.1 General

Public consultation is useful for gathering environmental data, understanding likely impacts, determining community and individual preferences, selecting project alternatives and designing viable and sustainable mitigation and compensation plans.

Public consultation in the ESIA process is undertaken during the project design, implementation and initial operation. The aim is to disseminate information to interested and affected parties (stakeholders), solicit their views and consult on sensitive issues.

6.2 Objectives of the public consultation

The specific aims of the consultation process are to:

1. Improve project design and, thereby, minimize conflicts and delays in implementation;
2. Facilitate the development of appropriate and acceptable entitlement options;
3. Increase long term project sustainability and ownership;
4. Reduce problems of institutional coordination;
5. Make the resettlement process transparent; and
6. Increase the effectiveness and sustainability of income restoration strategies, and improve coping mechanisms.

An important element in the process of impact assessment is consulting with stakeholders to gather the information needed to complete the assessment. The main objectives of community consultations are to:

- Provide clear and accurate information about the project to the communities;
- Obtain the main concerns and perceptions of the population and their representatives regarding the project;
- Obtain opinions and suggestions directly from the affected communities on their preferred mitigation measures; and
- Identify local leaders with whom further dialogue can be continued in subsequent stages of the project.

6.3 Public consultation plan

A public consultation and disclosure plan is outlined in Table 6-1 below:

Table 6-1 Public consultation and disclosure plan

Activity	Disclosure information	Tool	Responsibility	Audience	Expected output	Ref
Introductory meetings:	Screening	• Formal meetings (Stakeholders consultative meeting)	• Project proponent • Lead EIA Expert	• Project Regulators • Project implementers • Project beneficiaries. • Affected and interested parties	• Identification of stakeholders. • Classification of stakeholders. • Development of stakeholder database. • Pre-emption of potential impacts.	• Workshop Report 1. Appendix IV • Key Stakeholders Log Appendix VI
Information dissemination	Proposed expansion project and the environmental requirements.	• Formal meetings • Barazas • Informal meetings • One-on-one interviews • Emails	• Lead EIA Expert • Project Team	• Project Regulators • Project implementers • Project beneficiaries'	• Stakeholder reaction to proposed project i.e. community concerns and inputs. • Number of potentially affected stakeholders.	• Barazas minutes and attendance list Appendix V & Workshop Appendix IV, Key Stakeholders Log Appendix VI.
Public disclosure:	Findings of the ESIA study.	• Formal meetings • Barazas	• Lead EIA Expert • Project Team	• Project Regulators • Project implementers • Project beneficiaries'	• Stakeholder acceptance of proposed project.	• Workshop and NEMA Public Notices

It is the policy of the consultant that a participatory approach is taken in the investigations of impacts at all stages of the EIA. It is also a requirement of the Constitution and Government of Kenya that adequate consultations with all relevant stakeholders are done before the inception of any development project.

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The consultation exercise was planned as follows:

- Initial awareness / introductory meetings with several identified stakeholders'. The purpose of this was to introduce the stakeholders to the proposed expansion. Secondly, the initial consultations inform the detailed EIA study.
- A detailed stakeholder engagement where all groups identified from the initial meetings would be invited for 'barazas' and all aspects of the proposed expansion presented to them for their comments and observation. Stakeholders will have adequate time after any meetings to submit their comments. Questionnaires will be issued to individuals identified as key stakeholders.
- A public disclosure meeting once the EIA study is complete to inform all stakeholders involved of their final input and recommendations of the ESIA project team.

6.4 Introductory Consultations

The Consultant was committed to keeping the stakeholders engaged through information sharing at the lowest level during the entire study process. These consultations took the form of barazas, focus group discussions and even household interviews. At these initial stages, these consultations have been based on existing administrative units mainly sub counties, locations and sub-locations. However as the study progressed and clear boundaries of the project components such as reservoir, pipelines and other infrastructure were defined, the consultations were now based on residents inside such boundaries and others who will be deemed as interested.

Stakeholders Workshop at Machakos University

Table 6-2 shows photos of introductory stakeholder workshop at Machakos University.

The Consultant in close collaboration with the AWWDA/TAWWDA planned and executed the introductory consultative meeting in the Machakos sub- county in October 2018. This meeting was aimed at introducing the project to local leadership, getting goodwill from local leaders as key stakeholders and creation of entry points. As such the target group comprised of local National Government as well as County Government representatives.

Those in attendance included the Assistant County Commissioners (ACCs), Government Representatives, Machakos County Government Sectoral heads for Water & Sanitation,

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Agriculture Livestock & Fisheries, Public Health, Forestry, Development Officer, WRA sub-regional office representative and Machakos Water and Sanitation Company.
The administrative leaders pledged to give full support to the team when time comes to hold consultations with the affected people and but called on the project planners/implementers to continuously engage the stakeholders. It was also stressed that the selection of participants be done carefully and be representative of all affected as selection and working with the wrong group might mislead the course of the project.

6.5 Stakeholder identification

Stakeholders who will be consulted during the ESIA stage have been identified based on their needs, interests, relative power and potential impact on project outcome. In this regard, two broad categories of stakeholders have been identified. The table below shows government departments consulted and sample questionnaire appended as appendix VII.

Table 6-4 Government agencies Consulted

Nr	Institution	Designation
1.	TANATHI	Technical Team
2.	Athi Water	Technical
3.	CAS	Technical Team
4.	Machakos County Gov't	Office of the Governor
		CEC Water
		C.O/Director Water
		Sub County Administrator Machakos
		Director of Public Health
		Director Education
		Director Lands & Physical Planning
5	National Government	County Commissioner Machakos
		Ass County Commissioner (Vota Div)
		Sub County Water Officer
		Chief Township
		Chief Kiima Kimwe
		Chief Kathekakai
6	NEMA	CDE
7	MoTIHUD	KeRRA
		KURA
		KeNHA
8	MCA	MCA Mutituni,
		MCA Mumbuni North,
		MCA Machakos Centrall,
		MCA Muvuti,
		MCA Kalama,
		MCA Kola,
		MCA Mua
		MCA Kinanie
9	WRA	WRUAs Upper Mwania
		WRUAs Lower Mwania
		WRA
10	Opinion Leaders	2 Township

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		2 Kathekakai
11	WSP	Managing Director
		Technical Manager
12	Member of Parliament	MP
13	KETRACCO	Director
14	KALRO	Director
15	Kenya National Chamber of Commerce	Chair person
16	Kiima Kimwe Cooperative Society	Chair person
		Secretary
17	Representative	Women
18	Representative (Kathekakai)	Youth
19	Representative Disabled	Rep PLWD
Total number of stakeholders.		

6.6 Approach to Public Sensitisation Meetings

The Consultant organised and facilitated public consultations at the centres of all affected and benefitting sub-locations – during which the ESIA study was discussed and modalities for further consultation agreed upon. A total of 10 ESIA meetings were held during which, information on the proposed project was disseminated as well as views of stakeholders on information on various aspects were collected. All meetings were conducted by the Community Development / SIA Experts and EIA expert in attendance as well as the local provincial administration.

Table 6-5; Record of stakeholder consultative meetings

	Date	**Time**	**venue**	**Location**
1	October 17, 2018	10:00Hrs	Kiima Kimwe Chiefs Office	Kiima Kimwe
2	October 17,	15:00Hrs	Mumbuni market	Mumbuni
3	October 18, 2018	10:00Hrs	Town ship Chiefs Office	Township
4	October 18, 2018	14:00Hrs	Mikuyu markert	Kathekakai
5	October 19, 2018	10:00Hrs	Kyangala Chiefs Office	Kyangala
6	October 22, 2019	10:00Hrs	Ithaeni-Thwake River site	Ithaeni
7	October 23, 2019	10;00Hrs	Kaseve Chiefs Office	Kaseve
8	March 6, 2020	10:00Hrs	Kiima Kimwe Chiefs Office	Kiima Kimwe
9	March 6, 2020	14:00Hrs	Mikuyu Chiefs Office	Kathekakai

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10	March 5, 2020	10:00Hrs	Kyumbi junction Social Hall	Kinanie
11	March 5, 2020	14:00Hrs	Machakos Township Chiefs Office	Machakos Township

Minutes and attendance list attached as appendix V.

6.6.1 Summary of the Views Expressed

Comments from Land/Asset Owners:

i. Many land owners consulted are positive towards the project but they had questions in terms of compensation e.g. the graves and farms. They felt there was need to perform certain ceremonies before graves are relocated. This was important so as to appease their dead and avoid curses from their ancestors;
ii. They also anticipated possible land conflicts due to succession and multiple sales on land;
iii. Social disruption including livelihoods on the riparian lands;
iv. As far as residents are concerned compensation seems to be main issue of discussions in the dam projects future direction; as long as the affected persons are adequately compensated they had no problem with the proposed project
v. The residents were satisfied that few people, less than 12households will be relocated out of over 787 PAPs
vi. Concerns on already existing infrastructure including water, power, roads and schools in the area;
vii. Access to clean water and also water for irrigation.

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6.6.2 General Perceptions of the Community and PAPS:

i. The communities after understanding the project and what it entails are positive towards the project
ii. They have concerns just like any other person would be when they have to be relocated and look for land elsewhere.
iii. They also have issues towards the actual compensation which should be treated very fairly when the time comes
iv. It is also important that they are consulted so that they can air the issues they have towards compensation; in turn the issues should be addressed well so that they are satisfied so that they give support to the proposed project
v. Those who will be reallocated are willing to move as long as they are compensated well and given adequate time to relocate

Stakeholder Consultation	
	
Public meeting at Kyangala	Proposed dam site at Mwania
	
Public meeting at Ithaeni	Public meeting at Muvuti

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Public Meeting at Katoloni	Water situation in Urban areas of Machakos Sub County
	
Land use at the proposed dam site: grazing fields and crop production	Water situation rural areas of the Project area

Table 6-7 Public consultations (Baraza) at Machakos Sub County

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7 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 General

Following the site visits, potential environmental and social impacts of the proposed project have been identified to determine whether or not the proposed project will have a diverse impact on the environment.

7.1.1 Impact Identification

The ESIA Scoping has predicted and evaluated anticipated impacts using acceptable standard methods of impact prediction and evaluation. Constant reference to a checklist of project activities was made and scores assigned in an assessment table in order to make an objective assessment of how each of the project activities would impact on a particular environmental and social medium. The study team used several approaches such as brainstorming and use of checklists and matrices to identify the main sources and establish the potential impacts from the proposed main project activities. Public participation and consultation with a wide sector of the community and stakeholders were conducted to reduce uncertainty.

7.1.2 Impact Criteria

The positive and adverse project impacts assessment was based on the following impact criteria during pre-construction, construction, operation phases and decommissioning phase as follows:

i. Scale: Physical scale / area over which the impact will be felt: Local, Regional, National or International
ii. Duration: The length of time the impact is likely to occur: Short, Medium or Long Term
iii. Severity: The intensity of the impact: Low, Medium or High
iv. Certainty: The probability of the impact occurring: Possible, Likely, Highly Likely or Definite
v. Direction: Whether the impact is Positive (beneficial) or Negative (adverse)

7.1.3 Impact Assessment Scoring

Evaluation of identified impacts was guided by careful assessment and judgment of anticipated consequences with regard to set standards or pre-development environmental situation of the site. The assessment and assignment of values to each identified impact was based on the values developed in the table below which is adapted from the international good practices. Positive impacts are evaluated by assigning positive scores while the adverse impacts are evaluated by assigning negative scores.

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Table 7-1 Scale for Evaluation of Project Impacts

Score	(-1) (+1)	(-2).....(+2)	(-3) (+3)	(-4) (+4)	(-5) (+5)
Magnitude or extent	Impact will occur only on site	In between	Impacts will occur within a 3-5km radius of site	In between	Impacts will occur regionally
Significance	Low. Small changes which are hardly detectable	Moderate. Impact measurable but doesn't alter processes	High. Many people, animals, plants affected. Major disruption of ecosystem processes.	Very High. Loss of people, property loss, of local livelihood.	Unknown. Insufficient information is available apply precautionary principle
Probability of Occurrence	Possible. Impact can occur but controllable.	In between	Probable. The impact is likely to occur but can be controlled by effective measures	In between	Definitely to occur.
Duration of Occurrence	Short term. During construction phase only	Medium term. During early operations	In between	Long term. For the entire operational phase.	Very long term. For the entire operational phase and after closure.

7.1.4 Potential Positive Impacts Associated with the Proposed Project

There are a number of positive impacts which will benefit the local community and the nation in general. The benefits of the project in the proposed area are both social and economic and are outlined below.

i. The dam will be effectively used to regulate river flows downstream of the dam by temporarily storing the flood volume, utilizing and releasing it later ensuring a sustainable supply of water to various users.
ii. Increased value of land in the project area. The project will attract more investment to the region hence leading to accelerated business growth.
iii. The project will increase the overall access of safe drinking water in Machakos Sub County.
iv. Promoting the country's economic growth. The proposed project presents an opportunity for tourism, training and skills acquisition.
v. Creation of market for goods and services. This will be significant especially

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during construction period. The goods will be sourced from local suppliers thus creating a ready market leading to general economic growth.

vi. Provision of employment opportunities during both construction and operation phases of the project. Impoundment itself may however be favourable to some fish species.

vii. Improved infrastructural services within the project area opening it up for development opportunities.

viii. Improvement of national food security and vision 2030 through investments in energy, infrastructure and agriculture.

Table 7-2: Impact Scoring for Positive Impacts

Aspect	Score
Impact: improved access to safe drinking water	
Magnitude or Extent	4
Significance	1
Probability of Occurrence	5
Duration of Occurrence	4
Impact: Increased value of land in the project area	
Magnitude or Extent	2
Significance	2
Probability of Occurrence	3
Duration of Occurrence	4
Impact: Attracting more investment to the region	
Magnitude or Extent	4
Significance	5
Probability of Occurrence	5
Duration of Occurrence	4
Impact: technology transfer and skills	
Magnitude or Extent	5
Significance	5
Probability of Occurrence	5
Duration of Occurrence	5
Impact: Opportunity for tourism, training and skills acquisition	
Magnitude or Extent	3
Significance	1
Probability of Occurrence	4
Duration of Occurrence	4
Impact: Market for goods and services	
Magnitude or Extent	5
Significance	5
Probability of Occurrence	5
Duration of Occurrence	1
Impact: Employment opportunities	
Magnitude or Extent	5
Significance	1
Probability of Occurrence	5
Duration of Occurrence	4
Impact: River flow regulation and water storage	
Magnitude or Extent	4
Significance	2

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Probability of Occurrence	4
Duration of Occurrence	4
Impact: Improved infrastructural services	
Magnitude or Extent	4
Significance	5
Probability of Occurrence	5
Duration of Occurrence	5

7.2 Environmental Impacts of Site Clearing, Excavation, and Construction

i. There will be a large initial capital outlay for work on the dam to begin.

To maintain the environmental integrity of the dam and its surrounding area will require large amounts of money especially for implementation of the mitigation measures and environmental management plan.

ii. Loss of vegetation

There will be a significant vegetation loss both during the construction of the access road and the dam itself. The vegetation will be cleared so that the area where the construction work is to take place is clear for the construction work to be performed.

iii. Effects on farming and traditional land uses

As a result of the implementation of the proposed project, farming activities that have for a long time been practiced within the project boundary will have to be stopped. This is because the reservoir will take up these lands (300 acres) precluding other activities that have been going on in the past.

iv. Soil erosion

This will be as a result of the intensive activities that will be going on in the construction area. The heavy equipment and machines that shall be used in the construction process will interfere with the soil structure making it loose hence liable to erosion.

v. Dust effects

There will be a lot of dust from the construction activities. The excavation of the reservoir area and mining of the soil to be used in the construction of the embankment will both result in pollution from dust particles.

vi. Blasting and noise effects

This will heavily affect those living within the vicinity of the project area and workers at the project site. Huge rock particles especially at the place where the embankment will be constructed will have to be blasted during the overburden removal to give way for the construction process.

vii. Sanitary and health problems from construction camps.

There is a likelihood of a construction camp to accommodate construction workers. Disposal of wastes within the construction camp must be given a lot of weight.

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Unhygienic disposal may lead to spread of diseases.

viii. Extraction of Aggregates

Transportation and handling and associated impacts

ix. Dumping site near the Dam Reservoir

During the study, a dumping site was observed on the right bank of the dam after KETRACO Substation. Machakos County Government has also proposed a solid waste management site on the same area, parcel 66 of the Long Term Physical Development Plan (22014-2035) of the New Machakos Town. Discussions with Machakos County Department of Lands informed the Study team that the proposed facility is a modern solid waste handling facility. However, the officers indicated that upon development of the dam as proposed, they would reallocate another suitable land for the solid waste management. As such the project will also clear up the solid waste in collaboration with Machakos County Government.

7.3 Potential Impacts from Reservoir Preparation and Flooding

i. Imposition of a reservoir in place of a river.

The proposed dam will flood a vast area of land. Especially of significance is the fact that the land lost is of importance out of proportion to the size as it includes river habitats along the bank of river that are often among the most diverse ecosystems. This habitat will be replaced by a relatively uniform reservoir of 406 acres, which will provide habitat for a much smaller range of species.

ii. Changes in downstream morphology of the riverbed and banks.

The impact of the proposed dam on downstream habitats will be through changes in the sediments load of the River. All rivers carry some sediment as they erode their watershed. When the river is held behind a dam in the reservoir for a period of time, most of the sediment is trapped in the reservoir and settle to the bottom. Clear water below the dam will recapture its sediments load by eroding the downstream bed and banks. Eventually all the erodible material on the riverbed below the dam will be eroded away, leaving a rocky streambed, and a poorer habitat for aquatic fauna.

iii. Changes in the downstream water quality.

This will manifest itself in change in river temperature, nutrient load, and turbidity; dissolve gases, concentration of heavy metals and minerals. When river water is held in a reservoir for a period of time, the quality of the water is affected. When a reservoir is first firmed, submerged vegetation and soil decomposes. As it does so it will deplete oxygen in the reservoir water. Deoxygenated water can be lethal to both plant and animal lives. Another water quality problem is mercury contamination while mercury is often present in a harmless inorganic form in soil, once the soil is flooded bacteria may transform this inorganic mercury into methyl-mercury, which is toxic and can be absorbed, concentrated and passed up the food chain.

iv. Reduction of biodiversity due to blocking of movement of organisms.

Dams generally tend to fragment river ecosystems, isolating species population living up

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and downstream of the dam and cutting off migrations and other movement. The peak flows that carry suspended sediments to the shore will be reduced by the presence of this dam. This dam will block the upstream and downstream passage of migrating aquatic animals. This will isolate them from vital spawning and feeding areas. Many fish and inverbrates inhabit the gravely river bottom, but these habitats will decline due to depletion of riverbed gravels.

v. Spread of waterborne diseases, spread of malaria, bilharzias and river blindness may proliferate from stagnation of the watercourse.

This may be quite rampant in irrigation systems. Changes in the ecosystem will be responsible for the increase in diseases.

vi. Disposal of vegetation

The disposal of soil and vegetation removed from the reservoir area may be a problem due to the fact that no land has been specifically allocated for this activity.

vii. Exclusion of future land uses

Once the reservoir is in place, other land uses shall be excluded automatically and the benefits associated with them foregone.

viii. Turbidity and siltation during filling

This will mainly occur during the construction of the dam and the filling of the main dam. Suspended particles including soil from the neighbouring catchment area will contribute to this.

ix. Shoreline slumping and erosion

This will result from the constructed dam holding back the sediment load normally found in the river flow. This will deprive the downstream of this resulting in the downstream water eroding its channels and banks.

x. Environmental degradation from increased pressure on land

There is a likelihood of intensification of economic activities as a result of the construction of this dam. Farming activities are likely to increase leading to degradation of the environment.

xi. Danger of people drowning either intentionally or accidentally looms with the construction of this dam.

Because of the massive water body that will be created as a result of construction of the proposed dam, there is a likelihood of people on suicide missions drowning in the dam, as has been the case with other dams. Cases of people being killed elsewhere and dumped in the dam may also arise.

Table 7-3 Impact Scoring for Negative Impacts

Aspect	Score
Impact: Clearing of vegetation and loss of habitat	

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Aspect	Score
Magnitude or Extent	-1
Significance	-3
Probability of Occurrence	-5
Duration of Occurrence	-4
Impact: Surface and ground water pollution	
Magnitude or Extent	-3
Significance	-2
Probability of Occurrence	-3
Duration of Occurrence	-1
Impact: Erosion from earthworks and escape of hazardous materials	
Magnitude or Extent	-1
Significance	-5
Probability of Occurrence	-3
Duration of Occurrence	-2
Impact: Dust and Air Pollution	
Magnitude or Extent	-2
Significance	-3
Probability of Occurrence	-3
Duration of Occurrence	-1
Impact: Noise and Vibrations	
Magnitude or Extent	-2
Significance	-2
Probability of Occurrence	-5
Duration of Occurrence	-1
Impact: Quarrying and blasting hazards	
Magnitude or Extent	-2
Significance	-2
Probability of Occurrence	-1
Duration of Occurrence	-1
Impact: Pressure on social services and facilities	
Magnitude or Extent	-3
Significance	-2
Probability of Occurrence	-1
Duration of Occurrence	-3
Impact: Increases in the incidence of diseases such as HIV and STIs	
Magnitude or Extent	-2
Significance	-2
Probability of Occurrence	-2
Duration of Occurrence	-4
Impact: Clashes between the workforce and local communities	
Magnitude or Extent	-3
Significance	-2
Probability of Occurrence	-1
Duration of Occurrence	-2
Impact: Disturbances to the social practices and fabric of local communities	
Magnitude or Extent	-2
Significance	-2
Probability of Occurrence	-3
Duration of Occurrence	-3

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Aspect	Score
Impact: Inundation of quarry resources	
Magnitude or Extent	-1
Significance	-2
Probability of Occurrence	-5
Duration of Occurrence	-4
Impact: Human and petroleum waste disposal	
Magnitude or Extent	-1
Significance	-2
Probability of Occurrence	-3
Duration of Occurrence	-1
Impact: Some terrestrial animals will be drowned or their habitat destroyed	
Magnitude or Extent	-1
Significance	-2
Probability of Occurrence	-4
Duration of Occurrence	-4
Impact: Loss of connectivity preventing up and downstream migration of fish	
Magnitude or Extent	-1
Significance	-3
Probability of Occurrence	-5
Duration of Occurrence	-4
Impact: Danger of drowning	
Magnitude or Extent	-1
Significance	-4
Probability of Occurrence	-1
Duration of Occurrence	-4
Impact: Changes to the surrounding micro-climate	
Magnitude or Extent	-4
Significance	-5
Probability of Occurrence	-5
Duration of Occurrence	-5
Impact: Change in daily flows	
Magnitude or Extent	-5
Significance	-3
Probability of Occurrence	-5
Duration of Occurrence	-5
Impact: Stratification	
Magnitude or Extent	-5
Significance	-3
Probability of Occurrence	-3
Duration of Occurrence	-4

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Table 7-4: Summary of Environmental Impacts

ENVIRONMENTAL COMPONENTS / PROJECT ACTIVITY		Climate	Geology	Soils	Water Resources	Topography and Geomorphology	Flora	Fauna	Air Quality	Noise and Vibration	Local Communities	Rural Livelihoods	Land use	Local Economy	Health and Safety	Aesthetic and Amenity values
A	**Construction Phase**															
1.	Construction of Water Barrier															
2.	Diversion Works															
3.	Draw off Works/ Tunneling															
4.	Foundation Grouting															
5.	Cut-off															
6.	Filters															
7.	Construction of Embankment															
8.	Spillway															
9.	Instrumentation															
10.	Construction of Auxiliary Facilities															
11.	Storage															
B	**Operation Phase**															
1.	Lighting															
2.	Offices															
3.	Laboratories															
4.	Residential															
C	**Decommissioning**															
1.	Demolition of Facilities															
2.	Restoration Efforts															

7.4 Environment Health and Safety (EHS)

The EHS is a broader and holistic aspect of protecting the worker, the workplace, the tools / equipment's and the biotic environment. It is an essential tool in determining the ESIA study. The objective of the EHS on the proposed project is to develop rules that will regulate environmentally instigated diseases and occupational safety measures during construction and operation phases of the proposed project by:

- ✓ Avoidance of injuries
- ✓ Provision of safe and healthy working environment for workers comfort so as to enhance maximum output.
- ✓ Control of losses and damages to plants, machines, equipment and other products.
- ✓ Enhance environmental sustainability through developing sound conservation measures

7.4.1 Policy, Administrative and Legislative Framework

It is the primary responsibility of the Contractor to promote a safe and healthy environment at the workplace and within the neighbourhood in which the proposed project will be constructed by implementing effective systems to prevent occupational diseases and ill-health, and to prevent damage to property. The EHS Management Plan when completed will be used as a tool and a checklist by the Ministries of Public Health and Sanitation, Water and Irrigation, Medical Services and the contracted engineers in planning and modification of the construction of the proposed project infrastructure. This plan will also provide for the establishment of an appropriate legal and institutional framework for the implementation of EHS in conformity to relevant statutes like; The Public Health Act Cap. 242, Occupational Safety and Health Act (OSHA) of 2007, Environmental Management and Co-ordination Act 2015, Workmen's Compensation Act Cap. 236, Malaria Act, Local Authority Act cap 265 and other accompanying by-laws already mentioned elsewhere within this report.

7.4.2 Organization and Implementation of the EHS Management Plan

The contactor shall use the EHS plan at the proposed project site both during construction and operation phases of the project. The engineer will use it during construction phase with the assistance of an EHS consultant who shall enforce its provision throughout the construction period.

7.4.3 The Guiding Principles to be adopted by the Contractor

The company will be guided by the following principles: -

- ✓ It will be a conscious organization committed to the promotion and maintenance of high standards of health and safety for its employees, the neighboring population and the public at large.
- ✓ Ensuring that EHS activities are implemented to protect the environment and prevent pollution.
- ✓ Management shall demonstrate commitment and exercise constant vigilance in order to provide employees, neighbors of the project and the environment, with the greatest safeguards relating to EHS.
- ✓ Employees will be expected to take personal responsibility for their safety, safety of colleagues and of the general public as it relates to the EHS management plan.

7.4.4 EHS Management Strategy to be adopted by the Contractor

The following strategies will be adopted to achieve the above objectives:

- ✓ Create an Environment Health and Safety Management committee and incorporate EHS as an effective structure at various levels and units to manage and oversee EHS programs in all construction and operation phases of the project.
- ✓ Maintain an effective reporting procedure for all accidents.
- ✓ Provide appropriate tools and protective devices for the success of the project.
- ✓ Encourage, motivate, reward and support employees to take personal initiatives and commitment on EHS.

7.4.5 Safety Agenda for Both the Proponent and Contractor.

There will be a permanent EHS agenda during construction.

a) The Contractor

The contractor will ensure that:

- ✓ Safe means of entry and exit exist at the proposed project site.
- ✓ Ensure adequate briefing of job at hand on the safe system of work before commencement of work
- ✓ The EHS coordinator must be in attendance at all times throughout the duration of the project.
- ✓ Constant assessment of the risk involved as the work progresses must be maintained by the
- ✓ EHS consultant
- ✓ A safety harness must be worn before entry into all confined spaces
- ✓ An EHS consultant must be posted at the entrance at the project site to monitor progress and safety of the persons working at the construction site.

b) The Traffic / Drivers

Within the construction premises, the following traffic rules will be observed: -

- ✓ Observe speed limits and all other signs and obey traffic rules.
- ✓ Use the vehicle for the purpose to which it is intended only.
- ✓ Maximum speed limit within the project site will be 10km/hr for both operation and personal vehicles.

7.4.6 Emergency Procedures during Construction and Operation.

An emergency situation means:

- ✓ Unforeseen happening resulting in serious or fatal injury to employed persons or the neighbouring communities
- ✓ Fire or explosion.
- ✓ Collapse of dam walls or major work.
- ✓ Natural catastrophe.

In the event of such an emergency during construction, the workers shall:

- ✓ Alert other persons exposed to danger.
- ✓ Inform the EHS co-coordinator.
- ✓ Do a quick assessment on the nature of emergency.
- ✓ Call for ambulance.

When emergency is over the EHS coordinator shall notify the workers by putting a message: "ALL CLEAR"

In the event of such an emergency during operation the workers shall:-

- ✓ Alert other persons exposed to danger.
- ✓ Ring the nearest police station
- ✓ Call for an emergency response team.

7.4.7 Ambient Factors in the Workplace

TAWWDA shall ensure that the recommended levels for the following factors are adhered to:

- ✓ Noise Limits as contained in Environmental Management and Coordination Act (Noise and Excessive Vibrations pollution control Regulations) of 2009.
- ✓ Vibration in reference to The UK Health and Safety Executive on reduction of vibration risks and a "vibration exposure calculator"
- ✓ Hazardous materials in reference to IFC Hazardous Materials Management Guidelines
- ✓ Sanitation levels as per Public Health Act cap 242 laws of Kenya
- ✓ Measures to eliminate and control hazards from known and suspected biological agents at the place of work shall be designed, implemented and maintained in close co-operation with
- ✓ the local health authorities and according to acceptable international standards.

7.4.8 Training and Documentation

The project beneficiaries shall ensure that workers, prior to commencement of new assignments have received adequate training and information enabling them to understand the hazards of

work and to protect their health from hazardous ambient factors that may be present. The training must cover the following area:

- ✓ Knowledge of materials, equipment and tools
- ✓ Known hazards in the operations and how they are controlled
- ✓ Potential risks to health
- ✓ Precautions to prevent exposure
- ✓ Hygiene requirements
- ✓ Wearing and use of protective equipment and clothing
- ✓ Appropriate response to operation extremes, incidents and accidents

Table 7-5: Prevention and Management of Foreseeable Accidents

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
Fire/ Explosions	✓ All flammable liquid containers shall be adequately labelled with appropriate signs and kept safely away from direct heat or fire. ✓ Firefighting equipment's shall be put in easily accessible areas known to every worker. ✓ Fire escape roots shall be established and well known to all workers ✓ Fire assembly area shall be established with appropriate signs. ✓ Installation of automatic fire control devices in chemical storage areas, preparation of emergency plan, containment and collection measures. ✓ All workers and the general public shall be educated and trained on how to respond in the event of a fire incidence. ✓ The contractor shall ensure that first aid volunteers are trained and availability of first aid kit that is easily accessible at the site.	Dam area	Contractor	During construction and decommissioning
Drowning	✓ Construction of a perimeter wall around the dam ✓ Provision of watering points to discourage local people from direct access to the dam area ✓ Ensure safety of workers through awareness, safety training and safety clothing. ✓ Public awareness and education to local communities and training	Dam area	Contactor and TAWWDA	During construction and Operation
Injuries related to Construction work or falling materials and debris	✓ Daily and weekly safety briefing ✓ including inspection of jobsites and correcting of noted deficiencies ✓ Hand and power tools and similar equipment shall be maintained in safe condition and inspected prior to use. ✓ The contractor shall ensure that a fall protection work plan has been developed and implemented during dam	Dam area	Contractor	During construction and decommissioning

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
	embankment construction ✓ Appropriate personal protective equipment shall be identified, provided, and used for the safe operation of hand/power tools where need be. ✓ The contractor shall ensure that workers working in excavations are protected from cave-ins by an adequate protective system ✓ Daily clean up of the working area shall be ensured to reduce injuries from overcrowded floors, this shall apply also to storage of materials and equipments in stores. ✓ The worksite to be fully barricaded by protective hoarding so that the general public would be protected from work in progress.			
Spillage of hazardous substances	✓ Proper management and handling of gasoline products used by machine at the site ✓ Ensure appropriate maintenance of machines to avoid spillage	Dam area	Contactor	During construction and decommissioning
Flooding	✓ Ensure minimal internal erosion and sufficient shear strength of the foundation of the dam ✓ Restrict settlement or economic activities in the river flood plains. ✓ Maintain public awareness and provision of flood early warning system in case of any eventualities. ✓ Regular monitoring of internal hydraulic leaks and static ✓ Ensure routine inspection and regular maintenance of the dam embankment.	Dam area	TAWWDA and contractor	During Construction, implementation and decommissioning
Vehicular Accidents	✓ Ensure safety of residents by providing safety signs at strategic places around the dam access roads and barricading of the working area. ✓ Provision of safety driving training to all project drivers ✓ Imposing and controlling speed limits for all construction	Dam area	contractor	During construction

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
	vehicles. ✓ Public awareness and education on personal safety			
Landslides	✓ Ensure proper understanding of Geotechnical survey reports before commencement of construction, blasting or excavation activities.	Dam area	Contractor	During construction

7.5 Social Impacts

7.5.1 Land Acquisition Requirements

The Project will require permanent acquisition of land 406 acres as well as temporary occupation of land. Permanent land acquisition will occur for the construction of the Dam Wall, the creation of the Reservoir, as well as for other permanent infrastructure such as the access road to the Dam Wall, the spillway and a permanent operations office. Temporary land occupation will be required for the construction of temporary access roads, the operation of a quarry and for construction camps and offices.

The Project's anticipated land requirements are summarised below;

Dam Embankment and Reservoir; The Project will require the permanent acquisition of land, and inundation of communal resources and activities, improvements on this land (agricultural fields, privately-owned trees and a beehives). Land acquisition is estimated at 406 acres.

Access Road to Dam Wall; The new access road to the Dam Wall, which will require the permanent acquisition of land, anticipated to consist mainly of agricultural fields and rangeland.

Associated Infrastructure; This Project component includes the quarry (material borrow sites), works areas, temporary roads, construction camps, offices that will be required during the construction period. Most of the land will be occupied on a temporary basis, although some permanent land acquisition will be necessary for an operational office complex in the vicinity of the Dam Wall/power plant. Land required for the associated infrastructure is anticipated to consist of agricultural fields and pasture land.

Water Conveyance Pipeline; these pipelines will as far as possible be placed on reserves of existing roads and on private land. Land occupation outside public road reserves is anticipated to consist of agricultural fields currently being used for food, cash crop and fodder cultivation. Table below shows a summary of impacts on the social environment.

Table 7.6: Summary of Impacts on Social Environment

	Project Phase	Scale	Duration	Severity	Certainty	Direction	Significance
Socio-Economic Environment							
Land Resources							
Temporary loss of land	C	L	S	L	D	N	L
Permanent loss (>=406 acres of land)	O	L	L	M	D	N	M
Number of households (at least 12 HH affected/ 60 persons)	C, O	L	L	M	D	N	M
Livelihoods (240 farmlands)	C, O	L	L	H	D	N	H
Trees	C, O	L	L	H	D	N	H
Livestock Farming (reduced Pasture land)	O	L	L	M	D	N	M
Reduced food security due to Loss of Agricultural land	C, O	L	L	H	D	N	H
Population Relocation (up to 60 persons)	O	L	L	L	D	N	L
Vulnerable Households	O	L	L	M	D	N	M
Community safety	O	L	L	H	D	N	H
Downstream Irrigators	C, O	R	L	L	L	P	L
Health							
Air Quality	C	L	S	M	D	N	M
Potable water supply	C, O	L	L	M	D	N	M
Waste disposal	C, O	L	L	M	D	N	M
Noise (close to work sites, 3 year construction period)	C	L	S	H	D	N	H
Increased Insect nuisances	C	L	S	L	L	N	L
Increased communicable diseases (HIV/Aids, etc., influx of Large numbers of workers)	C	R	L	H	HL	N	H
Dam failure	O	I	S	H	P	N	H
Fire, explosion, chemical spill	C, O	L	S	H	P	N	H
Cultural Heritage (1 known site impacted)	C, O	I	L	H	D	N	VH

Legend:

Project Phase: Pre-construction, Construction or Operation
Scale: Physical scale / area over which the impact will be felt: **L**ocal, **R**egional, **N**ational or **I**nternational
Duration: The length of time the impact is likely to occur: **S**hort, **M**edium or **L**ong **T**erm

Severity: The intensity of the impact: **L**ow, **M**edium or **H**igh

Certainty: The probability of the impact occurring: **P**ossible, **L**ikely, **H**ighly **L**ikely or **D**efinite

Direction: Whether the impact is **P**ositive (beneficial) or **N**egative (adverse) Specialist Study Whether a specialist study is required or not

Significance: Based on the above criteria, an overall rating of significance of the impact: **N**il or **N**egligible, **L**ow, **M**edium, **H**igh or **V**ery **H**igh

7.5.2 Construction Impacts

Construction activities are likely to generate a range of impacts that may be adverse to the living and health conditions of affected communities. These could include:

i. damage to private property due to construction activities; for example, blasting operations and impact rollers; and
ii. Impacts on livestock farming practices during the construction period (e.g. acquisition of grazing areas; injuries to livestock).

Experience from other large-scale infrastructure projects also shows that the presence of a relatively large construction workforce drawn from outside the area may have a number of effects on the local social environment. These could include;

i. greater demand for, and pressure on, social services and facilities (e.g. health, educational and water supply facilities and systems);
ii. increases in the incidence of diseases (e.g. alcoholism, sexually transmitted diseases and other diseases such as tuberculosis);
iii. clashes between the workforce and local communities over construction jobs; civil disturbances; and
iv. Disturbances to the social practices and fabric of local communities (e.g. influx of job seekers; development of informal settlements; changes to the position of women and vulnerable groups).

The occurrence and significance of these impacts are a function of workforce size and composition: the larger and more foreign the workforce, the higher the anticipated social disturbances. The "development status" of local communities, similarly, determines the extent to which social disturbances may occur; the more isolated and underdeveloped the area, the higher the anticipated disturbances. The workforce that will be required at the proposed Mwania dam site is likely to be relatively large and could, therefore, have significant effects on local communities which are quiet and rural in nature. A strategy will be implemented to enhance the employment of local community members on the construction works. Nonetheless, the impacts referred to above will still occur and for individuals and households affected by them, the disturbances could be highly significant.

7.5.3 Operational Impacts

The presence of a large body of water in the post-construction period will pose a danger to community members, particularly of drowning. Although the creation of the proposed Reservoir will require involuntary relocation of some affected households, most households will only loose part of their land and will therefore be located close to the water level which could lead to safety concerns. The issue of proximity to the water body and associated safety impacts, especially for children and livestock, was frequently raised at community meetings. In all cases, communities suggested that either the entire Reservoir or village areas in close proximity to the Reservoir should be fenced.

Water fluctuations of the Reservoir will also be problematic; for example, areas close to water line will not be able to be used for cultivation, and any crossings will have to take water level changes into account. These potential safety impacts are rated as high, long-term and of high significance.

a) Biting flies and mosquitoes

In addition to being vectors for some disease like malaria biting flies and mosquitoes can be irritant when in season. It is important that the project does not exacerbate the already high prevalence of biting flies and mosquitoes in the area. Strategies for the management of dams have been described that may reduce the breeding sites of these insects.

b) Access to Health Services

The current availability of health services in the project area has already been analysed in other sections of this report. It was demonstrated that majority of the local population has fair access to health services in terms of distance to the nearest primary care unit, distance but wanting in terms of equipping, stocking of essential drugs and staffing of the institutions. Consequently, upgrading of the services in terms of provision of sufficient personnel and equipment as well as drugs as well as the building of new health clinics in the is recommended. This can be considered a form of mitigation for the various health risks that the project will generate, especially during the construction phase.

This obviously does not preclude the establishment of a first aid unit at the main construction site itself, a service which is necessary given the large size of the workforce. For health services that go beyond first aid, the managers of the project can make special arrangements with one of the already existing dispensaries and provide the needed upgrades. This will then benefit both the workforce and the local population.

c) Personal health practices

One of the major health concerns related to the project is its potential to significantly increase the spread of HIV/AIDS and other sexually transmitted infections (STIs) in the local population and among the workers. There is no doubt that the mobilization of a large workforce over the construction period which may be in excess of 24 months will bring about an intensification of sexual activity in the area and will see an increase in the number of active sex workers. Workers have salaries to spend and are away from home while the local population is poorer and young women are vulnerable to promises of money and unable to negotiate safe sex.

d) Child Development

By reason of their increased susceptibilities, and because of the long term and profound effects that both noxious and beneficial exposures to the embryo and small child

potentially have over the entire life of the individual, children deserve special attention during any health impact assessment. Consequently, the intent of this section is to summarize the positive and negative impacts that the project is expected to have on child development.

For the population living in the proposed area of the dam, possible impacts for children will be mostly experienced during the construction period. While the loss of agriculture land may result in a more limited diet for some households which could translate into higher levels of child malnutrition, it seems likely that the financial benefits of the project in terms of job creations and compensations will counterweight this negative impact and generally result in diet improvement for the majority of the population and its children. One condition for this to happen is for the local population to be given priority during the recruitment of workers, especially as regards the unskilled and semi-skilled jobs. As it is generally recognized that financial benefits to women often translate into more tangible benefits to the family and children in particular than when men are employed, the recruitment of women should therefore be given due emphasis by the managers of the project.

Children have been shown to be highly vulnerable to respiratory diseases. Consequently, the risks associated with deterioration in air quality parameters during the construction phase will have a greater negative impact on small children than on the adults of the local population. The implementation of the recommended control measures with respect to dust and combustion gases are consequently of special importance to the small children since below 12 years age. If such measures as well as those related to noise level are duly implemented, the potential negative impact of the project on the development of children will have been largely avoided.

e) Quality of Life

This is another broad category to assess the general impacts of the project on the quality of life of the potentially affected populations, bringing together findings already considered under the previous categories and wider issues related to socioeconomic development. Needless to say, increased agricultural productivity as a result of irrigation using stored water and the possibility of increased access to safe drinking-water are a major contributor to the enhancement of the quality of life of the hundreds of thousands of individuals in the recipient populations. For those living in the vicinity of the dam however, the situation is more complex, with a mixed bag of both positive and negative factors. Elements that will result in a deterioration of the quality of life during the construction phase include such stressors as dust, combustion gases, noise, the increased risk of road traffic accidents, a likely increase in the incidence of HIV/AIDS and STI, a probable deterioration of the general safety conditions in the area, as well as the loss of some resources such as agricultural land, trees, medicinal plants, etc.

Negative factors will also exist during the operation phase of the project, such as a more restricted access to the river and an increased difficulty to cross the river and use the services available on the opposite side. Elements contributing positively to the quality of life of the local population are related to compensations that will be paid for the loss of resources, the temporary employment during the construction phase of the project, the expected boom in local businesses during the same period, as well as the long-term improvement of the local road infrastructure. It can be seen from this mixed set of positive and negative elements that the nature of the mitigations measures that will be implemented as well as their efficient application will be a major factor in the balance between an improved or worsened quality of life for the local population.

8 MITIGATION MEASURES AND ENVIRONMENTAL MANAGEMENT PLANS

8.1 General

Mitigation is "the elimination, reduction, or control of a project's adverse environmental effects, including restitution for any damage to the environment caused by such effects through replacement, restoration, compensation, or any other means".

Mitigation and management measures have been proposed for the proposed Mwania Dam to minimize and control the generation, occurrence and magnitude of the negative impacts and to ensure compliance with the relevant environmental legislation and management standards.

8.2 Structured consultation

A structured consultation programme will be implemented to ensure that the affected persons are kept up to date with project developments. This will include advice on construction schedules and acquisition dates, valuation procedures, compensation and grievance resolution mechanisms, and construction employment procedures. Consultation with stakeholders is an ongoing process, and will continue to occur throughout the project cycle. It will form a key part of further development, implementation and operation of the project.

In order to ensure that grievances and complaints on any aspect of the project including land acquisition, compensation, and relocation are addressed in a timely and satisfactory manner and that all possible avenues are available to affected persons to air their grievances, a grievance redress procedure will be established by the project.

8.3 Mitigation and Management Measures during Construction Phase

8.3.1 Occupational Safety and Health issues

During construction phase, the following mitigation and management measures will be put in place:

- ✓ Dust control through regular watering of access roads
- ✓ Use of respiratory protective equipment by workers closely involved in excavation, blasting and crushing activities.
- ✓ Capacity building and training of personnel with respect to environment, health and safety shall be observed. Personnel protective equipment as per health safety regulations and medical checkup of workers as is required by factories and other places of work Act (cap 514) shall also be observed.
- ✓ Observing effective emergency response plans to reduce health and safety risks
- ✓ Waste, including excavated soil and debris shall be properly disposed off by backfilling and landscaping. The contractor shall provide acceptable and standard sanitary convenience to the workers.

8.3.2 Health and safety issues

- ✓ Limiting the extent of site clearance as far as possible.
- ✓ Keeping stockpiled materials moist.
- ✓ Rehabilitating disturbed areas as soon as possible.

- ✓ Keeping earth and gravel roads damp.
- ✓ Fitting silencers to ventilation fans.
- ✓ Maintaining vehicles in good order.

8.3.3 Workforce accidents

The following measures will be introduced to minimize adverse workforce-induced impacts, and enhance potential benefits:

- ✓ Implementation of a preferential employment strategy. In consultation with local authorities and community representatives, construction camps will be located and designed to maximise local service provision; minimize informal settlement development; and to promote the use of project infrastructure as community facilities in the post-construction phase.
- ✓ Ensure that acceptable facilities are provided at construction camps (e.g. health services, water and sanitation facilities, recreational facilities and fair-price shops).
- ✓ Ensure that health programmes and measures are provided for the construction workforce (e.g. Programmes on STDs and occupational health).
- ✓ Ensure in cooperation with other government agencies, that health programmes are made available to communities affected by construction activities (e.g. campaigns on STDs and general health improvement measures).
- ✓ A structured consultation programme will be implemented to ensure that there is regular liaison and interaction with community representatives, local authorities and NGOs. The consultation structure will be used to discuss workforce issues and community concerns, to agree on any corrective measures and to discuss ways to enhance the provision of basic services by local entrepreneurs.
- ✓ Crushing plant to be located at least 1000m from human agglomerations, use of hearing protection equipment for exposed workers, limitation of circulation of trucks between 0700hr and 1900hr.
- ✓ Road signs will be put in place and the speed of vehicles controlled. Heavy traffic shall be restricted to the day period for reasons of security and the restful sleep of the inhabitants.

8.3.4 Mitigation measures for risks

Management of security risks, as well as for flooding and a dam-break flood wave entail:

- ✓ Regular liaison with local authorities and community representatives to discuss security and safety risks and management plans;
- ✓ Fencing of high risk construction sites to prevent accidents;
- ✓ An early warning system at blasting areas; and
- ✓ An emergency preparedness plan for flooding and a dam-break event.

8.3.5 Mitigation against HIV/AIDs , STIs and Covid-19

Mitigation against HIV/AIDs and STIs will involve the following:

- ✓ Implementing an extensive HIV/AIDs and STI education campaign among the local population, targeting not only youth but adults as well. Such a campaign shall be initiated immediately, well before the start of the construction phase. It shall be complemented by increased access to condoms in the area as well as voluntary counselling and testing.

- ✓ Implementing a comprehensive and on-going HIV/AIDS and STI education campaign targeting all workers hired for the project, both local and international.
- ✓ Implementing a well thought and effective HIV/AIDS and STI education campaign among sex workers. Such a campaign shall be initiated immediately and pursued throughout the construction phase of the project as a constant flux of individuals involved in this activity is expected. It shall be complemented by increased access to condoms specifically targeted for this group as well as voluntary counselling and testing (VCT), together with improved access to medical services.
- ✓ Upgrading all local health clinics serving the local population in terms of training for the local nurses specifically focused on the diagnosis and treatment of STI and HIV/AIDS, the uninterrupted availability of rapid HIV testing and of AIDS counsellors, the increased accessibility to complementary laboratory tests provided by central laboratories, as well as the availability of periodical consultations by qualified physicians. These measures shall encompass both the public and private health sector.
- ✓ Establishing a strong, well-publicized, effectively applied and closely monitored zero tolerance policy in accordance with which workers and service providers seeking sexual favours in exchange for project related benefits will be banned for the remaining duration of the construction phase.
- ✓ Implementation of Ministry of Heath guidelines

8.4 Mitigation and Management Measures during Operation Phase

i. To cater for surface drainage, well-designed concrete drain channels will be proposed to harmonize management of the resulting storm water within the site.

ii. A water quality monitoring program is proposed for the following:
   - ✓ To provide information for optimal management of the dam with respect to the best draw off level to be used for abstraction to the Water Treatment Plant in order to ensure cost effective production of high quality potable water to consumers.
   - ✓ To provide information of impending treatment problems such as algal blooms with attendant problems such as production of toxins and taste and odour compounds, as well as high iron and manganese concentrations at 'turnover'.
   - ✓ To build up a database of dam water quality that can be used for prediction
   - ✓ It is suggested that a site situated, preferably within the dam main basin, at a mid- point across the dam width, approximately 100 m from the wall be established by means of anchoring a buoy.

8.5 Mitigation on downstream flooding

- ✓ Preparing an emergency plan.
- ✓ Incorporate flood management into operating rules for dam releases.

8.6 Mitigation on fire, explosion and chemical spill

- ✓ Installation of automatic fire control devices in chemical storage areas, preparation of emergency plan, containment and collection measures.

8.7 Mitigation on inaccessibility to safe drinking-water and sanitation

- ✓ Installation, maintenance or upgrading of small gravity water system in the surrounding villages

- ✓ Implement a programme for the promotion of VIP latrines targeting the local population that found to be without adequate sanitation facilities.

8.8 Mitigation on inaccessibility to health services

- ✓ Upgrade the existing primary health care units through supplementary training for the local nurses,
- ✓ Assisting in the provision of a wider range of medical services,
- ✓ Assisting in the enhancement of laboratory services,
- ✓ Assisting in making available periodical consultations by qualified physicians.
- ✓ Establish a first aid unit at the main construction site and make special arrangements with one of the already existing clinics to provide health services beyond first aid.

8.9 Mitigation and Management Measures on Pollution

8.9.1 Mitigation on combustion gases will include:

- ✓ Reduction of use of fossil fuels, limitation of exposure time, use of antipollution systems,
- ✓ Improved combustion performance of machinery and vehicles.

8.9.2 Mitigation on non-biological waste will include:

- ✓ Recovery of waste materials and restoration of site.

8.10 Mitigation on hygiene and biological waste will include:

- ✓ Providing sufficient toilets for both men and women with complete sanitary fixtures;
- ✓ Providing safe and clean potable water for drinking and hand washing, including sanitary detergents;
- ✓ Providing an adequate amount of water for washing facilities and sanitation

8.11 Socio-Economic Environment Management

Mitigation is "the elimination, reduction, or control of a project's adverse effects, including restitution for any damage to the environment caused by such effects through replacement, restoration, compensation, or any other means".

8.11.1 Guiding Principles for Compensation and Resettlement

The primary mitigation measure would be to avoid or minimize land acquisition and where feasible, exploring all viable alternatives; and where acquisition of land or other assets is unavoidable, compensation should be provided to the full value of the land or assets acquired and any loss of livelihood as a result.

The Project, in particular the Reservoir, will acquire a range of private fixed assets (fields, houses and trees) and communal natural resources for which appropriate compensation and/or mitigation measures are required. Project-affected persons will be entitled to a combination of compensation and rehabilitation support measures based on factors such as ownership rights and type of loss. The following guiding principles will apply to the Project. The principles are consistent with international involuntary resettlement safeguards, while also incorporating local legislation and practices.

- Principle 1: Relocation and land acquisition will be avoided or minimised.
- Principle 2: Ongoing and meaningful consultation will occur with project-affected persons and communities.
- Principle 3: Affected persons will be assisted to improve their livelihoods.
- Principle 4: Vulnerable groups and severely project-affected persons will be specifically catered for.
- Principle 5: Land acquisition/relocation planning, budgeting and implementation will be an integral part of the project.
- Principle 6: A proper database of affected persons will be established for management and monitoring purposes.
- Principle 7: Grievance and monitoring procedures will be in place.
- Principle 8: Legal obligations will be complied with.

8.11.2 Entitlements

The proposed demarcation line of the proposed Reservoir (i.e. the line below which all assets will be permanently acquired) is the full supply level plus a buffer area around the reservoir; any structures below this line will have to be permanently relocated. As previously indicated, up to about 183 households are affected. However, based on assessments with the available maps only a few (11) will be relocated. The preferred resettlement approach will be local relocation of displaced households within their localities. This has the benefit of allowing these households continued use of their remaining landholding and the maintenance of their existing social support networks. It also avoids many of the psychological stresses associated with involuntary resettlement to new areas and communities.

The relocation programme will entail assistance with the identification of new residential sites in the localities and beyond, physical preparation of sites for residential occupation, provision of appropriate sanitation facilities, provision of replacement housing or cash compensation, and payment of evacuation and displacement allowances.

The entitlements detailed here are applicable to the entire Project. They are based on the guidelines of the African Development Bank Operational safeguard 2 – Involuntary resettlement: land acquisition, population displacement and compensation, recent compensation developments in Kenya and the results of meetings held with communities at the proposed Dam site. Most of the requests/statements of the affected communities have been accommodated.

The following sections provide further details on the key measures in the Entitlement Framework

8.11.3 Buildings and Improvements

Compensation for buildings and other improvements will entail the following: Cash compensation or provision of replacement housing at full replacement value. Cash compensation for the loss of other structures such as fencing and animal shelters. Assistance with the identification and preparation of a new homestead site in the village/settlement area, or cash compensation (at replacement value) for the lost plot

Households who are relocated will be allowed to salvage reusable materials with no deduction from their compensation entitlements.

Informal traders and squatters on public land required for the installation of transmission lines will be assisted to move their operations. They will be allowed to

return to their old sites after completion of the civil works.

8.11.4 Cultivation Land

Land owners will be compensated for permanent cultivation land losses at replacement cost. This will be in the form of cash compensation or the provision of replacement land. Because of the scarcity of agricultural land, cash compensation is likely to be the preferred form of compensation.

An affected land owner may request the acquisition of his/her entire landholding where the remaining landholding is less than 500m^2.

Encroachers using public land for the cultivation of crops will not be entitled to compensation for land losses. They will, however, be compensated for any standing crops and paid a cultivation disruption allowance.

8.11.5 Standing Crops

Construction works will as far as possible be planned to allow for the harvesting of standing crops before land is acquired permanently or occupied temporarily. Where crops cannot be harvested or the destruction of crops is unavoidable, cash compensation will be paid for the loss of crops to land owners and encroachers using public land prior to the cut-off date. Rates will be based on the loss of one season's production.

If the land in question was cultivated according to a lease arrangement at the time of acquisition, compensation for the lost crops will be apportioned according to the arrangement. However, persons with secondary land rights (such as sharecroppers or renters) will not be entitled to any compensation for the loss of the land. A programme of capacity building will be implemented through which renters and other affected persons will be given advice on alternative livelihood strategies. They will also be provided with assistance through government departments, NGOs and/or other development agencies) to gain access to community development and poverty alleviation/social welfare programmes.

8.11.6 Trees

Owners of fruit and other trees located in areas required by the Project will be given advance notice to remove their trees. These trees will be compensated for as follows.

Compensation will be paid for future production losses, calculated for the productive life of the various timber and fruit tree species.

The owner will have the rights to all other resources (timber; firewood) from privately-owned trees that are felled.

Owners will be provided with replacement saplings, in addition to compensation for production losses as defined above. The Project will ensure that agencies such as the Department of Forestry provide technical assistance to affected owners with the planting of the replacement saplings.

8.11.7 Graves

Affected graves will be exhumed and reburied, with the costs being borne by the Project. Funds will also be made available to the family for reburial ceremonies.

8.11.8 Government land & Communtiy Buildings/Infrastructure

It is not anticipated that community buildings/facilities will be affected by the Project. However, KALRO land about 64 acres will be acquired. Consultation and coordination is underway between government ministries Ministry of Water and Ministry of Agriculture and Livestock regarding any impacts that the Project may have on government assets.

8.11.9 Restoration of Access

As a natural feature of the physical landscape, the Miwongoni and Botha rivers have always constrained the movement of people to some degree, and the location of social services such as schools. Impeded access resulting from reservoir inundation relate principally to the inundation of crossing points used to access services, facilities (e.g. schools, churches, mills), kinship, social and support networks.

Access across the Reservoir will be restored through the provision of a vehicular bridge across the dam crest; and the possibility of establishing small boat/ferry services, to be run as income-earning activities by community members, will also be investigated in consultation with the affected communities.

8.11.10 Rehabilitation Assistance

Where the permanent loss of agricultural land exceeds fifty percent of the affected owner's total agricultural landholding, the owner will be paid a cultivation disruption allowance equal agricultural production on the area of arable land that is lost. Any such households will be identified in consultation with the Dam Compensation Committee once a full cadastral survey of the landholdings of all land-losing households is undertaken and percentage loss can be determined. These households will also be registered for priority employment on the Project's civil works. Encroachers using public land for agricultural production prior to the cut-off date to entitlements will be eligible to a cultivation disruption allowance equal to one year's crop production on the area of public land used for cultivation.

Household who are required to relocate for project developments will receive a housing displacement allowance to cover expenses incidental to the change of residence. Informal traders and squatters on public land will also qualify for this allowance.

The Project will be responsible for covering the costs of any persons required to be relocated as a result of the Project. This will be in the form of an evacuation allowance or the provision of transport and physical relocation by the Project.

Affected households that are particularly vulnerable to project implementation will be identified in conjunction with the Dam Compensation Committee. These households will be supported through the following measures;

i. Payment of a vulnerable household rehabilitation allowance
ii. Priority registration for employment on the project civil works;
iii. Advice regarding project impacts, compensation alternatives and risks, and resettlement options (where required); and
iv. Advice on alternative subsistence and livelihood strategies, and assistance to gain access to poverty alleviation/social welfare programs.

8.11.11 Compensation Determination

A Compensation Determination Committee (CDC) will be established under the auspices of the implementing ministry to:

- ✓ Refine the principles and procedures detailed in the Entitlement Framework; and
- ✓ Determine and negotiate compensation norms and principles.

The compensation principles and norms determined by the CDC will form the basis for the establishment/ adjustment of compensation rates for the various items detailed in the Entitlement Framework.

The CDC will be composed of among others representatives from;

- ✓ the implementing agency;
- ✓ affected communities at the Reservoir site;
- ✓ Local Administrators;
- ✓

All rates determined by the CDC will be base-dated and indexed annually to allow for inflation adjustments.

8.11.12 Structured Consultation Programme

A consultation programme will be implemented to ensure that affected communities are kept up to date with project developments. This will include advice on construction schedules and acquisition dates, valuation procedures, compensation and grievance resolution mechanisms, and construction employment procedures.

8.12 Health and Safety

8.12.1 Construction Workforce Impacts

The following measures will be introduced to minimise adverse workforce-induced impacts, and enhance potential benefits;

i. Implementation of a preferential employment strategy.
ii. In consultation with local authorities and community representatives, construction camps will be located and designed to (i) maximise local service provision, (ii) minimise informal settlement development; and (iii) promote the use project infrastructure as community facilities in the post-construction phase.
iii. The implementing agency will ensure that acceptable facilities are provided at construction camps (e.g. health services, water and sanitation facilities, recreational facilities and fair-price shops).
iv. The implementing agency will ensure that f health programmes and measures are provided for the construction workforce (e.g. programmes on STDs and occupational health).
v. In cooperation with other government agencies, implementing agency will ensure that health programmes are made available to communities affected by construction activities (e.g. campaigns on STDs and general health improvement measures).
vi. A structured consultation programme will be implemented to ensure that there is regular liaison and interaction with community representatives, local authorities and NGOs. The consultation structure will be used to discuss workforce issues and community concerns, to agree on any corrective measures

and to discuss ways to enhance the provision of basic services by local entrepreneurs.

8.12.2 Biting flies and mosquitoes

Use dam management strategies that can reduce the breeding sites of biting flies and mosquitoes, such as:

i. allowing the rapid draw-down of the reservoir, allowing both a rapid drop in shoreline water levels and an artificial flood downstream that will flush out any vector breeding places in rock pools;

ii. avoiding leakages and pooling of water in the conveyance pipeline so as not to create vector breeding places;

8.12.3 Access to Health Services

Access to health facilities in the project area is a source of concern; mitigation measures/projects under this include an upgrade the existing primary health care units through;

i. Equipping, stocking and provision of personnel at local dispensaries– the contractor's camp buildings can also be availed as an additional health centre after project completion; the construction workers' medical camp can be open to residents during the construction period.
ii. Supplementary training for the local nurses,
iii. Assisting in the provision of a wider range of medical services and drugs,
iv. Assisting in the enhancement of laboratory services,
v. Assisting in making available periodical consultations by qualified physicians.

Establish a first aid unit at the main construction site and make special arrangements with one of the already existing clinics to provide health services beyond first aid.

8.12.4 HIV/AIDS and STIs

Implement an extensive HIV/AIDS and STI education campaign among the local population, targeting not only youth but adults as well. Such a campaign should be initiated immediately, well before the start of the construction phase. It should be complemented by increased access to condoms in the area as well as to voluntary counselling and testing.

Implement a comprehensive and on-going HIV/AIDS and STI education campaign targeting all workers hired for the project, both local and international. It should be complemented by easy access to condoms at the workplace as well as to voluntary counselling and testing.

Implement a well thought and effective HIV/AIDS and STI education campaign among sex workers. Such a campaign should be initiated immediately and pursued throughout the construction phase of the project as a constant flux of individuals involved in this activity is expected. It should be complemented by increased access to condoms specifically targeted for this group as well as voluntary counselling and testing, together with improved access to medical services.

Upgrade all local health clinics serving the local population in terms of training for the

local nurses specifically focused on the diagnosis and treatment of STI and HIV/AIDS, the uninterrupted availability of Rapid HIV testing and of AIDS counsellors, the increased accessibility to complementary laboratory tests provided by central laboratories, as well as the availability of periodical consultations by qualified physicians. These measures should encompass both the public and private health sector.

Establish a strong, well publicized, effectively applied and closely monitored zero-tolerance policy in accordance with which workers and service providers seeking sexual favours in exchange for project related benefits will be banned for the remaining duration of the construction phase.

8.12.5 Child development

As it is generally recognized that financial benefits to women often translate into more tangible benefits to the children than when men are employed, the recruitment of women should be given due emphasis by the managers of the project.

8.12.6 Cultural Heritage

It is recommended that:

i. The archaeology reconnaissance be undertaken to determine the extent to which the proposed dam development will impact on the historical and living heritage sites. It is recommended that detailed documentation be undertaken, to ensure that a proper database is established, which will record any uncovered heritage sites using the state of the art technology.

ii. That further site inspections be undertaken where dam excavation works penetrate below the Formations.

8.12.7 Vulnerable Groups

Resettlement operations will need to ensure children's nutritional needs are met, along with their access to education. In addition, if children contribute economically to family welfare, resettlement operations will include measures to eliminate child labour to the fullest extent possible. The resettlement operation shall enumerate the number and types of disabilities in the displaced population and make arrangements to provide the assistance needed by these individuals or their families.

The resettlement programming should ensure that meaningful consultations with women are included; so as to ensure women inclusion the resettlement program should issue information on resettlement entitlements and choices to every adult member of the household, not just to the head of the household. Informal contributions to household subsistence by women include subsistence agriculture and collection of fuel and water, not to mention cooking, cleaning, and childcare. All of these activities are to be included in calculating household incomes.

8.12.8 Reduced Agricultural Land and Food Production in the Locality

The agriculture and livestock sectors are key development drivers for Machakos County in which the proposed dam sits; the reservoir will inundate over 406 acres of land under different agricultural uses. This impacts on agriculture will affect food security and poverty reduction efforts in the locality. Although this reduction will by far be offset by the increased access to clean water and irrigation downstream of the dam, the local

shortfall can be bridged by ensuring that the project has a component targeting intensification of agricultural production in the area surrounding the dam so as allow for producing more food on the same amount of land in the process guaranteeing household food security. Similarly activities aimed at intensification of livestock production need to be incorporated considering that most households that had livestock in the baseline survey mostly kept stocks of low productivity. These would mainly entail further upgrading of the existing breeds into pedigree and better management methods.

8.13 Future Consultation and Disclosure Program

Consultation with stakeholders is an ongoing process, and will continue to occur throughout the Project cycle. It will form a key part of the further development and implementation. In brief, the implementing agency will provide sufficient personnel and resources to ensure that activities related to the social component of the Project (e.g. consultation and compensation) are properly implemented and managed.

With regard to public consultation and disclosure, the following are important activities to be managed and coordinated by the implementing agency;

i. The establishment of an information office in the reservoir area (Mikuyuni Sub location;
ii. Institutional and process development;
iii. Liaison and consultation with Project-affected stakeholders, and engagement protocols;
iv. Involvement of local NGOs in awareness-raising, capacity-building and other aspects of the consultation and participation process;
v. Dissemination of Project-related information;
vi. Participatory planning; and
vii. Management of a grievance resolution procedure.

A plan for future public consultation is a valuable tool to continue the process initiated in earlier project phases. The following future activities will be undertaken as part of the public consultation and disclosure process.

8.13.1 Public Consultation and Disclosure Review

An evaluation of the current consultation and disclosure process will be undertaken, making adjustments for future implementation. This will be undertaken through a workshop with the Mwania Site Dam Committee and the implementing agency. The review will consider institutional requirements for public consultation in further project phases, as well as possible risk factors (e.g. time delays affecting implementation; non-participation of specific stakeholders; inadequate or deferred disclosure of information).

8.13.2 Implementation

The following activities will be undertaken as a continuation of the current consultation process and forming the basis of the review referred to above;

Disclosure; Current methods of disclosure will be extended to include:

a) A continuous distribution of updated information about the Project in the form of information sheets/pamphlets, posters, newsletters and workshops; and
b) The establishment of an information office in the dam area.

Further consultation with stakeholders; this will include;

i. Further discussions with government officials at national, regional and local level, over legal and administrative issues;
ii. consultation with government stakeholders specific to the provision of support services;
iii. further consultation and workshops with communities and the relevant officials to finalise land acquisition procedures;
iv. ongoing consultation with affected households around compensation and livelihood restoration plans; and
v. Consultation with NGOs who may be contracted to assist with the restoration of livelihoods and social development plans, particularly of vulnerable groups.

8.14 Grievance Redress

In order to ensure that grievances and complaints on any aspect of the Project including land acquisition, compensation, and relocation are addressed in a timely and satisfactory manner and that all possible avenues are available to affected persons to air their grievances, a grievance redress procedure will be established by the Project.

In line with grievance redress procedures recommended/established for recent projects in Kenya, an approach will be adopted with regard to disputes over compensation awards; any person aggrieved by compensation payments made or not made by the implementing agency in connection with the acquisition of his/her land, housing or other assets or rights by the project shall lodge a written in accordance to the laid grievance redress mechanism.

Table 8-1: Potential Environmental Effects/Impact and Mitigation Measures

Potential Impacts	Mitigation Measures
Construction, site clearance and excavation	
1. Loss of vegetation	Reforestation in farmlands and forest degraded areas
2. Loss of habitats	Habitat recreation/ improvement of habitats
3. Effects on farming and other uses	Site planning for avoidance, compensation
4. Dust effects	Use of dust suppressants
5. Blasting and noise effects	Timing of activities, fish deterrents and safety provisions
6. Forestry effects	Recovery of merchantable timber and reforestation
7. Sanitary and health problems from construction camps	Avoid camps by employing locals
8. Workforce accidents by unsafe working practices during construction	Compliance to the provisions of the EHS management plan to safeguard workers Prepare and print safety manual for distribution to workers.
9. Need for an emergency response vehicle	Assign a vehicle specifically for emergencies
10. Disposal of construction wastes and other solid waste materials	Promote collection and storage of wastes during construction and operation in accordance with the waste management regulations. Contract a private waste collection firm.
11. Storage of oil, petrol and diesel for construction.	Construct storage tanks away from regular activities in compliance with Energy bill, 2003.
12. Physical environmental destruction	Limit vegetation clearance within the pegged section or the inundation area only Use water boozers to minimize dust pollution
13. Air, dust and noise pollution	construction vehicles and machinery shall switch off engines when not being used Generators to be well insulated or placed in enclosures to minimize noise levels. Sprinkling of water on graded routes to reduce dust
14. Cutting down of existing trees and destruction of native vegetation on the proposed dam location.	Planting more trees.

Reservoir preparation and flooding	
1. Disposal of vegetation	Controlled burns and biomass preparation
2. Exclusion of further land uses	Compensation to the communities or CFAs through community projects
3. Turbidity and siltation during filling	Erosion control
4. Shoreline slumping and erosion	Shoreline protection through vegetation planting
6. Environmental degradation from increased pressure on land	Improve management of land
7. Loss of wildlife habitat	Decrease reservoir size to decrease loss
8. Conflicting demands for water use	Equitable allocation between large and small holders (users)
Extraction of aggregates	
1. Transport handling	Use of excavated materials on site
2. Worker influx	Employ locals
Cofferdam placement and removal	
1. Turbidity increases to receiving waters	Silt barriers and selection of construction materials
Access roads	
1. Displacement of wildlife due to habitat loss	Alignment selection to avoid wildlife habitats
2. Loss of vegetation due to clearing	Alignment selection and reforestation elsewhere
Reservoir Operation	
1. Shoreline erosion	Shoreline protection e.g. rip rap and gabions
2. Creation of aquatic habitat	No mitigation
3. Mercury transformation and uptake by fish	Reservoir clearing, shoreline stabilization and removal and covering of organics
4. Loss or displacement of aquatic mammals, habitat and traditional uses associated with riverine ecosystem	Wildlife management (e.g. controlled harvesting, habitat improvement) or relocation measures
5. Increase in humidity and fog locally creating favorable habitat for insect disease vectors	Vector control
6. Methane release	Reservoir preparation and intake/station design to minimize anoxic conditions
7. Proliferation of aquatic weeds	Clearance of woody vegetation from inundation zone prior to flooding (nutrient removal), harvest weed for compost, fodder or biogas, weed control measures
8. Deterioration of water quality in reservoir	Clearance of woody vegetation before flooding, control of land uses

9. Sedimentation of reservoir and loss of storage capacity	Control of Land use in watershed, reforestation and soil conservation measures
10. Environmental problems arising from development made possible by the dam	Basin-wide integrated planning to avoid overuse, misuse and conflicting uses of water and land resources
11. Poor land use practices in catchment areas above reservoir resulting in increased Siltation and changes in water quality	Land use planning efforts which include watershed areas above dam
Spillway operation (downstream effects)	
1. Erosion and Siltation effects	Station design and shoreline protection
2. Scouring of riverbeds below dam	Design of trap efficiency and sediment release
3. Alteration in aquatic habitat	Flow regulation during critical periods
4. Water quality effects	Reservoir preparation, intake and station design e.g. removal of organics, erosion control and flow management

8.15 Environmental and Social Management Plan (ESMP)

8.15.1 Significance

ESMP involves the protection, conservation and sustainable use of the various elements or components of the environment. The ESMP for the propose project provides all the details of project activities, impacts, mitigation measures, time schedules, costs, responsibilities and commitments proposed to minimize environmental impacts of activities, including, monitoring and evaluation and environmental audits during implementation and decommissioning phases of the project.

The ESMP is a very important output of an ESIA since it provides framework or checklist for project monitoring and evaluation/audit. Mitigation measures provided in this chapter are aimed at making changes in any of the following ways:

- ✓ Project materials
- ✓ Raw materials
- ✓ Project site.
- ✓ Project timing
- ✓ Project technology
- ✓ Maintenance

8.15.2 Objectives

The objectives of the ESMP include the following:

i. To bring the project into compliance with applicable national, social and legal requirements, social policies and procedures.
ii. To outline mitigating/enhancing, monitoring, consultative and institutional measures required to prevent, minimize, mitigate or compensate for adverse environmental and social impacts, or enhance the project beneficial impacts.

8.15.3 Responsibilities

In order to ensure accountability and protect the environment from unnecessary degradation, specific people must be accorded responsibilities to ensure that all activities are carried out within the set out limits and environmental standards are maintained. The TAWWDA has the responsibility of ensuring the successful construction and maintenance of the proposed project infrastructure. This can be achieved by making sure that the contractors are of the category that is suitable for this work. The supervising engineer must ensure that contractors perform their duties up to the specified standards and that they adhere to the mitigation measures stated in the EMP and Environmental Health and Safety (EHS) provisions. The following entities will be involved in the implementation of this ESMP.

- ✓ Environmental consultants.
- ✓ Tanathi Water Works Development Agency
- ✓ National Environment Management Authority-(NEMA)

8.15.4 Environmental monitoring, audits and training

Environmental monitoring and audits are essential in a project's life span as they are conducted to establish if project implementation has complied with set environmental management standards for Kenya as spelt out in EMCA 1999 and the Environmental (Impact Assessment) and Audit Regulations 2003. In this Project, environmental

monitoring and audit will be conducted to ensure that identified potential negative impacts are mitigated during the project's implementation, operation and decommissioning periods.

Environmental concerns, that will be monitored and audited during the project's construction and maintenance period include: water quality, air Pollution, occupational health and safety (including worker accidents and hazards), soil erosion, Socio-cultural changes; dust and gaseous emissions; populations of disease vectors and socio-economic benefits

8.15.5 Monitoring Data

Regular sampling for observation and monitoring should be undertaken in the dam points and compared against water quality standards.

8.16 Health and Safety Plan

8.16.1 Overview

Occupational health and safety is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all occupational health and safety programs is to foster a safe work environment. As a secondary effect, it may also protect co-workers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment. It should be site specific to fully cater for the issues that might pose a risk to the workers on the site and the nearby communities. Apart from observing the requirements of the law on health and safety it is paramount to establish safe working practices and policies. It is also important to establish effective health and safety procedures for all the activities planned to be undertaken. All actors involved should be aware of and identify potential hazards. However everyone involved is held responsible to use common sense safety approach at work environments and report to the relevant authority any hazard that has been created but not addressed

Table 8-2 Health and Safety Plan

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
Accidents	✓Ensure good housekeeping by the contractor ✓Establish them appropriate safety measures for the construction phase, ✓Ensure a perimeter fence is constructed on most risk areas of the dam to avoid drowning ✓Safety signs should be put up ✓Isolate the construction sites from the general public, ✓Ensure safety of the construction workers by putting first aid area and injury reporting mechanism ✓ Fire fighting equipments should be easily accessible.	Access roads and dam area	TAWWDA and Contractor	During construction, Implementation and decommissioning

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
	✓ Public education and awareness to local communities and workers regarding personal safety measures. ✓Restrict settlement in flood plains ✓Proper understanding of geotechnical survey reports before commencement of construction, blasting or excavation activities ✓Ensure proper handling of hazardous substances to avoid spillage			
	✓Establish the appropriate safety measures in the O & M manual for the operation phases. ✓Ensure safety of residents by providing safety signs at strategic places around the dam access roads. ✓Ensure compliance to Occupational Safety and Health Act Cap. 514, its Subsidiary Legislations and ✓Factories and Other Places of Work (Repealed by s.129 of A15 of 2007) Act	Dam area	Contactor	During construction
Noise and Vibration	✓Notification of the residents on unusual noise and vibration levels during construction, ✓Construction need to be limited during the daytime only, ✓Maintain vehicles and equipments well to avoid unnecessary noise and vibration. ✓Construction of perimeter wall around dam construction and excavation site to reduce noise emitted. ✓Workers to be provided with safety clothing capable of absorbing noise and excessive vibrations ✓Use of improved equipments that emits less noise and vibration ✓Compliance to the Environmental Management and Coordination Act (EMCA noise and Excessive Vibration Pollution Control Regulations, 2009), ✓Compliance with occupational Safety and Health Act Cap. 514, its Subsidiary Legislations ✓Compliance with Factories and Other	Dam area	Site manager/ Contractor	During construction and decommissioning

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
	Places of Work (Repealed by s. 129 of A15 of 2007) Act and the Building by-laws of Kenya.			
Sexually Transmitted diseases	✓Ensure sexually transmitted diseases public awareness and education to both workers and local communities. ✓Provision of voluntary counseling and testing centers ✓Ensure health centre's are equipped to treat or handle STDs ✓Encourage local workforce and provide for leave to workers working away from their families for longer periods.	Dam area	Contractor and TAWWDA	During construction
Air Pollution	✓Construction need to be limited during the daytime only ✓Ensure dump conditions as much as possible during excavations and earth moving, ✓Construction machinery be maintained in good working conditions, ✓Construction materials be maintained covered whenever possible, ✓Local communities shall be informed on anticipated emissions for preparedness. ✓Planting of vegetation around the dam to reduce CO2 produce from decomposition of organic matter in the dam, ✓The workers shall be provided by protective clothing like masks and goggles.	Dam area	TAWDDA, Site manager/ contactor	During construction, Implementation and decommissioning
Water Pollution	✓Ensure appropriate wastewater discharge from construction site and worker's camps. ✓Remove logs and plants before operation. ✓The hygiene and sanitation standards within the construction site shall be improved and maintained ✓Public awareness and capacity building among workers and local community in regard to personal hygiene practice.	Dam area	Local communities, TAWWDA and contactor	During construction, Implementation and decommissioning

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
	✓Planting of vegetation around the dam and increased soil conservation/integrated farming methods by the communities Construction of a silt trap dam upstream of the main dam ✓Initiate water quality monitoring on the basic ambient water quality parameters in the reservoir to meet the applicable parameters of water quality standards (for domestic water/other use) of NEMA. EMCA (water Quality) Regulations, 2006			
Water-borne diseases	✓Enhance local people's public awareness and education in sanitation and personal hygiene ✓Provide adequate and clean drinking water to the workers and local communities and other domestic use.	Dam area	TAWWDA	During construction and implementation
Vector-borne diseases	✓The dam edges shall be deep enough to reduce vector breeding areas, ✓Clearance of bushes around the dam and water weeds to discourage breeding areas ✓Avoidance of pool areas /flooding areas around the dam ✓Encourage high speed flow for any outlet from the dam to kill or discourage vector breeding. ✓Enhance local people's public awareness and education on vector borne diseases and personal safety. ✓Proper drainage at construction sites to avoid waste water stagnation	Dam area	Contractor, TAWWDA and local communities	During construction and implementation phase
Waste generation	✓Contractor will be required to provide an adequate waste management mechanism to construction sites and worker's camps, ✓Categorize wastes into inert materials and others for safe disposal. Inert materials (concrete residuals& earth) may be used on local access roads, ✓Other waste materials to be disposed off into the approved disposal site. ✓Most waste materials shall be reused if	Dam area	Site manager/ contactor	During construction and decommissioning

Anticipated Impacts	Mitigation Measures	Location	Responsibility	Time Frame /Frequency
	necessary.			
	✓Apply the silt from the silt trap dam at the eroded sections of the dam downstream, and ✓Encourage appropriate and guided use of the silt by the farmers in reconditioning their farms. ✓Ensure compliance to EMCA (waste Management) Regulations, 2008.	Dam area	TAWWDA and contactor	During implementation
Psychological Stress	✓Ensure that family ties are respected during resettlement process including relocation of graves and any other cultural items ✓Enhance public consultation and awareness of the project activities and counseling where need be with the project affected persons. ✓Provision of alternative livelihoods to those resettled or affected by the project ✓Maintain public notices before commencement of any public nuisance activities.	Dam area	Contractor and TAWWDA	Construction, implementation and decommissioning
Soil Contamination	✓Appropriate maintenance of machines to avoid spillage ✓Proper drainage in the construction site to remove waste water. ✓Proper waste management in the construction site. ✓Ensure proper disposal of sludge.	Dam area	Contractor	Construction, implementation and decommissioning
Offensive odour	✓Ensure that the contractor appropriately manages waste water and waste in the construction site and camp sites in accordance to EMCA (waste Management) Regulations, 2008.	Dam area	Contactor	Construction and decommissioning

8.17 Environmental Management Plan

8.17.1 Management Plan Principles

This proposed project is geared towards meeting the water demand for Machakos County, Machakos Sub County. The project will observe environmental conservation requirements in accordance to the established laws and regulations. To realize this goal, an Environmental Management Plan (EMP) has been prepared. Major factors that were

considered in this EMP include;

i. Enhancing integration of environmental, social and economic functions in the project implementation.
ii. Compensations or appropriate acquisition process of any land and/or property affected by the project in accordance with the laid down guidelines.
iii. Ensuring the water resources conservation throughout the project area and downstream.
iv. Ensuring soil erosion control and prevention of siltation into the water sources.
v. Ensuring prevention of pollutants discharge into the water sources, and
vi. The contractors and other players in the project activities will be prevailed upon to implement the EMP through a sustained supervision and continuous consultations.

8.17.2 Environmental and Social Management Plan

The matrices below outlines the action plans and responsibilities on negative impacts anticipated from the project activities. The matrices are clustered into construction and operation of the project.

Table8-3:EMP on Social Aspects

Environmental Issue	Action Required	Responsible Party	Time Frame	Estimated Cost (KES)
Land Use & Utilization of Local Resources	✓Rehabilitate the vegetation around the dam as much as possible.	Contractor/ TAW WDA	Once during construction	5,000,000.00
Existing Social Infrastructure &Services	✓Contractor to consult with local leaders for appropriate access during construction/operation, ✓Provide alternative access routes where necessary during construction,	Contractor / TAWWDA	During constructio n	No additional Costs
Elderly, the Children, and Physically Challenged People	✓Provide easy and safe access to public utilities such as schools, health centers and watering points.	Contractor/ TAWWDA	Throughout the constructio n phase	10,000,000.00
Misdistributio n of Benefits and Damages	✓Ensure adequate compensations to residents who are going to be affected, ✓Compensation on damages to the local communities should be harmonized e.g land and structures	TAWWDA	Once when preparing the RAP	No additional Costs
Dumping site near the Dam	✓Relocation and site clean up	TAWWDA	Once	10,000,000.00

Environmental Issue	Action Required	Responsible Party	Time Frame	Estimated Cost (KES)
Reservoir				
Cultural Heritages	✓The appropriate compensation and/or relocation shall be decided in consultation with the affected owners and relevant government officials, if any cultural/historical heritage is found during construction.	TAWWDA	Throughout the construction phase	5,000,000.00
Water Usage or Water Rights& Rights of Common	✓Adopting the established water resources management rules, Institute a liaison committee to provide an accessible communication channel between the community and TAWWDA/Government.	TAWWDA	Throughout operation phase	No additional Costs
	✓Provide convenient alternative access to water during construction and operation.	TAWWDA	Once construction phase	
Sanitation	✓Appropriate waste Water and waste management shall be implemented for the construction site and worker's camps	Contractor	Throughout the construction phase	10,000,000.00
Hazards, Risks &Infectious Diseases such as HIV/AIDS	✓Ensure compliance with regulations Occupational health and safety regulations during construction, ✓Provide safety gear to the construction workers and ensure application at all times, ✓Isolate safety risk areas and work camps from the public, ✓Collaborate with other players in community training and sensitization on disease control during construction	Contractor	Throughout the construction phase	20,000,000.00
	✓Provide necessary Awareness and information	TAWWDA	Throughout the operation phase	

Environmental Issue	Action Required	Responsible Party	Time Frame	Estimated Cost (KES)
	to the communities on dam safety aspects,			

Table 8-4: EMP on Physical Environment

Environmental Issue	Action Required	Responsible Party	Time Frame	Estimated Cost (KES)
Topography & Geographical Features	✓Establish a comprehensive rehabilitation plan including Landscaping and repairs of the dam site and the material/disposal sites.	TAWWDA/Contractor	Once during construction	No additional costs
Soil Erosion	✓Minimise clearing vegetation during construction, Construction to be confined during the dry season.	Contractor	Throughout the construction phase	20,000,000.00
	✓Encourage vegetation along the main stream to intercept additional silt (if any) during construction and operation, ✓Encourage vegetation around the dam buffer zone to control soil loss ✓De-silted soils from the sand trap dam upstream of Miwongoni and Botha Rivers	TAWWDA & the other relevant institution	Throughout construction / operation phase	
Groundwater	✓Observe the groundwater change by regular site visits/ communications through local governmental officers/leaders as an overall project monitoring.	TAWWDA	Throughout the operation phase	No additional Costs
Hydrological Situation	✓Monitor the flow trends of Mwania River over time.	TAWWDA in cooperation with WRA	Monthly during The operation phase	No additional Costs
	✓Ensure that minimum	TAWWDA	Throughout the	

	flows in Mwania River are maintained at all times in accordance with Water Resources Management Rules.		operation phase	
Fauna, Flora and Biodiversity	✓Minimise plants (trees and shrubs)to be removed and provide compensation plantation when necessary,	Contractor	Throughout the construction phase	5,000,000.00
	✓Establish a controlled vegetated buffer zone upon completion of the dam	TAWWDA	Once before commissioning	
Meteorology	✓Enhance awareness raising among the residents on changes, ✓Encourage tree planting around the dam to moderate humidity effects.	TAWWDA	Throughout the operation phase	No additional Costs
Landscape	✓During construction, provide temporary walls and landscaping for the dam site if necessary, ✓Ensure the contractor to use approved material/disposal sites and rehabilitate the sites appropriately.	Contractor	Throughout the construction phase	10,000,000.00

Table 8-5: EMP on Environmental Pollution

2d	Mitigation Measures	Target Area	Responsibility	Frequency	Budget KES
Air Pollution	✓Construction need to be limited during the daytime only ✓Ensure dump conditions as much as possible during excavations and earth moving, ✓Construction machinery be maintained in good working conditions, ✓Construction materials be maintained covered whenever possible, ✓Inform communities on anticipated emissions for preparedness.	Entire dam area	Contractor	Throughout project period	10 Million
Water Pollution	✓Ensure appropriate waste water discharge from construction site and worker's camps. ✓Remove logs and plants before operation.	Entire dam area and including the pipeline	Contractor	Throughout project period	10 Million
	✓Initiate water quality monitoring on the basic ambient water quality parameters in the reservoir to meet the applicable parameters of water quality standards (for domestic water/irrigation water) of NEMA	Dam area	TAWWDA (examination of some parameters to be subcontracted to a NEMA accredited laboratory)	Twice a year at minimum, rain and dry seasons	2 million
	✓Enhance guided application of agrochemicals such as Integrated Pest Management (IPM) in the neighboring farms by providing training and seminars for farmers	Area around the Dam	TAWWDA	Once a year	1 million
Waste	✓Contractor will be required to provide an adequate waste management mechanism to construction sites and	Entire dam area and	Contractor	Throughout project period	5 Million

2d	Mitigation Measures	Target Area	Responsibility	Frequency	Budget KES
	worker's camps, ✓Categorize wastes into inert materials and others for safe disposal. Inert materials (concrete residuals& earth) may be used on local access roads, ✓Other waste materials to be disposed off into the approved disposal site.	including the pipeline			
	✓Apply the silt from the sand trap dam at the eroded sections of the dam downstream, and ✓Encourage appropriate and guided use of the silt by the farmers in reconditioning their farms.	Dam area	TAWWDA	Once a year	11 Million
Noise and excessive vibration	✓Construction need to be limited during the daytime only, ✓Notification of the residents on unusual noise and vibration levels during construction, ✓Maintain vehicles and equipments well to avoid unnecessary noise and	Dam area	Contractor	Throughout construction phase	3 Million
	✓Compliance to the Environmental Management and Coordination Act (EMCA), Occupational Safety and Health Act Cap. 514, its Subsidiary Legislations and the Building by-laws of Kenya. ✓Ensure the contractor will comply with all legislation (such as NEMA's standards) for the noise and vibration emitted from construction works as well as at the quarry sites.	Entire dam area	Contractor and TAWWDA	Monthly during construction	2,750,000 for Noise and excessive vibration meters
Offensive Odour	✓Construction needs to be limited during the daytime only, ✓Construction machinery be maintained in good working conditions, ✓Ensure that the contractor appropriately manages waste water and waste in the construction site and camp sites	Dam area	Contractor	Throughout construction phase	1 Million
Bottom	✓Appropriate maintenance of the sand trap dam.	Dam area	TAWWDA	Once a year	12 Million

2d	Mitigation Measures	Target Area	Responsibility	Frequency	Budget KES
sediment					
Accidents	✓Establish the appropriate safety measures for the construction phase, ✓Isolate the construction sites from the general public, ✓Ensure safety of the construction workers.	Entire dam area and along the pipeline	Contractor	Throughout construction phase	10Million
	✓Establish the appropriate safety measures in the O & M manual for the operation phase ✓Ensure safety of the residents by providing safety signs in strategic points along the dam area and pipeline	Entire dam area and pipeline	TAWWDA	Throughout the operation phase	3 Million

8.18 DECOMMISSIONING

8.18.1 Introduction

Decommissioning takes place during the final phase of a project life-cycle, but a degree of environmental planning is necessary before any decommissioning activities should be allowed to commence. The reason for this is that a project earmarked for decommissioning has in all likelihood been operational for some time, and as such, the environment within which it lies has stabilised in response to the presence of the associated infrastructure, activities and facilities. The decommissioning of one or all components of such a project would therefore have an effect on the environmental status quo, either in a positive or in a negative way.

In this respect, this section contains broad brush environmental guidelines which will assist decision makers to take environmentally responsible and sustainable decisions in terms of which infrastructure to retain, which to develop further (and how to do this), and which to remove completely with regard to this project. In this way, the positive aspects of decommissioning may be maximized and the negative aspects minimized or even avoided.

8.18.2 Purpose and objectives of decommissioning

The generally accepted purpose of decommissioning is the release of valuable assets such as machinery and sites for alternative use, recycling and reuse of materials and the restoration of environmental amenity. In all cases, the basic objective is to achieve an end-point that is sensible in technical, social and financial terms, that properly protects workers, the public and the environment and, in summary, complies with the basic principles of sustainable development. Stringent regulatory controls protect the public, the environment and workers from the hazards associated with decommissioning activities.

8.18.3 General requirements ahead of decommissioning

Ahead of decommissioning , sustainable environmental planning may have an impact on fundamental project decisions, such as whether or not decommissioning is the best course of action, and if so, what actions are required and when. This may in turn have an impact on the project budget as well as project programming. It is important to note the following:

- ✓ Should a decommissioning plan entail a change in land use then the project should be subjected to the requirements of the Environmental Management and Conservation Act (EMCA) of 1999 and thus obliged to follow the Environmental Impact Assessment process.
- ✓ A plan for decommissioning may entail the further development of certain infrastructure, and structures to accommodate the alternative uses decided upon during decommissioning planning. In such situations, the exercise ceases to be one of decommissioning, rather becoming a planning exercise and as such will be subjected to EIA.
- ✓ Once a Decommissioning Master Plan has been finalised (detailing future utilisation of buildings, structures, infrastructure and open space, as well as removal of redundant infrastructure), the planning phase of a decommissioning project is complete. The implementation of the Decommissioning Master Plan

must then be approached as a Construction Contract.

In summary, the following should be determined ahead of the decommissioning process:

i. Infrastructure, buildings, structures and land uses to be retained
ii. (Alternative uses and further development proposals for retained infrastructure, buildings, structures and open space
iii. Infrastructure, buildings and structures to be dismantled, removed, sold for recycling and/ or disposed of.

8.18.4 Environmental Guidelines for Decommissioning Planning

a) Biophysical Environment

Compile a 'Harvesting of Natural Resources' policy where the project will entail large scale environmental change or where stakeholders will be affected by the project. Such a policy will address the proper preparation, harvesting, use and utilisation of:

- ✓ Flora (in term of medicinal plants and endangered species);
- ✓ Useable / saleable materials

b) Surface hydrology

- ✓ Retain surface water features of conservation value (e.g. Wetlands) within structural developments.
- ✓ Promote the productive use of water features and sources (e.g. for fish production, irrigation, recreation etc.).

c) Soil

- ✓ Promote good farming practices and avoid land uses that will greatly increase the erosion of susceptible soils.
- ✓ Retain fertile soils with a high agricultural potential for agricultural use.

d) Flora

- ✓ Retain and protect endangered plant species within natural open space or other suitable land uses. Retain and protect vegetation communities of particular conservation value (e.g. those exhibiting species variety, soil binding functions, aesthetic attraction etc.).
- ✓ Compile a 'Harvesting of Natural Resources' policy where the project will entail large scale loss of species.
- ✓ Promote the systematic eradication of invasive plant species infestations, especially close to streams.
- ✓ Minimise threats to vegetation communities or plant species (e.g. Through firewood collection, charcoal burning, overgrazing, vandalism etc.).

e) Fauna

- ✓ Promote the eradication or containment of animal species that threaten local ecosystems.
- ✓ Minimise threats to animal species or communities (e.g. through habitat loss or human intervention) and retain migration corridors.

f) Aesthetic environment

- ✓ New developments must integrate and blend with the surrounding landscape and land use.

g) Socio-economic environment

- ✓ Establish a Project Steering Committee (PSC), where Interested and Affected Parties (I&AP's) can present their inputs and where informed decision making may take place.
- ✓ Make use of existing social communication structures as basis for all community interaction initiatives.
- ✓ Ensure that all project related social issues are addressed. This may include the establishment of a Community Action Committee (CAC), a Labour Desk, Compensation Policies and an Equity Policy. Such issues must be planned well in advance.
- ✓ Allow for remuneration, transport and catering at meetings involving Stakeholders and Interested and Affected Parties.
- ✓ Make Strategic Development Plans available to stakeholders and I&AP's. Such plans aid in explaining and describing the extent of the project and all its components.

h) Social issues

- ✓ Propose measures to revitalize depressed areas, or for their adaptation to new circumstances.
- ✓ Take into account the population growth, rate of urbanisation, the future need for resources (such as land and water) and the future need for services when considering future land uses.
- ✓ Take note of the income of the community when considering future land uses.

i) Land use and services

- ✓ Take note of any existing regional plans, including Development Frameworks, Development. Plans and other planning Schemes that may be of relevance to the area under investigation.
- ✓ Attempt to integrate new and existing land uses.
- ✓ Protect high potential farmland (i.e. crops, orchards and vegetable gardens) against land uses, misuse or development that can damage or reduce their productivity.
- ✓ Formulate guidelines to reduce the impact of farming activities in unsuitable areas, such as phasing out of activities, installing erosion protection etc.

9 CONCLUSION AND RECOMENDATIONS

9.1 Conclusion

Based on the findings, it is evident that construction of the proposed dam will result in overall economic growth and development as a result of the improvement in the availability of water for both domestic and irrigation uses. The Environmental Impact Assessment (ESIA) Scoping for the proposed Mwania Dam indicates that, the potential positive impacts can be easily mitigated without any major effect to the environment. However, some important aspects need further interrogation on their impacts and these are not limited to:-

i. Land acquisition;
ii. Biodiversity of the dam area;
iii. Safety and Health aspects
iv. Material sources;
v. Catchment conservation;
vi. Target irrigation area;
vii. Dam safety; and
viii. Stakeholder consultation

9.2 Recommendations

The dam will be constructed in a river valley to ensure minimal destruction to the environment and at the same time this is a cost - effective approach as fewer resources; material/ financial and natural will be utilized. The destroyed vegetation and trees will be planted elsewhere through massive afforestation activities to protect the dam catchment. Most of materials will be sourced from within the neighbourhood thus empowering the local people economically. Many people are also likely to benefit from the project compared to those who will be affected negatively. The benefits will be reaped by many generations to come. We further recommend:-

i. Minimal vegetation destruction
ii. Rehabilitation of quarries and borrow pits
iii. Afforestation/reinstatement within dam area and any other Degraded Areas
iv. Ensure occupational safety and Health (OSH)
v. Undertake environmental monitoring and audits
vi. Record keeping
vii. Good housekeeping
viii. Continuous stakeholder participation
ix. Catchment protection

10 REFERENCES

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11 APPENDICES

11.1 Appendix I: Lead Firm 2021 License

FORM 7 (r.15(2))

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

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

License No : NEMA/EIA/ERPL/14167

Application Reference No: NEMA/EIA/EL/19264

M/S **CAS Consultants Limited**
(individual or firm) of address

P.O. Box 20023-00200, Nairobi

is licensed to practice in the

capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Firm of Experts**
registration number **006**

in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **2/18/2021** Expiry Date: **12/31/2021**

Signature ....

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified

Conditions For Licensing

1. This license expires on 31st December of the year it is issued.
2. The expert shall comply with code of practice and Professional Ethics for EIA/EA experts.
3. The expert shall comply with the attached conditions.

General Conditions

1. All Environment Experts certified and registered in the accordance with the provision of relevant Regulations, may establish professional associations to complement and implement the objectives of the Code of Practice.
2. An Expert shall act professionally, accurately, fairly and in an unbiased manner in undertaking his work.
3. The Director General, in consultation with relevant stakeholders, may from time to time issue guidelines for the proper conduct of registered Environmental Impact and Audit Experts.
4. Every Environmental Expert shall each year attend at least two relevant seminars organized by the authority for the purposes of improving the professional expertise of its members.
5. No Expert shall exploit the inexperience, lack of understanding, illiteracy or other lack of technical knowledge in environmental matters of a project proponent, owner or the public, for his personal gain.

Receiving Instructions

1. No Environmental Expert shall act for any project proponent unless he has received written instructions form such project proponent or his authorized agent.
2. An Environmental Expert shall not unreasonably delay the carrying out of instructions received from the project proponent of his authorized agent.
3. An Environmental Expert shall discharge his responsibilities to the project proponent with due diligence and integrity.
4. An Environment Expert may terminate a contract on carrying out an environmental impact assessment or audit as stipulated in section 8 of the Code of Practice and Professional Ethics of EIA/EA Experts.

Carrying out an EIA/EA

1. An Environmental Expert shall follow relevant regulations or guidelines and directives issued by the Authority.
2. As Environmental Expert shall take due care and diligence to collect the relevant data to address the significant environmental issues in the various stages of the assessment or audit process and fully acknowledge the source of any data that is not the result of his findings.
3. Environmental Expert shall consult widely with all the relevant agencies, stakeholders, interested parties and the general public on all the matters that likely to affect them.
4. An Environmental Impact Assessment or Audit Report shall be based on the Terms of Reference of the Assignment and shall include all the matters relevant to the findings of the study, all the relevant matters are required by statutory provisions, and must be guided by professional standards and judgments.

Responsibility of Lead Environmental Experts

1. (1) An Environmental Lead Expert shall be responsible for the documents prepared by him/her on behalf of the project proponent.
   (2) An Environmental Expert shall guide the proponent throughout the preparation of the environmental impact assessment and/or environmental audit, and/or during implementation of the Environmental Management Plan.
   (3) An Environmental Expert shall disclose to a client or employer any relationships of conflicting or competing interests that may influence his judgment prior to the carrying out of work.

Misconduct of Environmental Experts

1. An Environmental Expert who contrivances a provision of Code of Practice and Professional Ethics shall be deemed to have committed professional misconduct and shall be subject to disciplinary action by the Authority as appropriate and as stipulated in the Code of Practice and Professional Ethics of Environmental Experts.

Disciplinary Action

1. Where an Environmental Expert is found to have committed professional misconduct by the Environmental Experts' Advisory Committee/Authority shall be punished as stated under section 19 of the code of Practice and Professional Ethics.

Appeals

1. (1) An Expert aggrieved by the decision of the Authority may apply for the review of such decision in the High Court.
   (2) If an application for judicial review shall not have been fined at the expiry of 30 days from the date of the decision of the Authority, the director General may publicize the disciplinary action taken against the Expert.

FORM 7 (r.15(2))

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

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

License No : NEMA/EIA/ERPL/14139

Application Reference No: NEMA/EIA/EL/18492

M/S **Kenneth Kibet Koech**
(individual or firm) of address

P.O. Box 5028-30100, Eldoret

is licensed to practice in the

capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert**
registration number **1609**

in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **2/18/2021** Expiry Date: **12/31/2021**

Signature.....

(Seal)

Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified

Conditions For Licensing

1. This license expires on 31st December of the year it is issued.
2. The expert shall comply with code of practice and Professional Ethics for EIA/EA experts.
3. The expert shall comply with the attached conditions.

General Conditions

1. All Environment Experts certified and registered in the accordance with the provision of relevant Regulations, may establish professional associations to complement and implement the objectives of the Code of Practice.
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4. Every Environmental Expert shall each year attend at least two relevant seminars organized by the authority for the purposes of improving the professional expertise of its members.
5. No Expert shall exploit the inexperience, lack of understanding, illiteracy or other lack of technical knowledge in environmental matters of a project proponent, owner or the public, for his personal gain.

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1. No Environmental Expert shall act for any project proponent unless he has received written instructions form such project proponent or his authorized agent.
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1. An Environmental Expert shall follow relevant regulations or guidelines and directives issued by the Authority.
2. As Environmental Expert shall take due care and diligence to collect the relevant data to address the significant environmental issues in the various stages of the assessment or audit process and fully acknowledge the source of any data that is not the result of his findings.
3. Environmental Expert shall consult widely with all the relevant agencies, stakeholders, interested parties and the general public on all the matters that likely to affect them.
4. An Environmental Impact Assessment or Audit Report shall be based on the Terms of Reference of the Assignment and shall include all the matters relevant to the findings of the study, all the relevant matters are required by statutory provisions, and must be guided by professional standards and judgments.

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1. An Environmental Expert who contrivances a provision of Code of Practice and Professional Ethics shall be deemed to have committed professional misconduct and shall be subject to disciplinary action by the Authority as appropriate and as stipulated in the Code of Practice and Professional Ethics of Environmental Experts.

Disciplinary Action

1. Where an Environmental Expert is found to have committed professional misconduct by the Environmental Experts' Advisory Committee/Authority shall be punished as stated under section 19 of the code of Practice and Professional Ethics.

Appeals

1. (1) An Expert aggrieved by the decision of the Authority may apply for the review of such decision in the High Court.
   (2) If an application for judicial review shall not have been fined at the expiry of 30 days from the date of the decision of the Authority, the director General may publicize the disciplinary action taken against the Expert.

11.2 Appendix II: ESIA Terms of Reference

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

Mobile Lines: 0724-253 398, 0723-363 010, 0735-013 046
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NEMA/TOR/5/2/257

14th April 2021

ATHI WATER WORKS DEVELOPMENT AGENCY
RECEIVED
14 APR 2021
TEL: 2724292/3
P.O. Box 45285 - 00100 NAIROBI

The Chief Executive Officer
Athi Water Works Development Agency
Athi Water Plaza
Muthaiga North Road, off Kiambu Road
P O Box 45283-00100
NAIROBI

RE: ACKNOWLEDGEMENT AND APPROVAL OF TERMS OF REFERENCE (TOR) FOR ENVIROMENTAL IMPACT ASSESSMENT

We acknowledge the receipt of TOR for the above subject.

Pursuant to the Environmental Management and Coordination Act, 1999 the second schedule and the Environmental (Impact Assessment and Audit) Regulations 31 and 35, your terms of reference for the Environmental Impact Assessment (EIA) for the proposed **MWANIA/MWONGONI DAM WATER SUPPLY PROJECT IN MACHAKOS COUNTY** has been approved.

You shall submit ten (10) copies, a soft copy summarised version of the ESMP in **WORD** form and one electronic copy of your report prepared by a registered expert to the Authority.

JOSEPH MAKAU
FOR: HEAD EIA SECTION

11.3 Appendix III: Consultancy Terms of Reference

Section 7. Terms of Reference

1. Project Background and Location

Due to the growing population, the areas of Machakos town and parts of lower Athi, located to the north of Machakos county headquarters have been faced with persistent water consumption shortages. The growth of the towns and lack of water infrastructure development has led to the increased intensity of water shortage.

The area is faced with serious water shortfall in the near future, at which point the existing water sources which are already outstretched may be obsolete. Water vending has become a booming business as the precious commodity gets scarce by the day. This water shortage will continue increasing in respect to the rapid expansion of these towns and their populace.

Therefore, the basic goal of the dam Project is to supply clean drinking water demanded by the ever growing towns and to fill the water availability shortfall faced by these towns and their populace. Secondary goals are to provide irrigation water to enable small scale irrigated farming as the rains have proven unreliable over the past years.

2. Objective of the Present Consultancy Service

The key objective of the assignment is to develop Feasibility Studies and Detailed Studies for Mwania/Miwongoni dam Project. It should include project plan where it clarifies the timing, sequencing and coordination of studies in the implementation plan, and finalize the TOR for a Consultancy Services for Supervision of Civil Works.

Another objective of the assignment is to assist Athi Water Service Board and the stakeholders in adjusting the Environmental and Social Management Framework to specify sufficient safeguard policy measures for effective mechanisms to ensure its implementation.

3 Project Objectives

The principal use of water is water supply and to small extent irrigation purposes. The proposed project will also contribute to enhanced hygiene and sanitation as well as food security. This will also reduce the dependence on relief food as well as contribute towards alleviation of poverty within the area through production of both subsistence and cash crops. At present, irrigation within the project area is mainly rain-fed and hence very unreliable because of the erratic nature of rainfall. Consequently, the dam after its implementation will harness runoff waters and thereafter make them available for irrigation for purposes of achieving food security and poverty reduction.

4. Scope of the Assignment

The primary task of the consultant/s is to support the activities of the Athi Water Services Board and other stakeholders in the preparation of Detailed Studies for the Mwania/Miwongoni Dam and Water Supply Project. It is assumed that the Consultancy Team will provide professional guidance with high quality services within a timeframe of 12 months.

The scope is to build from any available desk materials, field data and carry out preliminary studies set out in this document. The consultant/s will be accountable for ensuring that the Designs are in

line with international standards and the Ministry of Water and Irrigation design manual among other accepted reference manuals for water projects.

The consultant is also required to identify any other alternatives, if any, and assess the alternatives in terms of geotechnical condition, technical possibilities, generation efficiency, preliminary environmental impacts and other related costs. Propose the best site for the dam based on the assessment. Consider alternative dam sites and whether there will likely be more dams in the future upstream or downstream. Consider possible stepwise development, if applicable.

The consultant/s shall recommend the types of further studies and assessments needed based on current internationally accepted practices applied when preparing similar projects.

The consultant/s will be expected to undertake following tasks in order to prepare the detailed Design Study of Mwania/Miwongoni Dam and Water Supply Project:

1. Carry out preparatory studies including geotechnical, hydrological, and topological
2. Perform analysis of alternatives
3. Additional preparatory studies for the chosen site
4. Develop a preliminary design of the dam and water supply
5. Conduct preliminary economic and financial study
6. Develop studies for:

    (i) Detailed Economics and Financial Study; and
    (ii) Technical Detailed Design and interrelating those parts in one process; and

7. Finalize the TOR for consultancy services in Design Review and Supervision of Works in consultation with the AWSB, and Stakeholders, including holding public consultations/hearings.

    The detailed scope of works shall include the following;

    (i) Detailed Feasibility Study and Conceptual Design,

    (ii) Preliminary Design

    (iii) Social and Environmental Impacts Assessment and Resettlement Action Plan for the selected dam site

    (iv) Detailed Design Reports and preparation of tender documents

5. Study Execution

The study will be conveniently split up into two main stages / phases as follows:

Stage I: Feasibility Study and Preliminary Design Report

Stage II: Detailed Final Designs and tender documentation

6. Key Tasks/Activities

The key tasks/activities under this consultancy include the following:

A. Feasibility Study and Preliminary Design.

(i) Obtain from the relevant government offices data on population and irrigation water demand and project the water demand under scenarios and time horizon agree with the Client.

(ii) Collect hydrological data and conduct water balance analysis under different flow conditions (use at least 20 years of data) to determine necessary water storage capacity of the reservoir. Due consideration should be given to the ability of the reservoir to sustain the water demand during dry period of about six (6) months. In case existing hydrological data is insufficient for the purpose of this analysis, develop hydrological model to reproduce past river flow data using rainfall data. Water balance analysis should take into consideration the evaporation from the open surface and seepage losses through the embankment.

(iii) In determining storage capacity, consult with the Client to agree on acceptable return period of drought events, and propose a dam operation procedure for drought periods when dam will not be able to supply full demand.

(iv) Using results of climate model and projections, assess likely impacts of climate change on water resources and propose practical adaptation measures to ensure sustainability of the infrastructure.

(v) Compute sediment loading and loss of storage capacity and provide estimates of dead storage.

(vi) Explore the possible sites with a view to identifying the most suitable site which will ensure storage capacity and in-flow defined above.

(vii) Carry out preliminary assessment of the suitability of the site with regard to various types of dams, topography and geology, availability of construction materials and possible location of the spillway.

(viii) Using the topographic maps of the area, delineate the catchment area of the proposed dam with regard to the selected axis of the dam.

(ix) Digitize the existing Topographic Survey maps of the area.

(x) Based on the above, determine the height of the dam, the crest length and the volume of the fill material.

(xi) Determine the reservoir characteristics of the proposed dam and the useful and dead storages respectively.

(xii) Establish the economic suitability of the dam.

(xiii) Collect, compile, analyze and process data for the design of the dam. The data shall include meteorological data such as rainfall and its intensity and duration.

(xiv) On the basis of the above, estimate the flood runoff in the orders of Q_5, Q_{25}, Q_{50} Q_{100} Q_{500} Q_{1000}

(xv) Obtain from the relevant government offices data on population and livestock and project the same to the ultimate year 2032 taking 2012 as the base year.

(xvi) With the population and livestock projections for the three stages of development, establish the water demand using the parameters recommended either locally in the Design Manual or by the World Health

(xvii) Carry our preliminary design of the water treatment plant capable of treating the water demand for the ultimate stage. Under this activity, the consultant will also design the intake tower and the water transmission mains and the storage tanks.

(xviii) Using the topographic maps, estimate the area to be acquired for the development of the project. In this connection, further explore the willingness of the communities to surrender their parcels of land for the development of the project.

(xix) Approach the Land Registrar and the District Agricultural Officer to find out the possible values of land and crops in readiness for compensation and establish the amount of compensation required.
(xx) Establish possible borrow areas.
(xxi) Establish the tentative cost of the project.

B. Detailed Design

Under the preliminary design phase, the Consultant will embark on the preliminary design of dams. The studies that go along with this activity are as follows:

(i) Carry out topographic survey work to produce maps with suitable scales e.g. 1:20,000 for horizontal scale and 1:200 for vertical scales for plans and profiles as recommended in the design manual. The survey work should be extended to cover an area for the spillway if need be.
(ii) Develop flow duration and/or water balance curves and compute the required dam capacity/volume.
(iii) Fine-tune the hydrological analysis of the area to facilitate the design of the permanent spillway.
(iv) Compute sediment loading and loss of storage capacity and provide estimates of dead storage.
(v) Carry out geological investigations to determine the geological subsurface conditions at the selected dam site/site and the soil overburden and configuration of the rock systems to be encountered at the dam site and the reservoir area.
(vi) Conduct in-situ permeability and other soil and rock investigations to locate suitable borrow areas for use during the construction of the dam.
(vii) Conduct geological, seismological and geotechnical surveys for detailed design level studies for selected sites.
(viii) Carry out geotechnical investigations around the dam, the reservoir area and along the proposed spillway axis.
(ix) Conduct seismic or any other suitable geo-physical traverse of the dam site in order to estimate the vertical profiles, field tests such as penetration and vane sheer tests for soils, seepage test, as well as laboratory testing of soils and rocks.
(x) Detailed economic and financial analysis of the project.
(xi) Preparation of detailed technical design report.

With the available information, the Consultant will prepare and submit a technical design of the dam and associated works.

C. Environmental and Social Impact Assessment

After selecting the dam site, the Consultant shall further carry out an Environmental Impact Assessment study of the project in accordance with the Environmental Impact and Audit Regulations 2003, and submit the EIA Report to NEMA for approval.

The Consultant shall carry out a survey to collect, collate and present information on the baseline characteristics of the existing environment within and around the project area.

This shall involve but not limited to:

1. Physical environment (topography, geology, climate, meteorological, air quality, hydrology, drainage, soil erosion, wetlands, and water quality.
2. Biological environment (flora and fauna types and their diversity endangered species, sensitive habitats etc).
3. Socio-cultural environment including present and projected where appropriate i.e.
    i. Population,
    ii. Land use,
    iii. Planned development activities,
    iv. Community structures,
    v. Employment
    vi. Labor market,
    vii. Sources and distribution of income,
    viii. Historical and cultural heritage,
    ix. Communication network and
    x. Community Health issues
4. Land Compensation. The Consultant shall carry out preliminary estimate of the acreage of private land that will be acquired for the construction of the dam as well as the area to be submerged by the reservoir after its impoundment.
5. Prepare Environmental and Social Management Plan that describes the mitigation measures along with costing, scheduling and responsible entities, as well as monitoring and evaluation procedure.
6. Prepare a Resettlement Plan for the communities to be affected.

7. Literature review

The following materials are relevant to the study:

- National Water Master Plans Study Report 1992 and 2002
- Sessional Paper No. 1 of 1999 on the National Policy on Water Resources Management and Development.
- Water Act 2016
- Water Sector Reforms Documents
- National Water Resources Management Strategy
- National Water Services Strategy
- Ministry of Water and Irrigation Design Manual
- Poverty Reduction documents-the Economic Recovery Strategy (ERS)
- Environmental Management and Coordination Act
- Any other relevant reports

The consultant shall review all the previous reports available and not only rely on the reports named above.

8. Time Schedule

The consultancy period is 12 months from the date of commencement.

9. Reporting and deliverables

The deliverables during the initial stages will be the

- Inception Report,
- Feasibility Study and Conceptual Design Report.
- Preliminary Design Report
- Detailed Design Report
- ESIA and RAP reports

The Client will make comments on the draft which will then be finalized through the inclusion of the comments.

The study phases are broken as shown below:

Phase I (4.0 months)

The relevant reports will be presented as hereunder:

- Inception Report (1.0 months, 4 hard copies and a soft copy)
- Feasibility Study and Conceptual design Report (3.0 months, 4 hard copies and a soft copy)

After the submission of the Feasibility Study Report, 1 no. community sensitization workshop will be held and feedback reported to the client.

Phase II (4.0 months): Full Preliminary Design, ESIA and RAP reports

- Phase II Draft Preliminary and Detailed Report complete with Technical Drawings (3.0 months, 4 hard copies and a soft copy)
- Stakeholder Workshop comprising of technical personnel for comments (1.0 month)

Phase III (4 months): Detailed Design and Tender Documentation

- Final design Reports after receipt of comments from Client (4 hard copies and 1 soft copy)

10. Key Staff and Expertise Required

In response to this TOR, the Consultant should propose a team of professionals whose skills and experience are able to carry out the described tasks. Knowledge of local economic conditions, social and cultural practices, will be essential to accomplish contract tasks.

It is envisaged that the successful completion of this assignment will heavily rely upon the establishment of a strong, focused team of specialists. The Consultant will demonstrate that the proposed project team comprises both a sound technical competence in the policy, organizational, and engineering fields.

11.4 Appendix IV: Work shop Report

ATHI WATER SERVICES BOARD

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

CONTRACT NO. AWSB/KTSWSSP/CS-09/2017

MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT

MINUTES OF FEASIBILITY FINDINGS REPORT PRESENTATION WORKSHOP MEETING HELD AT MACHAKOS UNIVERSITY HOTEL AND CONFERENCE ON 30TH APRIL 2019.

Minutes of Feasibility Findings Report Presentation Workshop meeting between AWSB, TANATHI Water Services Board, Machakos County Representatives, CAS Consultants Limited and other stakeholders held at Machakos University Hotel and Conference on 30th April 2019.

AGENDA

1. Adoption of Agenda[WU1]
2. Introductions
3. Remarks from the Client and Consultant
4. Presentations of the Feasibility Findings Report
5. Reactions to Presentations
6. Any Other Business.

ATTENDANCE

(See Attendance sheet attached)

Minute 1: ADOPTION OF AGENDA

Jane Nzei from TANATHI-WSB called the meeting to order at 1045 hours, welcomed the members and started with a word of prayer. The agenda for the day was presented. The agenda was agreed upon and adopted for the meeting.

Minute 2: INTRODUCTIONS

After the adoption of the agenda, Jane Nzei called for self-introduction of the members present.

Minute 3: REMARKS FROM THE CLIENT AND CONSULTANT

Remarks from the Client: Eng. Kyalo from TANATHI was called to introduce project background. Although the project area falls under Tanathi Water Services Board jurisdiction area, the implementing agency was Athi Water Services Board (AWSB) on behalf of the Government of Kenya. AWSB was to undertake the design for Miwongoni dam as originally planned for, but the water was found not enough to cater for the demand in the urban and rural Machakos areas. Mwania dam is not new. It was washed away earlier on as a small dam. Mwania dam was the new study where Financiers are the AfDB. AWSB is the project Client. The TAWSB are the Engineer for the project. CAS Consultants are the designers. Mwania dam was just a study for the future as they are currently doing the Miwongoni dam. He thanked the stakeholders for finding the opportunity to attend the meeting and requested the members to portray an active interaction and participation throughout the session.

Remarks from the Consultant: The consultant thanked the attendants for allocating time to contribute towards enriching the development of concepts and design of Mwania Dam project and assured a commitment to continued consultation of all stakeholders throughout the design process.

Minute 4: PRESENTATION BY THE CAS CONSULTANT LTD

CAS Consultants Ltd was then invited to make their presentations. George Kamau thanked Eng. Kyalo for giving CAS Consultants an opportunity to present the feasibility findings report. He begun by giving key highlights of the contract details: Consultancy Contract was signed on 19th June 2018 and commencement date, 3rd July 2018. He informed the meeting that there was some delay during the studies in deciding on the dam to be undertaken and other hydrological matters. But these were later sorted out and they are now back on track ever since. The delay was due to harmonization of CAS and SCET/LOSAI assignments which were different scopes of the assignments with both of their components including design of dam for water supply targeting the same area.

The scope of services to be provided by the Consultant include: -

- Carry out preparatory studies including geotechnical, hydrological and topographical investigations.
- Perform analysis of alternatives.
- Undertake additional preparatory studies for the chosen site.
- Develop a preliminary design of the dam and water supply infrastructure.
- Conduct preliminary economic and financial study.
- Develop final studies for:
  - ✓ Detailed Economics and Financial Study; and
  - ✓ Technical Detailed Design and interrelating those parts in one process; and
- Prepare TOR for consultancy services in Design Review and Supervision of Works in Consultation with AWSB, and Stakeholders, including holding public consultations/hearings.

DONE:

- Consultant has so far undertaken the following studies: -
  - Socioeconomic studies
  - Water demand projections
  - Project area mapping
  - Geological mapping
  - Hydrological analysis
  - Concept designs
  - Environmental screening
  - Financial and economic analysis

These studies informed the major presentation components for the findings:

i. Contract details, TOR for consultancy services and project progress components presented by George Kamau.
ii. Socio-economic Studies component presented by Kibet.
iii. Proposed Population projections and water demand estimation component by George Kamau.
iv. Dam sites Explorations component by George Kamau.
v. Hydrology component presented by Waititu.
vi. Tea Break
vii. Dam Design concept presentation component by George Kamau.
viii. Potable Water supply infrastructure and area coverage component by Eng. Lenny Kirimi.
ix. Preliminary Financial and Economic Analysis component by Joel.

Minute 5: STAKEHOLDER REACTIONS TO PRESENTATIONS

At the end of the Consultant presentation, the following comments / remarks were made during the plenary session by attendants as follows;

Jonathan Mutinda from Machakos County requested to know if the water project had these strict things to adhere to: Was it documented? Is the key information available online? Was Financial Studies done? Was public participation done and is there evidence documented for the same? We are concerned that we don't have anything indicating a stakeholders meeting was done. Was EIA was done and NEMA livcence issued?

Consultant Response:

Projects with Financiers as AfDB and World Bank are done in accordance to the World Bank stringent procedures and regulations. The details of the project will be availed in the next phase of detailed design. More information will be shared and disclosed. Stakeholders meetings, ESIA and NEMA License are slightly ahead of time and will be carried out during detailed designs. The activities shall be carried out in a very consultative processes involving all stakeholders. ESIA and RAP once approved by the Bank are made available to the public. So, these are ahead of us and we are fully aware of the requirements for health and safety.

Sebastian Kyalo:

1. We were invited and we are hearing about it for the first time and we wish to get the information. Do we have a site online where information on the project can be accessed? With the consultative governance where people want to know what is happening, we can't rule out this. We have not been fully informed about it. Ignorance is not an excuse.

Consultant Response:

TAWSB is the client and we submit project deliverables to them according to TORs. The dissemination of the same rests with the TAWSB. Consultant suggested other boards usually form committees with stakeholders to keep track and steer ahead the projects. It can be adopted along TAWSB.

2. Why is the Key shareholders not available? E.g. Why is the physical planning not represented and there is an issue of cemetery and dumpsite near the proposed dam location?

TANATHI - WSB Response:

Invitation was sent to the Physical Planning. They were needed to be in attendance. As some think Dam Site is near a cemetery / dumpsite, others feel it is on the other side so they were to come to answer such questions. Since that they were invited and did not attend, TANATHI shall undertake further consultations on the same.

Also, the consultative process was not limited to the meeting. They assured to visit other offices to help shape the ideas and designs of the concept. They noted they rely on engaging the stakeholders at their offices.

Priscilla WRMA

Asked a question on the management of the wastewater disposal generated from the Sewer treatment works a threat to possible pollution. What was considered to manage the wastewater?

Consultant Response:

This is one of the issues considered as we inject water into the town. Consultant was already aware of waste generation by the households. But for this case, there was an improvement of sewer coming in through Machakos Water and Sewerage Company (MaCHWASCO) even before the development of the dam so the potential of water pollution might be mitigated by this.

Peter Mutua; Assistant Chief

Peter Mutua noted that the dam location was within his area of jurisdiction and a KARI dam was swept away sometimes in the past. Was the study adequate in ensuring that it doesn't happen to the new dam? Is it concrete that the dam will not be swept away?

Consultant Response:

Any dam with height greater than 15m and storage capacity greater than 3MCM of water is a large dam and the international ICOLD regulations are to be applied. The proposed dam is classified as high-risk dam (class C) as per the classification criteria by the Water Resources Management Rules of 2006. Its spillway will be designed for a 1 in 10,000-year flood and checked for the probable maximum flood (PMF). The minimum net freeboard shall be 1.0 m. The consultant would also be doing a geotechnical study underneath the wall of the dam to inform on the design of the foundation.

WAY FORWARD:

Consultant stated that they are moving on to the preliminary geotechnical investigations for detailed design on the geotechnical permeability, to see what method of foundation treatment will be done on the rocks and cut out seepage under the foundation. Detailed topographical surveys including aerial surveying on the dam site. On-land topo surveys for the water supply pipelines shall be carried out. The dam shall be rockfill dam with clay core. Consultant shall establish rock resource for the clay core. Detailed designs will then be done. ESIA and RAP shall be undertaken with full consultation with all stakeholders.

Minute 6: AOB

CEC Comments: Requested, with all stakeholders to journey together to the end. Urged to make consultations with the various offices at the county level. Declared to engage technical people and leaders will on the ground for the effective adoption of the project in all phases. County has directorate of public participation which is very dedicated on projects. When they are not informed, they may not be of much use to the project. So, inform them. They have a nice database of the stakeholders so the client won't be wrong. For the meeting, CEC understood the underlying challenges to be engaged by the client. CEC promised to the client that in future, if we partner, CEC will be working for the client without their knowledge. The client doesn't need to come and do what CEC could have done for them earlier on. Also, CEC urged Client to involve the leaders of the areas or they won't be easy to convince in the later phases of the project.

Consultant Comments: Consultant noted the importance of the County Offices which is capable to engage everyone to work together.

Priscilla WRMA: Urged TANATHI to share information of the feasibility to the Water Resources Authority.

TANATHI-WSB: Inquired on who to contact on the event of Public participation.

CEC: It will depend on what you want to if it is a public participation. The Public participation are involved through Directorate of the County Administration to get technical staffs. It consists of 235 village administrators, 80 ward administrators, etc... It is so spread that if the client wants some area, by giving the directorate a notice, they will be able to call upon everyone especially on public participation. But for technical areas you will be set to go to the relevant departments. When the CEC got the invitation through the minister, he attended the meeting as a mere shareholder otherwise he would have tagged along the water person, the physical planning person himself, etc… From the Department of water, at least the water engineer should have been present. They should have sent one single letter to the county secretary indicating there will be a shareholders meeting for them to organize and get the relevant people to attend the meeting. The Governor also would have ensured that they attend the meeting.

Consultant Comments: Consultant requested the client to borrow from RVWSB client of a project in Baringo County. The Board approached the County and the County consequently appointed contact persons to work with the project since inception to the final stages. The consultant also expressed need to work together with all stakeholders.

JANE TAWSB: In Oloitoktok dam mobilisation recently, she was told not to bother with the county CEC so he looked for the MCA (CEC) in charge of water and it was more effective than the meeting they had.

CEC: She was advised to write through the county secretary as he/she would issue letters to the various departments to attend the meeting. Also, to remember to involve the MCAs of the areas concerned. Else they could counter the meetings with another one elsewhere.

VOTE OF THANKS:

The vote of thanks was given by the AWSB engineer Albert Ocharo.

He thanked the County director, WRMA, TAWSB, AWSB, local administrators, Guests and CAS Consultants for the good meeting. He specifically congratulated CAS for the Good presentation.

There being no other business, the meeting was adjourned at 1430 hours.

APPROVAL OF MINUTES

For the Client Athi Water Services Board

Name	Signature	Date
Chief Executive Officer, AWSB		

For CAS Consultants Ltd.

Name	Signature	Date
Dr. Eng. Sebastian Mwarania **Managing Director, CAS Consultants**		

CAS CONSULTANTS Ltd

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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA -MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA - CONTRACT NO. AWSB/KTSWSSP/CS-09/2017 – MACHAKOS UNIVERSITY HOTEL AND CONFERENCE, APRIL 2019; FEASIBILITY FINDINGS PRESENTATION WORKSHOP

ATTENDANCE SHEET

No	Name	Organization	Phone No. and Email address	Signature
13	ALBERT OCHARO	AWSB	0700549112 aochano@awsboard.go.ke	
14	YIENKA WAITHERA	AWSB	0704711293 Ykabura@awsboard.go.ke	
15	GIDEON MUTUA	RED CROSS	0724870140 machakos@redcross.or.ke	
16	PRISCILLAH MWITHI	WRA	0719698591 prisillahm@gmail.com	
17	Simon Kimanzi	Machakos	0722466872 kenkich gmail.com	
18	PETE N. MUTUA	ASS-CHIEF	0715101187 Pmgmutua...	
19	DAVID MWANGO	TAWSB	0723043458	
20	JAMES K. WAITITU	CAS	0722338891/ j.waititu@gmail.com	
21	GEORGE MUHUGU	CAS	Muhugug@yahoo.com 0722324900	
22	GEOFFREY IKOBE	CAS.	0722379518- ikobegc@gmail.com	
23	Joel Mains	CAS	0721630460: Joel.mains@afriplc.com	
24	Lenny Kirimi	CAS	0722265385 lennykirimi@yahoo.com	

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ATTENDANCE SHEET

No	Name	Organization	Phone No. and Email address	Signature
1	AUGUSTINE KYALO MUTISO	COUNTY GOVT OF MKS	0722737479. kyalo7e@gmail.com	
2.	MICHAEL M. KIKUVI	COUNTY GOVT OF MKS	0725257360 kikuvimichael6123@gmail	
3.	BRIAN M. MUTUKU	COUNTY GOVT OF MKS	0728469778 brmochukwu@gmail.com	
4	BEN M. KILONZO	COUNTY GOVT OF MKS	0727174179 benkilonzo Private@gmail.com	
5.	BENSON MWONGELA MUANGE	COUNTY GOVT OF MKS	0717561330 kyulumuange@gmail.com	
6.	KIPROTICH NGENO	NEMA - MACHAKOS	0718683395 jkiprotich@nema.go.ke	
7.	DENNIS N. KIBUA	COUNTY GOVT OF MKS	0725285671 dkibua@gmail.com	
8.	JONATHAN M. MAKAU	COUNTY GOVT OF MKS	0727-635878 mutindajonathan.mk@gmail.com	
9	Jane Sein	TANATH WATER SERVICES BOARD	0721791297 janesein@gmail.com	
10	GIDEON KAVOO	TANATHI	0721793743 kavoogideon@gmail.com	
11.	COLLINS KIPRONO	AWSB	0717734328 ckiprono@awsboard.go.ke	
12.	JIMMY WAMBUA	COUNTY GOVT.	0729809018 jimmywambua@gmail.com	

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ATTENDANCE SHEET

No	Name	Organization	Phone No. and Email address	Signature
25	Hon. Timothy W. Kilonzo	Machakos County	0717579837	
26	OSCAR KIPTUM	CAS-Kibet	0715570959	
27	Simon KARIUKI	AWSB	0721993403	
28.	Evans Wambua	CAS	0708172687	
29	Kibet Koech	CAS	0722829697	

11.5 Appendix V: Baraza Minutes and Attendance Lists

CAS CONSULTANTS Ltd

CONSULTING ENGINEERS AND ENVIRONMENTALISTS

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P.O. Box 20023- 00200, Nairobi, Tel: +254 020 4445265 Fax:+254 020 4440049
e-mail casconsult@africaonline.co.ke

Nairobi **March, 2020**

To

_____

_____

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, DETAILED DESIGN AND PREPARATION OF TENDER DOCUMENTS FOR MWANIA DAM WATER SUPPLY PROJECT

INVITATION TO A PUBLIC BARAZA

Above caption refers.

CAS Consultants Ltd has been awarded consultancy for the above captioned services by **Athi Water Works Development Agency**. As part of the contracted services, AWWDA and CAS Consultants Ltd in the spirit of participatory approach to projects invites you for public consultative meetings for the proposed water supply project for selected 8 wards of Mutituni,Mumbuni North, Machakos Centrall, Muvuti, Kalama, Kola, Mua and Kinanie. The Meetings are as scheduled below.

Venue	Date	Time
Chiefs Camp Kiima Kimwe Location	March 6, 2020	10:00Hrs
Mikuyu Market	March 6, 2020	14:00Hrs
Kyumbi Market	March 5, 2020	10:000Hrs
Township Chiefs Office	March 5, 2020	14:00Hrs

We look forward to your active participation, and should you have any clarifications/ questions please contact the undersigned on 254-020-2721696.

Yours faithfully,

Kibet Koech
CAS CONSULTANTS LTD

CAS CONSULTANTS Ltd

CONSULTING ENGINEERS AND ENVIRONMENTALISTS

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P.O. Box 20023- 00200, Nairobi, Tel: +254 020 4445265 Fax:+254 020 4440049
e-mail casconsult@africaonline.co.ke

Nairobi **March, 2020**

To
_____TANATHI WATER WORKS DEVELOPMENT AGENCY

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, DETAILED DESIGN AND PREPARATION OF TENDER DOCUMENTS FOR MWANIA DAM WATER SUPPLY PROJECT

INVITATION TO A PUBLIC BARAZA

Above caption refers.
CAS Consultants Ltd has been awarded consultancy for the above captioned services by **Athi Water Works Development Agency (Client) and TANATHI Water Works Development Agency (Engineer)**. As part of the contracted services, AWWDA and CAS Consultants Ltd in the spirit of participatory approach to projects invites you for public consultative meetings for the proposed water supply project for selected 8 wards of Mutituni,Mumbuni North, Machakos Centrall, Muvuti, Kalama, Kola, Mua and Kinanie. The Meetings are as scheduled below.

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Yours faithfully,

Kibet Koech
CAS CONSULTANTS LTD

CAS CONSULTANTS Ltd

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e-mail casconsult@africaonline.co.ke

Nairobi **March, 2020**

To
_____MACHAKOS WATER & SANITATION COMPANY

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, DETAILED DESIGN AND PREPARATION OF TENDER DOCUMENTS FOR MWANIA DAM WATER SUPPLY PROJECT

INVITATION TO A PUBLIC BARAZA

Above caption refers.
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We look forward to your active participation, and should you have any clarifications/ questions please contact the undersigned on 254-020-2721696.

Yours faithfully,

Kibet Koech
CAS CONSULTANTS LTD

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, DETAILED DESIGN AND PREPARATION OF TENDER DOCUMENTS FOR MWANIA DAM WATER SUPPLY PROJECT

Project: Mwania Dam Water Supply Project

Meeting Date: 6th March, 2020

Meeting Time: 11.20 am

Location: Katoloni chiefs post, Machakos County

Meeting called by: CAS Consultants

Meeting Purpose: Environmental Social Impact Assessment

In Attendance

1. See attached list
2. Senior Assistant Chief, 2 Asst. chiefs
3. Deputy ward admin
4. MCA Representative
5. Village admins
6. CHV Members
7. CAS Consultants

Agenda:

- Preliminaries
- Briefing on the Project Design and Progress
- Plenary Discussion
- A.O.B
- Conclusion

Important Discussion Points

Min1/2019 Preliminaries

- The meeting kicked off with a word of prayer from a local resident.
- The area chief welcomed those in attendance to the meeting.
- He then invited CAS consultants to introduce themselves and also inform the participants of the theme of the meeting.

Min 2/2019 Briefing on the Project Design and Progress

CAS Consultants lead expert Mr. Kibet Koech begun by introducing the project to the public. He also informed them that its purpose is to provide water to the residents of Machakos. He handed the people maps of the project area and continued to illustrate on the plan where the dams and the storage tanks will be put up. He added that the dam will supply water to 9 wards among them being Mumbuni, Mutituni, Kalama etc.

He informed them that the meeting was to allow the public get information and also comment on the planned project. He told the residents that the project will ensure they have access to clean water on a daily basis since the tanks will hold huge volumes of water e.g. Kiima Kimwe tank will hold 3 million litres, Kitanga 500 thousands litres etc. He added that once the project is complete, water distribution will be under Machakos Water company and residents will apply for connection to their homes.

Regarding the land where the dams and tanks will be, he informed them that some of the land is owned by the County, KARI and some from local residents. On any land that was to be acquired he told them that they will receive compensation according to market value. He added that all pipes will be laid along the existing road reserve. Some of the materials to be used in the project will be sourced from land owned by the residents hence he asked them to ensure that the agreements with the contractor should clearly indicate amounts to be paid and rehabilitation plans to ensure no open pits are left. He told them that during construction the contractor will follow guidelines on times of work, extent of noise and vibrations, containing dust and disposal of waste.

Mr. Kibet informed them that during the project, jobs will be created and he encouraged them to apply for such jobs on unskilled and semi skilled jobs. He cautioned them that since the project will involve a lot of money, which would tempt people to engage in social ills, drug abuse instead they should use it for economic growth. He however asked the parents and the local leaders to ensure no children will be working in the project.

He concluded by informing them that the ESIA report will provide mitigation measures to impacts on the environment and residents can access the report once it was approved by NEMA so that they familiarize with the project and on environment conservation.

Min 3/2020 Plenary Discussion

The following are some of the issues raised and recommendations given as outlined in the table below:

No.	Issues	Responses
1.	The Asst. chief was concerned on the purity of water since the dam will be located near the sewerage and a cemetery, saying that water from	He was informed that the water draining from these areas won't find its way into the dam and also the water will go through purification before it is pumped into the tanks for storage. The public was

	these areas will get in the dam and it may cause them diseases.	also informed that there will be a wastewater treatment plant and they should not worry that waste water will mix with the pure water. Mr. Kibet also said that discussions with the County will advised on whether to relocate the cemetery in the physical development plans.
2.	One residents noticed that the location of Kiima Kimwe tank should be positioned at a higher point and suggested Iluvia primary school which is located on a hill to ensure that water flows to all residents.	This was noted and it will be considered in the design after deliberations
3.	Another resident wanted to know how soon the project will begin	The construction will take a period of close to 3-4 years
4.	A member asked what will happen to the group of people at Kiima Kimwe who were given 240 acres by the County on where the dam will be located and they have allotment letters	They were informed that just few land portions will be affected and they have so far been identified and process is underway to communicate with them on acquisition.
5.	A resident asked if the water will be offered free to the residents and if not he asked that they get the water on flat rates	He was informed that the water company will use metres for each connection due to variations in water use per home. The money collected will also help in purification, maintenance and operation of the water supply.

A.O.B

Mr. Kibet also added that the aim is to harvest flood flow and the dams will have spill ways to ensure residents downstream also get water.

The chief said that they were happy that residents have been allowed to participate in the project. She informed the Consultants that currently, most people in the area are suffering to access water and most have been advised to harvest rain water. She added that the residents get free water from a borehole but they have to incur transportation costs to their homes and for this she is positive that the residents are eager and ready to have water connected to their homes.

Conclusion

The meeting was closed with a word of prayer at 12.30 pm

Signed by: PROJECT LEAD CONSULTANT	**Confirmed by AREA CHIEF**
Name:	**Name:**
CAS Consultants	**Location:**
Sign	**Sign**
Date	**Date**

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, DETAILED DESIGN AND PREPARATION OF TENDER DOCUMENTS FOR MWANIA DAM WATER SUPPLY PROJECT

Project: Mwania Dam Water Supply Project

Meeting Date: 6th March, 2020

Meeting Time: 2.05 pm

Location: Mikuyu Sub-location, Machakos County

Meeting called by: CAS Consultants

Meeting Purpose: Environmental Social Impact Assessment

In Attendance

1. See attached list
2. Senior Assistant Chief, 2 Asst. chiefs
3. Deputy ward admin
4. MCA Representative
5. Village admins
6. CAS Consultants

Agenda:

- Preliminaries
- Briefing on the Project Design and Progress
- Plenary Discussion
- A.O.B
- Conclusion

Important Discussion Points

Min1/2019 Preliminaries

- The meeting started at 2.05 pm with a word of prayer
- The chief mentioned the people present in the meeting among them being village admins, retired teachers, WRUA member and local residents. He asked CAS Consultants to introduce themselves and inform people of the agenda of the meeting.

Min 2/2019 Briefing on the Project Design and Progress

Mr. Kibet issued out project maps and continued to explain in details the areas where the dam and storage tanks will be located targeting 9 wards in Machakos. The dam will collect excess water from rivers and it will also have a spill way to ensure people downstream also get water. He also informed them of the capacities of each storage tanks which will be capable of ensuring the town has access to water on a daily basis. He informed them that the land for dam and tank location will be sourced from County, KARI, and local people.

Compensation will be offered for any land acquired from locals a process which will include valuation of the land and any property on it. He added that all pipeline work will be laid along existing road reserve and asked anyone with property on the road reserve will be required to vacate and distribution of water to their homes will be done by the water company upon application and payment of a fee.

He mentioned that eventually the access road to Mikuyu will be rerouted but will remain as it is during construction. This will be done in a way that it will not affect access and transportation by local residents.

The meeting was informed that there will be such impacts as noise, vibrations dust and production of waste, and that the contractor will have guidelines and mitigations to ensure that these do not affect the environment negatively. Mr. Kibet outlined some benefits of the project including access to clean water, economic growth and creation of jobs. He added that construction activities will create jobs to the locals especially on unskilled labour, urging them to be active in seeking information about these jobs from the contractor. They were informed also that some lands will be identified as sources of materials and that they should ensure to have written agreement on payment amounts and means of rehabilitation.

Mr. Kibet however cautioned them that there will be influx of new people working in the project and they should be careful not to engage in interactions that may cause erosion of morals. They were asked to also ensure child protection by ensuring no child labor in the project. He told them that the contractor will educate people on HIV/AIDs during construction.

Min 3/2020 Plenary Discussion

The following are some of the issues raised and recommendations given as outlined in the table below:

No.	Issues	Responses
1.	Mr. Kioko wanted to know when the road to their access road will be rerouted	He was informed it will remain same during construction, but will later be rerouted to a suitable location or make use of the dam crest

2.	One madam asked whether WRUAS will be involved in the project	Mr. Kibet informed her they will be involved for consultations and also during issuance of dam permits.
3.	A resident asked if the water from the dam can also be used for irrigation as there are people already practicing horticulture along the river banks	He was told that the water will be for domestic use, however they can apply for pumping permits from the rivers.
4.	Mr. dominic asked when the project will begin as people are suffering due to inadequate water.	He was informed that the project is currently at the design stage, then Tanathi Water will later tender for contractors and the construction period will take 3-4 years.
5.	A youth representative was concerned on how they can access the jobs during construction	He was informed that most unskilled labour positions will be available to the locals and once the contractor is on site they can apply then. They were also advised to appoint a community liason person to get information on the employment opportunities.
6.	One resident was concerned about being relocated and hence he wanted to know if there will be any relocation as he has received people on his land conducting markings. He further said that there were people telling them that they will have to relocate.	Mr.Kibet informed him that there will be land acquisition but there are no expected relocations. He told them that the land to be acquired currently has no people living there. He cautioned them on being duped by opportunists but rather only get information from the Consultants, County or the Water company
7.	Mr. Kaloki wanted to know if after the dam construction they can continue farming on the remaining portion since it will be near water	He was advised that after the completion the dam and the acquired land may be fenced off for safety purposes.
8.	One madam asked if after completion individuals can pump water directly from the dam	She was informed that pumping will be the mandate of the water company and this is to ensure that the water will not be contaminated by anyone as it is for domestic use. They will only access

		water after applying for connection to their houses.
9	Mr. Daniel Kioko said that there is a rumour that there will be introduction of animals into the dam e.g. crocodiles and hippopotamus	Mr. Kibet informed the meeting that this was a government project and there are no plans to introduce any animals in the dam and the ai is to supply clean water to residents. He however asked if the rivers to supply the dam had such animals and the residents said there were none.
10.	A resident also pointed that where the location of the tank is put on the map, it is not an ideal position and that it should placed higher to ensure flow of water to everyone. He added that it would be unfortunate if they missed to get the water since the river supplying the dam is located in their area. He also asked if the storage tank can be moved near to Mikuyu.	He was informed that the issue had been noted and it will be addressed in the design. The design will also consider the possibility of having a dedicated line to Mikuyu. Residents were assured that the location of the tank will depend on the number it can serve and hence it will not be ideal to move it to Mikuyu since hence that will mean pumping it back to other areas which will eventually be costly.
11.	Mr. John pointed that they fear that the cemetery and sewerage are too near the dam and it would cause contamination of water and later diseases	He was informed that presently the flood water from these areas do not drain into the dam are, but the design will also look at possibility of relocating these services to ensure good water quality and no possible sources of contamination are near.
12.	One resident said that there has been people telling residents that murram to be used in construction has already been identified in their lands so he wanted to know when will that happen.	Mr.Kibet informed the meeting that only samples have been taken for testing of suitability and once that has been proved residents will be informed whether their land will be used as borrow areas. He added that process of material extraction had not yet began.
13.	A woman wanted to know if there will be any other benefit projects to be brought to the area during construction	She was informed that benefits will be many among them access to jobs, upgrading access road and if funds will

		be available some local facilities may be upgraded.

A.O.B

The chief asked residents to cooperate with project consultants on accessing credible information regarding the design of the project. He cautioned them against being duped by people on matters of acquisition, relocation and sourcing construction materials. He also asked the Consultants to update the locals on process of the project regularly. The chief also put in a request that the access road be upgraded ahead of works.

Conclusion

The meeting was closed with a word of prayer at 4.30 pm.

Signed by: PROJECT LEAD CONSULTANT	**Confirmed by AREA CHIEF**
Name:	**Name:**
CAS Consultants	**Location:**
Sign	**Sign**
Date	**Date**

20/09/18

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

STAKEHOLDER CONSULTATION FORM AMI MEETING

No.	Name	Organisation	Title	Contact	sign	Date
1.	Kubet Kweeh	CAS	Environmentalist	0722829697		20/09/18
2.	George Muhuyu	CAS	Coordinator	0723244900		
3.	Noah Wadia	KALRO-AMRI	Institute Director	0722623661		20/09/18
4.	Michael Kivondo	KALRO-AMRI	SHRA -	0726588697		20/9/18
5.	Nasirembe Wanjala	KALRO	Engineer	0733812953		20/9/18
6.	Naboth Olonde	KALRO	Livestock Manager	0727903490		20/09/18
7.	Christine Mbae G	CAS	Environmentalist	0713232959		20/9/2018
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

STAKEHOLDER CONSULTATION FORM

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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

STAKEHOLDER CONSULTATION FORM

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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: ITHAENI LOCATION FGD

No.	Name	~~Task~~ Phone Number.	sign	Date
1.	Justina M. Kalaki	0725167195 500		3-10-2018
2.	Charles M. Mutua	0711717976 500		3/10/2018
3.	LOISE KILONZO	0710541542 500		3/10/2018
4.	Esther K. Musembi	0742799754 500		3/10/2018
5.	RICHARD MAIVE MUTUA	0710724994 500		3/10/2018
6.	JOHN M. MUNDE	0703640874 500		3/10/2018
7.	Bernard Mutie Kafoni	0719221158 500		3/11/2018
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Mumbuni Location FGD

No.	Name	Task	sign	Date
1.	AGNES WAMBUI KITUNGAI	0721553944		21/10/2018
2.	JOSEPH NZUKI MITUKU	0720711870		2/10/018
3.	DANSON MUTUME KILONZO	0713113882		2/10/2018
4.	BARNABAS MWANZIA NGATI	0723382649		2/10/2018
5.	JOSEPHINE MUNYAO	0720272141		11
6.	JOSEPHINE MUTINDA MWEWA	0712601985		21/10/2018
7.	Jane mutinda wambua	0713713431		21/10/2018
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Township Location FGD.

No.	Name	Task	sign	Date
1.	SHEIKH ANAS ALI ABDALLAH	0723555755		2/10/2018
2.	ABDI JUMA ABDI	0721603245		2/10/2018
3.	Simon Kayela	0717459009		2/10/2018
4.	Daniel Kaleve (Rev)	0722482793		2/10/2018
5.	Scholer M WAMBUA	0728285034		2/10/2018
6.	Sarah Naumo	0707744666		2/10/2018
7.	EDITH MUENI KITOLO	0712595090		2/10/2018
8.	FAUZIA MUKAI	0713067122		2/10/2018
9.	Gibson Mwakideu	0722363876		2/10/18
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: ITHAENI LOCATION FGD

No.	Name	~~Task~~ Phone Number.	sign	Date
1.	Justina M. Kalaki	0725167195 500		3-10-2018
2.	Charles M. Mutua	0711717976 500		3/10/2018
3.	LOISE KILONZO	0710541542 500		3/10/2018
4.	Esther K. Musembi	0742799754 500		3/10/2018
5.	RICHARD MAIVE MUTUA	0710724994 500		3/10/2018
6.	JOHN M. MUNDE	0703640874 500		3/10/2018
7.	Bernard Mutie Kafoni	0719221158 500		3/11/2018
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Mumbuni Location FGD

No.	Name	Task	sign	Date
1.	AGNES WAMBUI KITUNGAI	0721553944		21/10/2018
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4.	BARNABAS MWANZIA NGATI	0723382649		2/10/2018
5.	JOSEPHINE MUNYAO	0720272141		11
6.	JOSEPHINE MUTINDA MWEWA	0712601985		21/10/2018
7.	Jane mutinda wambua	0713713431		21/10/2018
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Township Location FGD.

No.	Name	Task	sign	Date
1.	SHEIKH ANAS ALI ABDALLAH	0723555755		2/10/2018
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3.	Simon Kayela	0717459009		2/10/2018
4.	Daniel Kaleve (Rev)	0722482793		2/10/2018
5.	Scholer M WAMBUA	0728285034		2/10/2018
6.	Sarah Naumo	0707744666		2/10/2018
7.	EDITH MUENI KITOLO	0712595090		2/10/2018
8.	FAUZIA MUKAI	0713067122		2/10/2018
9.	Gibson Mwakideu	0722363876		2/10/18
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: KATHEKA-KAI FGD

No.	Name	Task	sign	Date
1.	Judith M Mumo	0711611574	Just	1/10/2018
2.	PETER N. MUTUA	0715101187		1/10/2018
3.	Patrick M. MBAI	0721585384		1/10/2018.
4.	HELLEN NJAMBI	0711328833		1/10/2018
5.	JONAH KISIO KYOTHO	0701 784939		1/10/2018
6.	Janet Muli	0726946539	Janet	1/10/2018
7.	Serah Mwangi	0727264297	Serah	1/10/2018
8.	Caroline Mutuku	0743505755		1/10/2018
9.	RACHEAL MUMBI	0707269775	Racheal	1/10/2018
10.	Peter Ikioo	0713 267 511		1/10/2018
11.	EMMACULATE S. MUTUKU	0719440135		1/10/2018
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: FGD KYANGALLIA

No.	Name	Task	sign	Date
1.	JOYCE KITHEKA	0726427011		1/10/2018
2.	JONES MUTETI	0725246419		1/10/2018
3.	AGNES KIMONDIU	0728669531		1/10/2018
4.	DAVID N. MULI	0716202990		1/10/2018
5.	PENINAH M. MAKAU	0712295958		1/10/2018
6.	SABINA N. MUKALA	0720605514		1st Oct 2018.
7.	John Wambua	0725299115		1/10/2018
8.	Josphat K. Kioko	0721573201		1/10/2018
9.	BENSON M. KIVAYA	0720022845		1/10/2018
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Machakos

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th Oct

Baraza

Form: Attendance List

Task: ~~Mark~~ Kalumoni

No.	Name	Task	sign	Date
1.	Hon. Caleb M. Mule (MCA	MCA (Muvuti Kima Ward)		18/10/2018
2.	Sw. chief - Benjamin M. Ngomoli	Muvuti Location		18/10/2018
3.	ASSISTANT chief ELIZABETH K. MWANGANGI	Muvuti Sub-Location		
4.	James M. Musyimi (Snr Ass chief)	Kyaneluni sub-Loc.		
5.	PETRONILLA NZIOKA (SNR WARD ADMINISTRATOR	Muvuti/Kima Kimwe Ward.		
6.	MARTIN MBITHI - Dp. WARD ADMIN - MUVUTI WARD	Muvuti/Kima Kimwe Ward.		
7.	ARON MUTUKU - KATUMO - VILLAGE ADM.	Muvuti/Kima Kimwe Ward.		
8.	Keziah Adhiambo - ED	Athi water S. Board		
9.	Christine Mbae	CAS Consultants		
10.	TONNY RAO	TANATHI WSB		
11.	GIDEON KAVOO	TANATHI W.S.B		
12.	Josephat M sila P.A. Hon. Caleb			
13.	Daniel M. Ndiso - Manager Kalumoni Polytechnic			
14.	Catherine nduku mutiso.	Kima kimeu		
15.	Kavindu Mutua	Muvuti	Kavindu	
16.	CATHERINE MUASYA	Muvuti		

Machakos

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th oct

Kalumoni Baraza

Form: Attendance List

Task: .....

No.	Name	Task	sign	Date
1.	SELESTINE MWENDE			18/10/2018.
2.	DAMARIS MWANIA			11
3.	PENINA MUTINDA			11
4.	ANNATH MANWEU			18-10-018
5.	DAMARIS MUENDO			18-10-108
6.	JOSEPHINE SYOMEU		syomeu.	11
7.	SYONBII NDONTE.		Syondie	11
8.	KATULI NZIOKA		Katuli	11
9.	WAVINYA YOANA		Wavinya	11
10.	ROSELIA M. MUTUNGA		Roselia	11
11.	MICHAEL MANGELI		Michael	11
12.	NDUKU MUTISO		Nduku	11
13.	Hannah Munde		Munde	18/10-208
14.	Zakayo Mr. Mutua		Mutua	11
15.	Munde Anthony Munde			
16.	Mary Kasalu			11

Machakos

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th Oct

Kalumoni Baraza

Form: Attendance List

Task: .....

No.	Name	Task	sign	Date
1.	Judy Musungu			
2.	Wayua Kilonzo		W.K	
3.	ANN MUSYOKA.			
4.	SUSAN MUIMOI			
5.	Carol Mutinda			
6.	Nthenya Nzioka			
7.	Jesinah M. Mutinda			
8.	Mwangeli Mutua			
9.	Wayua Mutuku			
10.	Mueni Musyoka			
11.	Fine Kimatu			
12.	Scholastica Mutua (Jimmy)			
13.	Ndeku Kimuyu			
14.	Wayua Kyalo			
15.	Wayua Mbilu			
16.	Kavuu Musau			

18th Oct

Machakos

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Kalumoni Baraza

Form: Attendance List

Task: ....

No.	Name	Task	sign	Date
1.	RICHARD MUNUVE	Chairman (Athi Dam)	[signature]	18/10/2018
2.	PETER KIMEU NGILA	VICE CHAIR (KAMYUNU DAM)	[signature]	11
3.	IBRAHIM OTWERE	G.CC MACEDONIA CHURCH	[signature]	18/10/2018
4.	Pst Milka W. Mutisya	Gcc Kalumoni	[signature]	18/010/2018
5.	ANTHONY M. MUSAU	Market Chairman	[signature]	18/010/018
6.	CELESTINE M. KASYOKA	M.CA'S OFFICE	[signature]	18/10/018
7.	PETER M. MUTAVI	Market secretary	[signature]	18/10/2018
8.	Alfred Mwei Muange	Community policing	[signature]	18/10/2018
9.	Dalas Musau	RDS	[signature]	18/10/218
10.	Francisca Muange	Village Manager	[signature]	18/10/2018
11.	D.K. Nzioka	Village manager	[signature]	18-10-2018
12.	John W. Ngumbi	Member	[signature]	18.10.2018
13.	Michael Mutia Ngila.	Member.	[signature]	18-10-2018
14.	Mbwaei Ngila	Member	[signature]	18.10.2018.
15.	Edward M. Nzioka	member	[signature]	18/10/18
16.	Peter Ndembuki	member	[signature]	18/10/18
17.	Munguti Mulwa	Member	J mulwa	18/10/18
18	Mary Kyalo	Member	[signature]	18/10/18
19.	JONES MACKENZIE MUMO	MEMBER	[signature]	18/10/2018.

Machakos

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th oct

Kalumoni Baraza

Form: Attendance List

Task: .....

No.	Name	Task	sign	Date
1.	Julius Nzoki Musi			18/10/018
2.	Duncan K. Ngaiki			11
3.	Nicholas M Nyaumoi			11
4.	Martin W Mwia			11
5.	Joel M. Kiviasa			11
6.	George Ndambuki			
7.	Kennedy M Kyalo			11
8.	Kelvin Kituva			11
9.	Antony Kiambua			11
10.	Mwendwa Michael			11
11.	Mutua Ndambuki			11
12.	Nzioka Wambua			11
13.	Mutisya Ngwilu			11
14.	Mwau Ngulu			11
15.	James Musyoka			11
16.	Mungai Muthani			
17.	Mwendwa Mutua			11
18	Margaret Musyoka			11

18th Oct

Machakos.

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Baraza

Form: Attendance List

Task: Kathekakai

No.	Name	Task	sign	Date
1.	Veronica Peter		Mutato	18-10-2018
2.	Mary Ngovu		Mary.	18-10-2018
3.	Stella Wambua		[illegible]	18/10/2018
4.	Teresia Ndeti		Teresia	
5.	Margaret Ikyengo		MK	
6.	Naomy Wally			
7.	Veronica Kilonzo		[illegible]	
8.	Chrysostus Mwange		[illegible]	
9.	Susan Kimuyu		[illegible]	18/10/2018
10.	Lista Mutisya			
11.	Annah S. Titi			
12.	Patricia Kaveto		[illegible]	
13.	Janet Kyalo			
14.	Stella Mutuku			
15.	Catherine Mwanzia			
16.	Daniel Masiko			

Machakos.

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th Oct

Baraza

Form: Attendance List

Task: Kathekakai

No.	Name	Task	sign	Date
1.	Amos Kioko		[signature]	18/10/2018
2.	Rebecca Wambua		[signature]	
3.	Florence M Mbuli		[signature]	
4.	Benson Mutevu		[signature]	18/10/2018
5.	Benjamin Ndonge		[signature]	18/10/18
6.	K Ndunge Muia		[signature]	
7.	Salome Nzioka		[signature]	
8.	Damaries Mutinda		[signature]	18/10/18
9.	Caterine Reu		[signature]	18/10/18
10.	Emmaculat Mutuku		[signature]	18/10/18
11.	GRACE KAHOMBI		[signature]	18/10/20
12.	GEORGINA Ndonde		[signature]	18/10/20
13.	MARY PIUS		[signature]	18/10/20
14.	Judith Mumo		[signature]	
15.	Agnes Ndeleu		[signature]	
16.	Josphine Ndilangu		[signature]	

Ikuchakas

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th Oct

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Form: Attendance List

Task: Kathekakai

No.	Name	Task	sign	Date
1.	Zuperah Kamuri			15/10/2015
2.	Catherine Makanzi			
3.	Hilda Mutisо			
4.	Caroline Mukau			
5.	patricia Mwende			
6.	Catherine Mumanya			
7.	Lucy Keli			
8.	Agnes Nduku		Agnes	
9.	Salome Daniel		SD	
10.	Teresia Mwikya		TES	
11.	Mary Kavenyi		M.K	
12.	Ndinda Kilyi			
13.	Eunice Nzasi			
14.	CAROLINE MUTUKU			
15.	Rosa NDUKU			
16.	Mary David		Mary	

18th Oct

Machakos

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Baraza

Form: Attendance List

Task: Kathekakai

No.	Name	Task	sign	Date
1.	Rodol Mwangao		[signature]	18/10/2018
2.	Benard Kimanthi		[signature]	18/10/2018
3.	Denis Kaio		[signature]	-
4.	mary Kioko		[signature]	18/10/2018
5.	Kamini nyamwu		[signature]	
6.	Angela Kalua		[signature]	18/10/2018
7.	Kasini Kyulo		[signature]	"
8.	Michael Kavith		[signature]	"
9.	Justus Kilu		[signature]	"
10.	Domitilla Kanini		[signature]	"
11.	Regina Wambua		Regina	"
12.	Kilele Muthei		[signature]	"
13.	Mwikali Mutua		[signature]	
14.	Afrina Pius		[signature]	
15.	Alice Nzuki		[signature]	
16.	Dorcell Mutile		[signature]	

Machakos.

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th Oct

Form: Attendance List Baraza

Task: .....

No.	Name	Task	sign	Date
1.	Phillis Musyoka			18/10/2018
2.	Promena Kisuu			18/10/2018
3.	[illegible]			
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Machakos.

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

18th Oct.

Baraza

Form: Attendance List

Task: Kathekakai

No.	Name	Task	sign	Date
1.	Daniel Muli Nzioki		[signature]	18/10/2018
2.	Veronica Mutindo		[signature]	" " "
3.	Maiso Mutuo		[signature]	
4.	Victorie Muthini		[signature]	
5.	Ndunge Musau		Ndunge	
6.	Evelyn Mwanwangangi		[signature]	18/10/2018
7.	Florence mbai		florence	"
8.	Elizabeth Mbindyo		Mbindyo	
9.	Alice Kyalo		[signature]	
10.	Rosemary Kimondi		Kimondi	
11.	Ann Ndila		[signature]	
12.	Christine Mbaluo Mutuo		[signature]	
13.	Mbatha Peter		[signature]	
14.	Jane Ndambuki		[signature]	
15.	Agnes Muinga		Wanyga	
16.	Kakwi Mutisyo		[signature]	

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

23/10

Form: Attendance List

Task: Kuma Kumwe

No.	Name	Task	sign	Date
1.	MUIA MAKAU			
2.	NZAU KYULE			
3.	JACKSON Mutua	Driver		23/10/18
4.	Jonathan Wambua	~~farmer~~		23/10/2018
5.	Wanjiku Mutuku			
6.	David Kituku			
7.	GIDEON KAVOO	TANATHI WSB		23/10/18
8.	Makusi Kituli			23/10/18
9.	Joseph Musyoki			23/10/18
10.	~~Asst~~ Dominic - K. NGUE	~~Asst~~ - Chief - Mwaya		23/10/2018
11.	Dominic - M. Ndwo	~~Asst~~ - Chief - Katolani		23/10/2018
12.	~~Anna~~ Mutave Francis	~~Asst~~ - Chief - Kiima Kimwe Loc.		23/10/2018
13.	~~Anthony~~ M. Mongo	~~Asst~~ - Chief Mbumbuni		23/10/18
14.	~~Alice~~ - N. MUSA	Chief - Kiima - Kimwe Loc -		23/10/2018
15.	ROSE JOTHI	TANATHI WSB	None	23/10/2018
16.				

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

23/10

Form: Attendance List

Task: Kiima kimwe

No.	Name	Task	sign	Date
1.	Mwaini Mwoki			
2.	Joyce Mulwa			
3.	Anna Mueni Mutisya			
4.	Kithei Muloki			
5.	Salome Katunge Musyoki			
6.	Nduku Kithome.			
7.	David Makau.			
8.	HELLEN MULWA			
9.	ROSE MULWA			
10.	Mwina LUKA			
11.	LUISI SOSI			
12.	JANGI STEPHEN			
13.	Veronica Musila			
14.	mumo musembi			
15.	Rose Thomasi			
16.	JOSEPH NDETU			

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

23/10

Form: Attendance List

Task: Kilima kimwe

No.	Name	Task	sign	Date
1.	BENEDETTA MUTISO.			
2.	JANE WILLY			
3.	JANE MUAMBA			
4.	TELESIA MUTUA			
5.	BETH JOHN			
6.	JANE Peter			
7.	Josphine KIOKO			
8.	Winfred mwikali Mawen			
9.	Marrieta KISILU			
10.	Joshphat Ngina Muthoka			
11.	John M. KIVINDA			
12.	MUTHAMA MBITHI			
13.	NDONYE NZAU			
14.	PAUL MBITHI	FARMER		23.10.2012
15.	ANTONY MUSYIMI KYULE			
16.	Stephen Musila Makau			

19th Oct

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Kyangala Baraza.

No.	Name	Task	sign	Date
1.	Eunice MBAIHA Kyalo	MITHU		19/10/2018
2.	Felisters Ndeto	KINOI		19/10/2018
3.	GIBSON NZUVO	KINOI		19/10/2018
4.	PIUS KITHOKOI	KINOI		19/10/2018
5.	CATHERINE M MAWEU	KINGANGUNI		19/10/2018
6.	ESTHER M SIMON	KANYONGO	Easter	19/10/2018
7.	COSMUS WA-MUTUNGA	Center		19/10/2018
8.	NELLIUS M MUTUNGA	IVUTINI		19/10/2018
9.	JOSPHINE W MUTAVA	IVUTINI		19/10/2018
10.	Mary Ndeti	KANYONGO		19/10/2018
11.				
12.				
13.				
14.				
15.				
16.				

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

19th Oct

Form: Attendance List

Task: Kyangala Baraza

No.	Name	Task	sign	Date
1.	VERONICA K. Nikilo		[signature]	19/10/2018
2.	Agnes Kimondiu	Member		19-10/2018
3.	Jane Kitheka	"	JMK	19-10-2018
4.	Monicah Mangiu	"		19-10-2018
5.	Mary Mutiso	"		19-10-2018
6.	Queen Mutemwa	"		19-10-2018
7.	Bendetar Musyoka	"		19-10-2018
8.	Damaris Musyoki	"		19-10-2018
9.	Agelinah Malcato	"		19-10-2018
10.	Esther Mbaluka	"		19-10-2018
11.	Rose Muange	"		19-10-208
12.	Emma Kyalo	"		19-10-2018
13.	Lucy Mutisya	"		19-10-2018
14.	Christina Kithika			
15.	KITHEKA Muindi			
16.	Peter Mutuku	"		

17) Steve Munyoki

18) Dawson Joseph -

19 Nathan Kimondiu

"

19-10-2018

19th oct.

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Kyangala Baraza

No.	Name	Task	sign	Date
1.	JONATHAN KIOKO KYANGA	ASSISTANT CHIEF-KINYOI	[signature]	19/10/2018
2.	David M. Kango	Co-ordinator Cairo Kyangala WaterBT	[signature]	19/10/2018
3.	Sammy J. Ntalua	Kyuluni C. Botte	[signature]	19/10/2018
4.	Benedict M. Kiilu	Kyuluni C. b/hole	[signature]	19/10/2018
5.	Peter W. Kiili	Senda	[signature]	19/10/2018
6.	Morris M. Mwalili	Kakayuni	Mwalili	19/10/2018
7.	Joseph M. Musau	Kakayuni	[signature]	19/10/2018
8.	Joel M. Mwalili	"	[signature]	"
9.	JONES M. MUTETI	Kyangala	[signature]	19.10.2018
10.	DANIEL M. MUTIE	Kyangala	[signature]	19.10.2018
11.	JOEL M. MUTISO	Kakayuni	[signature]	19.10.2018
12.	Peter M. Ndoka	Kyangala	[signature]	19.10.2018
13.	Phillip Martha	Kyangala resident	Phillip	19/10/2018
14.	Muthini Ndunda	— "	[signature]	19/10/2018
15.	Ruth W. Mutungi	KINOI	RW.	19.10.2018
16.	Hudson Musyoki Kekela.	Kyangala	[signature]	19/10/2018

19th oct.

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Kyangala Baraza

No.	Name	Task	sign	Date
1.	Timothy M. Musinda	Asst. Chief		19/10/2018
2.	Jackson M. Mwathi	Member		19/11/2018
3.	phyllis N Mbai	Member	phyllis	19.10 2018
4.	Carol M Silo	Member		19.10.2018
5.	Christina Kimote	Member		19.10.2018
6.	Charles Musyimi	Member		19/10/2018
7.	Paul Mariithi	11		19/10/2018
8.	Boniface M Kasivu	member		19/10/2018
9.	Katua Muthusi	11		19/10/298
10.	Margret Kitheme	Member		19/10/2018
11.	JOYCE KITHEKA	11		19/10/2018
12.	JACINTA MUSYOKI	11		19/10/18
13.	ROSE KITHEGNZO	11		19/10/2018
14.	IRENE MUTHINGA	11		19/10/2018
15.	IRENE KIOKO	member		19/10/2018
16.	JANE ORES	member		19/10/2018

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

19th oct.

Form: Attendance List

Task: Kyangala Baraza

No.	Name	Task	sign	Date
1.	BENSON M. KIUAFA	CHIEF		19th October 2018
2.	DAVID N. MULI	V. chairman KADEG		19/10/018
3.	FLORENCE N. MUVVYAO	member	Florence	19/10/2018
4.	Joyce M. Mbaluka	member	Joyce	19/10/2018
5.	Joyce mbai	Area manager		19/10/2018
6.	Catherine mutinda	member		19/10/2018
7.	JACKLINE MAIKO	member		19/10/2018
8.	Ngina Kamiti	Member		19/10/2018
9.	JAMES MWANZA	Area manager		19.10.2018
10.	EUNICE KILONZO	Member		19-10-2018
11.	Jane Phillph	Member		19-10-2018
12.	Regina Muleti	Member		19-10-2018
13.	Joyce mutie	Member	Joice	19-10-2018
14.	Lucy N. DAVID	MEMBER	Lucy	19-10-2018
15.	MARY - M. MULLY	MEMBER	MARY	19-10-2018
16.	Mulei Mutua	Member	Mbuia	19-10-2018

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Hhaeni / Vyulya 22/10/18

No.	Name	Task	sign	Date
1.	Peter Mbithi		[signature]	22/10/018
2.	Daniel Mutuso		[signature]	〃
3.	John M Nzioka	Kyangii	[signature]	22/10/2018
4.	Gregory Nzaya	Kyangii	[signature]	.
5.	John M. Mumole	Kyangii	[signature]	22/10/2018
6.	Timothy Sore	Kyumbe	[signature]	22/10/2018
7.	J Adziozi Musieke	UAMANI	[signature]	22/10/2018
8.	Pius Ntiwima	Kikondi	[signature]	22/10-2018
9.	Josehp Mbathi	Kituluni	[signature]	22-10-2018
10.	Joseph K. Muli	Milaani	[signature]	22.10.2018
11.	Joseph M Maingi	Kuwea	[signature]	22/10/2018
12.	John Kioko Musilu	Kituluni	[signature]	22-10-2018
13.	DANFRED M'NZAU	Matiotoy	[signature]	22/10/2018
14.	Agnes M. Mutisya	Kivwea	[signature]	22/10/2018
15.	Sharon Ndinda	Muaani	[signature]	22/10/2019
16.	Patricia NZIOKA	Hhaeni	[signature]	22/10/2018

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Ithaeni / Vyulya 22/10/18

No.	Name	Task	sign	Date
1.	JACKLINE N. MUTISO	KIIULUNI	[signature]	22.10.2018
2.	Lucy mbulo	Kikombi	[signature]	22/10/2018
3.	RUTH MBITHE	KIKOMBI	Ruth	22/10/2018
4.	RUTH MUNYIVA	KIKOMBI	[signature]	22/10/2018
5.	Rose Mbaike K.	Kikombi	[signature]	22/10/2018
6.	BENSON M. MULI	Kyangii	[signature]	22/10/2018
7.	Colleta muli	Ithaeni	[signature]	22/10/2018
8.	Philip M. Mbasi	Kyangii	[signature]	22/10/2018
9.	mutisya mutua mbelenzu	Kalian.	[signature]	22/10/2018
10.	Manana M Mbithe	Kyangii	Manana	22/10/2018
11.	Jones W Kaloki	Ithaeni	[signature]	22/10/2018
12.	Peter N. Muthundu	Ukuni	[signature]	22/10/2018
13.	William M. Kalongo	Water officer - Kathuensd	[signature]	22/10/2018
14.	GIDEON KAVOO	TANATHI W.S.B	[signature]	22/10/18
15.	ROSE [illegible]	TANATHI WSB	Rose	22/10/18
16.	TONNY RAO	TANATHI WSB	[signature]	22/10/18

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Ithaeni / Vyulya 22/10/18

No.	Name	Task	sign	Date
1.	TITUS M. VUVA	CHIEF	[signature]	22/10/2018
2.	JUDITH. M. MWAITU	ASS. CHIEF	[signature]	22/10/2018
3.	JOSPHINE N. KIILU	V/Elder	[signature]	22/10/2018
4.	Benard M Mbiku	~~Farmer~~ Villager	[signature]	"
5.	ELIZABETH N. MUTHINI	"	[signature]	"
6.	LILIAN M. NTHENGE	"	[signature]	"
7.	TIMOTHY M. MUTISO	V/Elder	[signature]	"
8.	John Mutua Mulwa	Villager	[signature]	"
9.	Nzenge Wambua	Mathunthini	[signature]	"
10.	Janet MBali	Mwaeni	[signature]	"
11.	STEPHEN KIOKO	Ithaeni	[signature]	"
12.	MBITHI MULWA	Ithaeni	[signature]	
13.	Wambua Muthuku	Farmer	[signature]	
14.	Peter Mutiso	Ithaeni	[signature]	"
15.	Peninah Mwenga	Nzoka	[signature]	"
16.	Nicodemus Musyoka	Ithaeni	[signature]	"

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Ithaeni / Yyulya 22/10/18

No.	Name	Task	sign	Date
1.	NICHOLAS MR. NGANDI	YYULYA (AG. CHIEF)		22/10/2018
2.				
3.				
4.				
5.				
6.				
7.				
8.				
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Form: Attendance List

Task: Training Attendance list

No.	Name	Task / mobile No	sign	Date
1.	Samia Sydney	0725414657		21/09/2018
2.	Diana Nana	0724540395	Diana	21/09/2018
3.	Ann Mueni	0715623850		21/09/2018
4.	JULIE KITTAH	0726301685		21/09/2018
5.	Charles Mutunga Musau	0728920562		21/9/2018
6.	GEORGE MUEMA	0720706811		21/9/2018
7.	Livingstone Mukosi	0711164653		21/9/2018
8.	Urbanus Kioko	0707316920		21/09/2018
9.	KIYCCHIT KITUKU	0748648098		21/09/2018.
10.	Robin Malonza	0704955027		21/09/2018
11.	Beryl Ongoge Getrude	0753673506/0703424028		21/09/2018
12.	CATHERINE MWENDE	0710195502		21/09/2018
13.	Sarah mwende Naomo	0707741666		21/09/2018
14.				
15.				
16.				

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue:	*Date: ..../...../2020*	*CAS CONSULTANTS LIMITED*	
Name	Location	Contacts	Sign
PATRICK MUSYOKA	KIIMA KIMWE	0710432157	
JOYCE MULWA	KIIMA KIMWE	0703 813419.	
MARGRET NZI DAVID	KITTA KIMWE	0700580797	
JOSEPH M KAMUWA	KIIMA KIMWE	0724916512	
Norman Kabuga	Mutituni/Kithankiwe	0720318136	
JOSEPH NDEO	KIIMA KIMWE	0714348478	
Josphine Mutheka	Kiima Kimwe	0725920738	
Mwikali Muoki	Kiima Kimwe	0712540664	
Kaluki Musyoka	Mwithini Kiimakwe	0722981965	
Salome Musyoki	Kiima Kimwe	0719333424	
Jacinta Mutheka	Kiima Kimwe	0700610185	
Eunice Mutuku	K/Kimwe	0715775069	
Nduku Mbuvi	K/Kimwe	0704512400	
Marrieta Kisilu	K/Kimwe	0718014736	
JANET W. KIVUKU	KIIMA/KIMWE	0702067650	
Muthle Musau	Kiima /Kimwe	0725632556	
Florence Mbula	Kiima/Kimwe	0701119775	
Juliana Kamene	Kiima/Kimwe	0718186700	
Maria Ngina	Mbilini	0710855207	
Maria J. Mule	Katolom/Kiima/Kimwe	0718367824	
Annastacia M. David	Mbilini/K. Kimwe	0723003500	
MILDRED A. SITATI	MUTHINI/K. KIMWE	0713245259	
Chiefs Name			
Location and Signature			

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue:	***Date: …./…../2020***	***CAS CONSULTANTS LIMITED***	
Name	Location	Contacts	Sign
JULIUS KINGOO	KIMA KIMWE	0718498546	[signature]
Samuel Musembi	Kiima Kimwe	0717365332	musembi
Peter N. Kilungu	Kiima Kimwe	0716807021	[signature]
Mutete Philip	Kiima Kimwe		Mutete
JOSEPH NZEW	Kiima Kimwe	0714384878	[signature]
Joyce N. Sami	Kiima Kimwe	0729304482	J. Ndinge.
MARY MUTISYA	Kiima Kimwe		
KATUKU NZIOKA	Kiima Kimwe		
NZIOKA Ndambuki	Kiima Kimwe	0716936621	Nzioka
Chiefs Name			
Location and Signature			

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue: T/ship Chiefs office	***Date*** 05/03/2020	***CAS CONSULTANTS LIMITED***	
Name Grace Ndiuki	Location	Contacts	Sign
Peter Muli		0725180811	[signature]
Edward M. Kathuku	Township	0714092692	[signature]
Augustine K. Ndiwa	Township	0725686714	[signature]
Grace Ndiuki		0723791946	[signature]
Kamso Vui	Mitumbani	0725-895866	[signature]
Ndiku Kimeu	Jeep Mjini	0726907604	[signature]
ABDUL MOHD MAKAU	MJINI	0724662729	[signature]
PETER KIMEU	Village Elder - Mji	0719417482	[signature]
KILONZO MUTUI	Village elder MKS	0723[illegible]680	[signature]
PETER M. MUSYIMI	KUTHANI	0723949823	MUSYOKI
KIPIPI	MUTHINI		
KABABU RAMATHAN	MJINI	0702943584	[signature]
IRENE MUKULU	KIARIOBAGI	0728840997	
Mutinda	Kitu[illegible]	0740274[illegible]	
HIVNAH Ndunde	SOLOH	0715307	[signature]
Regina Mbeke	Salem	0725207[illegible]	[signature]
PATRICK KIOKO	Kathale	0721957631	[signature]
Jamila Swaley	MTINI	0712012903	JM

Chiefs Name: Joshua N. Kimeu

Location and Signature: [signature]

JOSHUA N. KIMEU
SNR. CHIEF
MASAKU TOWNSHIP LOCATION
P.O. Box 1253 - 90100 MACHAKOS

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue: T/ship Chiefs Office	*Date:* 5../03../2020	**CAS CONSULTANTS LIMITED**	
Name	Location	Contacts	Sign
1 Joshua N. Kimeu	SNR CHIEF MASAKU	0722816928	[signature]
2 MULI MUTISO	SNR ASST. CHIEF	0720013970	[signature]
3 Francisca W Kilu	Village elder	0729291407	Francisca
4 CHRISTINE K. MUTISYA	VILLAGE ELDER	0716706085	[signature]
5 MARY M MUTISYA	V/ELDER	0729011214	Mutisyo
6 SCHOLAR M WAMBUA	V/ELDER	0728285034	[signature]
7 Boniface M. Ndiwa	Township	0710478947	[signature]
8 Ronald M. KYULI	V/ELDER	0715271497	[signature]
9 FRANCIS N NZIOKA	Vikuzors	0719766326	[signature]
10 PHILIP MULASYA	V/ELDER	0797030635	[signature]
11 LUCIA MUMBUA JOAN	Serena	0715355739	[signature]
12 MONICAH MUTISYA	SOKONI	0708959766	[signature]
13 Marget WANZA	Sokoni	0722834030	
15 Ndundwa Muia	SOKONI	0720729148	[signature]
FAITH MUTHEU	SOKONI	0790949118	
MANLE	MUTHUKOI	0714007278	[signature]
NZOMO MUSYOKI	SOKONI	0720257790	[signature]
Anne Munyao	Sikusiuli	0715655837	Anne
JOSPAT MUTISYA V.ELDER	GERIZIM	0727166109	[signature]
ZAINAB MZEE KANUNA	V. Elder	0724698208	[signature]
Khadija Omar	SOKONI	33374026	
OMAR R. MUSA	MJINI	0321841	Omary
FAZIA MUKAI	MJINI	189789	[signature]
JAMILA MUSA	3BABERMBI	35617182	[signature]
HAMIS MOHAMED	MJINI	0798068510	[signature]
MUKUI NZIOKA	[illegible] 38	2493 4538	[signature]
ANNA Ndinde	SOKONI	0717153078	[signature]
MONALISE WAYUA	SOKONI	0791576321	[signature]
PEGGING MBEKE	Serena	0725207794	
Stephen MUTUA	Kiwanjani	0712385123	[signature]
NEWTON MUTEMI	Kiwanjani	0798668193	[signature]
CHRISTINE MUMBUA	SOKONI	0719779961	[signature]
Philip NGULI	Sokoni	0702419021	[signature]
John Muthoka	Sonja redemed	0711140098	[signature]
Eunice Mbatha Mulwa	Kariolangi	0710858844	[signature]
Lydia Ndunge Muindi	Serena	0729860641	[signature]

Chiefs Name JOSHUA KIMEU 0722 816 928 [signature]

Location and Signature MASAKU TOWNSHIP

JOSHUA N. KIMEU
SNR. CHIEF
MASAKU TOWNSHIP LOCATION
P.O. Box 1253 - 90100 MACHAKOS.

[signature]

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue:	*Date: 06/03/2020*	*CAS CONSULTANTS LIMITED*	
Name	Location	Contacts	Sign
REGINA M MUTHAMA	KATHEKA I	0721480220	
Angelina N. Mbau	Kathekai	0715 273153	
Marian Paul	Katolani	0710386935	
NICHOLAS KATUA MBITHI	KATHEKA KAI	0708637703	
EUCLID M. MBAI	KATHEKA KAI	0721585384	
Agnes Katumo	Kathekakai	0729784466	
ROSE MILE	Kathekakai		
MARY MUSAU	KATHEKA KAI	0721868228	
FRANCIS NDICHU	KATHEKA-KAI	0722-269973	
Kimedy Mutunga	Kathekakai	0705506149	
Jackson M. MUTUNGA	KATHEKA-KAI	0715125513	
JOHN NDIKYULE	KATHEKA-KAI	0724503946	
ALEX K. SILA	KATHEKA-KAI	0702482408	
Mutiga	Mikuyu	0703447440	
Michael Mwaki	Mikuyu	0717579807	
DAVID Ndithi	Mikuyu	0704 230318	
DAVID Ndeti	Mikuyu		
MICHAEL MAKAU	Mikuyu		
Stella Wambua	Mikuyu	0746323243	
JOSEPHINE KAVITA	MIKUYU	0711917930	
HELEN PETER.	Mikuyu		
THERESIA WAMBUA	MIKUYU	0748733246	
MUSEMBI MUIA	MIKUYU	0727355556	
ROSE Ngiuya	Mikuyu	0702760954	
[illegible]	Mikuyu	0736273886	
NICHOLAS MUTUNGA	MIKUYU	0792460570	
HENRY MUSAU	MIKUYU	0745075963	
NZOMO NZOKA	MIKUYU	0724941399	
NZOMO KAMUYA	MIKUYU	0721838296	
Joshua Mulinge	MIKUYU	0787908755	
JOSEPH MUIA	MIKUYU	0713062943	
MWIOVE MUIA	MIKUYU	0703536111	
Daniel Muia Nzioki	MIKUYU	0711501628	
Josephine Ndolo	MIKUYU	0796309929	
VICTORIA K MUTHINI	MIKUYU	0716376448	
JANE M NDAMBUKI	MIKUYU	0713188385	
Chiefs Name			
Location and Signature	Certified by		

PIUS K. KIOKO
CHIEF
KATHEKĀKAI LOCATION
P. O. Box 1-90100, MACHAKOS
Date: 6/2/2020 Sign:

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue:	***Date:*** 06/03/2020	***CAS CONSULTANTS LIMITED***	
Name	Location	Contacts	Sign
RAPHAEL M. MBUVI	MIKUNYU	0721287240	[signature]
	Certified by PIUS K. KIOKO CHIEF KATHEKAKAI LOCATION P. O. Box 1-90100, MACHAKOS Date: 6/3/2020 Sign: [signature]		
Chiefs Name			
Location and Signature			

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue:	***Date: 06/03/2020***	***CAS CONSULTANTS LIMITED***	
Name	Location	Contacts	Sign
1. Muema Mwangangi	Kathaka Kai	0772312500	[signature]
2. Pete Mutinda	Kathaka Kai		[signature]
3. John Mwanzia	Kathaka Kai	0729726797	[signature]
4. Jonah Kisa	Kathaka-Kai	0708749939	[signature]
5 Windsor Bahati	Vota	0704491661	[signature]
6 Grace Muthengi	Vota	0791573856	[signature]
7 Albanus Mutua Katumo	Kathoka-Kai	0712667202	[signature]
8 Daniel Kioko Mbithi	Kathoka-Ka	0706320844	[signature]
9 Charles Kilu Ewa	Kathoka Kai	0721463696	[signature]
10 STEPHEN N KATUMO	VOTA	0728236970	[signature]
11 JOSHUA M THITU	KATHEKAKAI	0739138602	[signature]
12 Shadrack Muuwa	VOTA	0712637021	[signature]
13 David Mutua	- -	0410577336	[signature]
14 ABDALLAH SWALEH	— —	0713573086	[signature]
15 JOSHUA M. MULINGE	MIKUYU	0705577536	[signature]
16 FRANCIS M. NDISO	MIKUYU	0713892169	[signature]
17 Richard Mutinda	Mikuyu	0711102111	[signature]
18 ALPHONCE NZASI	Mikuyu	0728114257	[signature]
19 Callistus Peter	Mikuyu	0712808677	[signature]
20 MUEMA WAMBUA NDOLO	KATHAKA KAI	0727461048	[signature]
21 MBULWA MUTUA WAMBUA	KATHAKA KAI	0710486601	[signature]
22 Daniel Kioko K.	Mikuyu Area	0708703510	[signature]
23 JOSEPH WAMBUA	Mikuyu Area	0707084057	JOSEPH
24 MICHAEL J. MUNYAO	MIKUYU AREA	0745328244	[signature]
25 CHARLES MTHITU TITI	MIKUYU AREA	0746607285	[signature]
26 David Mutwota	Mwania	0722420324	[signature]
27 Paul Ndunda Mbaa	Mikuyu		[signature]
28 SAMMY MBILA TITI	KATHEKA-KAI	0720350144	[signature]
29 MORRIS MUTETI KATUMO	KIIMA KIMWE	0728134881	[signature]
30 ASUMANI MAINGI	KIIMA-KIMWE	0728134881	ASUMANI.
31 MUSEMBI MAINGI	MIKUYU	0799380008	MAINGI
32 Peter Mutoo	Mikuyu	0712267511	[signature]
33 Paul Nguku	Mikuyu	0734509178	[signature]
34 Tomas Kimeu	Mikuyu	0711682062	[signature]
35 JANET NDUKU	Mikuyu	0712402167	[signature]
Chiefs Name			
Location and Signature	Certified by		

PIUS K. KIOKO
CHIEF
KATHEKAKAI LOCATIO.
P. O. Box 1-90100, MACHAKOS
Date: 6/3/2020 Sign: [signature]

/

ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

Venue:	***Date: …./…../2020***	***CAS CONSULTANTS LIMITED***	
Name	Location	Contacts	Sign
BENSON MANGENGE	Kiima-Kimwe	0713888588	[signature]
JOSEPH NZOMO	KIIMA-KIMWE	07,9551673.	[signature]
GABRIEL M MAKAU	KIIMA KIMWE	0795064512	[signature]
Philomena Muli	Kiima Kimwe	0715202094	Phile
Mbula P. Musyoki	Kiima Kimwe	0722422697	Mbula
Priscilla K. Mutie	Kiima Kimwe	0713815493	Prisly
Telesia M. Nzioka	Kiima Kimwe	0716895125	[signature]
Mary Muthama	Kiima Kimwe	0707071838	[signature]
Mueni Mutisya	Kiima Kimwe	0717111706	[signature]
fredrick Nduva	K	0720391552	[signature]
Joseph. M. Mutiya	Kiima Kimwe	0708292023	[signature]
David makau	Kiima Kimwe	0721471749	makau
Dominic M. Ndivo	K/Kimwe	0726515089	[signature]
Jonathan Musau	" "	0703625441	[signature]
Alice N. Musa	" "	0712389686	[signature]
ANTHONY MUNYAO	KIIMA KIMWE	0725642689	[signature]
Priscillah Wanjiru		0716833701	[signature]
Chiefs Name			
Location and Signature			

MACHAKOS SUB COUNTY

S. NO.	COUNTY	SUB COUNTY	LOCATION	SUB LOCATION	ASST.CHIEF NAME	PHONE NO.
1.	MACHAKOS	MACHAKOS	TOWNSHIP	CHIEF TOWNSHIP MJINI EASTLEIGH	JOSHUA KIMEU MULI MUTISO PATRICK LOKI	0722810928 0720013970 0713766509
2.			MUVUTI	CHIEF MUVUTI KIVANDINI	BENJAMIN NGOMOLI ELIZABETH JAMES MUSYIMI	0726509576 0703193159 0711228833
3.			MUMBUNI	CHIEF LOWER KIANDANI UPPER KIANDANI KASINGA MUNG'ALA MISAKWANI	MATHEW MULEE JOEL NZIOKI LAWRENCE MUNYAO MATHEW MULEE JACKLINE VUVA CHRISTINE TOM	0720573021 0715273082 0726360166 0720573021 0720573021
4.			NGELANI	CHIEF NGELANI NZOWENI KAMUTHANGA	NOEL KILONZO MARTHA MUTUA RAPHAEL MWENGA	0721491382 0725990230 0702699575 0719276756
5.			MUA HILLS	STANLEY MWANZA MUA HILLS KYAANI KYANDA	ALBNUS NDETI ALEX SUKYA	0720529209 0735739413 0723623222 0721941480
6.			KATHEKAKAI	CHIEF MIKUYU KATELEMBO KATHEKAKAI KITANGA	PIUS KITUVA PETER NGOVU PIUS KITUVA NZAU MUTUNGA FRANCIS MBALUKU	0721690478 0715101187 0721690478 0704700446 0704700446
7.			KIIMAKIMWE	CHIEF MUTHINI KATOLONI KATHEKAKAI KITANGA	ALICE MUSA DOMINIC NDIVO ANTONY MUNYAO DOMINIC NGUI ANNE MUTAVE	0712389686 0726515089 0725642689 0735480310 0786364252
8.			MUTITUNI	CHIEF VACANT NDUU MUTITUNI KIVUTINI	MUTUA MALEI DAUD KIILU ANCENT NZIOKA	0720628838 0717576217 0720577887

11.6 Appendix VI: Key Stakeholders Log

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

STAKEHOLDER CONSULTATION FORM

No.	Name	Organisation	Title	Contact	sign	Date
1.	NTHIWA PATRICIA	INTERIOR & COORDINATION	ACC	0726254782		18/09/20
2.	KASSIM M. BOSO	INTERIOR	DCC	0722 177308		18/9/2018
3.	GEORGE K. KABWIKA	INTERIOR	ACC I	0723531216		18/9/2018
4.	Noah Wawin	KARBO-KMRI	Institute Director	0722-623661		18/9/18
5.	ALICE 'N' MUSA	Chief INTERIOR	CHIEF	07123896 86		18/9/2018
6.	JACKSON MUTHUI	County gvt	C.O Water	0722162992		18/9/18
7.	JOSHUA NI KIMEU	INTERIOR	SNR CHIEF I	0722 810928		18/9/18
8.	PIUS K. KIOKO	INTERIOR	CHIEF	0721 690478		18/9/2018
9.	Benjamin M. Ngomoli	INTERIOR	SNR. CHIEF	0726509576		19/09/2018
10.	JOSEPHAT W. KYUNGU	INTERIOR	ASST. CHIEF	0729 [illegible]597		19/09/2018
11.	LYDIA KIMEU	INTERIOR	A.C.C	0723747542		19/09/2018
12.	BENSON KIUAFA	INTERIOR	CHIEF	0720022845		19/9/2018
13.	TITUS M. MUVA	CHIEF (INTERIOR)	CHIEF	0714-163601		24/9/18
14.	JUDITH M. MWAITA	ASS. CHIEF ITHANGI	ASS. CHIEF	0708/69166		20/9/18
15.	Jonathan M. Mawa	S.C.A Makueni County	S.C.A	0727-635678		21/9/18
16.	CHITECHI MARY STELLAH	Interior	ACC	0716092092		4/10/18
17.	MARGARET MBUGUA	INTERIOR	DCC	0722403632		4/10/2018
18.	John N. Kinyanjui	WRA	Ag. RM.	0722100667		4/10/18

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

STAKEHOLDER CONSULTATION FORM

No.	Name	Organisation	Title	Contact	sign	Date
1.	DOMINIC-M. NDIVO	Administration	Ag Chief f- Kathiani	0726-515089		5th Oct 2018
2.	Joseph Mutende	Machakos WSP	Technical Manager	0714835218		8/10/2018
3.	Isaac Musya	Machakos WSB	Projects Manager	0722685769		8/10/18
4.	GIDEON KAVOO	TANATHI	Snr. Engineer	0721 793 743		12/10/18
5.	TONNY RAO	TANATHI	ICT	0723-107065		12/10/18
6.	ROSE JUMA	TANATHI WSB	Principal Water Utility Officer	0727 922802		12/10/18
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CONSULTANCY SERVICES FOR FEASIBILITY STUDY, PRELIMINARY DESIGN AND DETAILED DESIGN OF THE PROPOSED MWANIA/MIWONGONI DAM AND WATER SUPPLY PROJECT IN TANATHI WATER SERVICES BOARD AREA

STAKEHOLDER CONSULTATION FORM

No.	Name	Organisation	Title	Contact	sign	Date
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11.7 Appendix VII: Sample Key Stakeholder Questionnaire