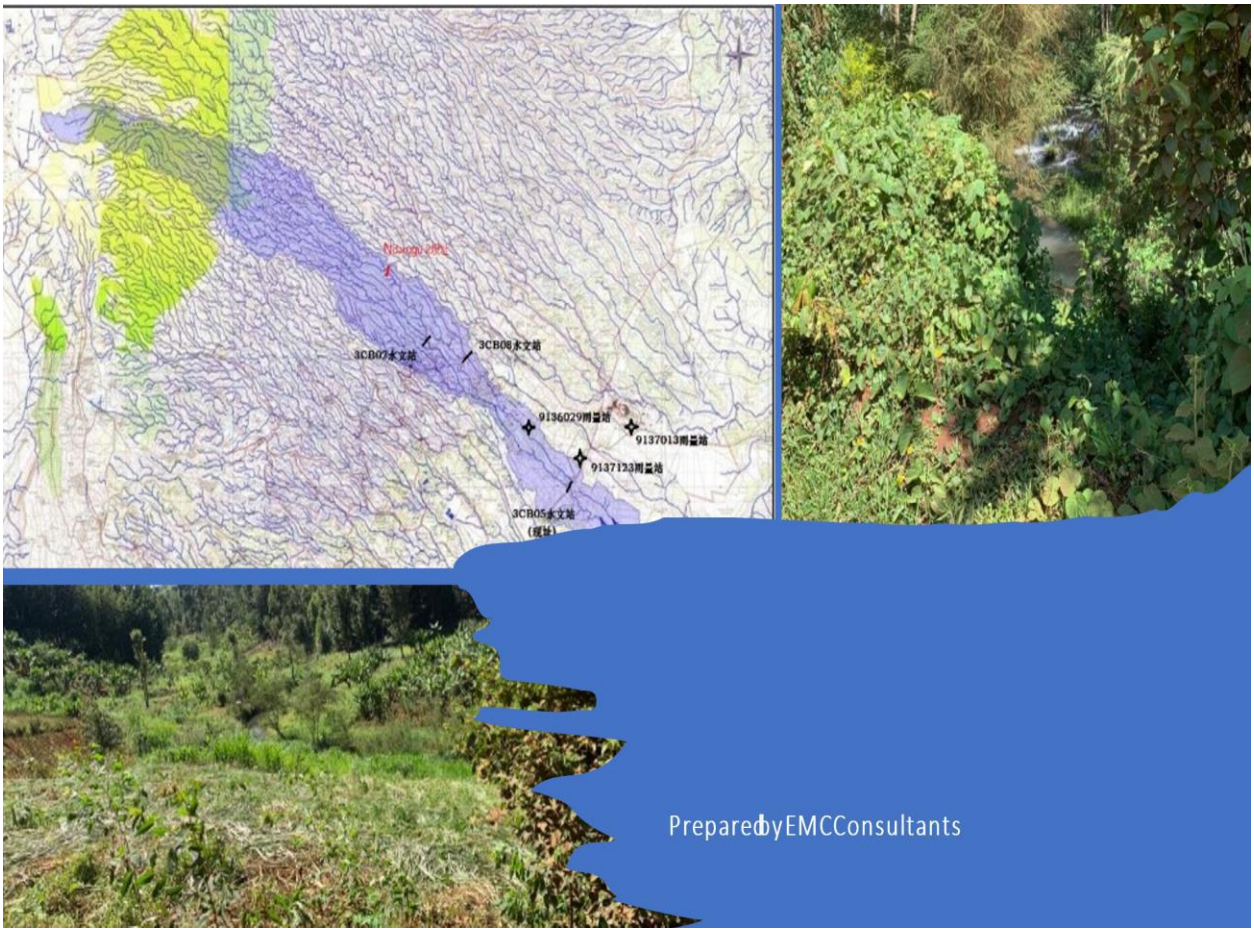
ATHI WATER WORKS
Accelerating Access to Water and Sanitation

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY FOR THE PROPOSED NDARUGO II DAM WATER SUPPLY PROJECT , KIAMBU COUNTY



January 2023

This Environmental Social Impact Assessment report is submitted to the National Environment Management Authority (NEMA) pursuant to the Environment Management and Coordination Act, chapter 387 and the Environmental (Impact Assessment and Audit) Regulations, 2003

PROPONENT

ATHI WATER WORKS DEVELOPMENT AGENCY
PO BOX 45283-00100
NAIROBI

PREPARED BY

ENVIRONMENTAL MANAGEMENT CONSULTANCY (EMC)
DIAMOND PLAZA,
2ND FLOOR SUITES A8 & A9,
PO BOX 3891- 00100.
NAIROBI.
TEL: 0724055357

DECLARATION

Athi Water Works Development Agency

This ESIA report is submitted for approval to the National Environment Management Authority (NEMA) according to the Environment Management and Coordination Act, CAP 387 and the Environmental (Impact Assessment and Audit) Regulations, 2003.

The ESIA is based on the proposed construction of Ndarugo Dam water supply project in Thenge-ini area, Kiambu County. Therefore, the ESIA has been prepared to the highest environmental standards possible.

NAME: …….

DESIGNATION: ……..

SIGNATURE: ……..

DATE……..

EIA CONSULTANTS:

The ESIA report is based on the proposed construction of Ndarugo II Dam water supply project in Thenge-ini area, Kiambu County.

To my knowledge, all information contained in this document is an accurate and truthful representation of all findings relating to the proposed environmental impact assessment study as per projects information provided by the proponent to the consultant:

NAME: Vincent Oduor (NEMA Registration Number 346)

SIGNATURE: ……..

DATE: ……...

ACRONYMS AND ABBREVIATIONS

AWWDA	Athi Water Works Development Agency
CBD	Convention on biological diversity
CRA	Commission of Revenue Allocation
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMCA	Environmental Management Coordination Act
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment IFC
GOK	Government of the Republic of Kenya
HIV	human immunodeficiency viruses
IFC	International Finance Cooperation
KNBS	Kenya National Bureau of Statistics
MOE	Ministry of Energy
MOH	Ministry of Health
MEWNR	Ministry of Environment, Water and Natural Resources
NEAP	National Environmental Action Plan
NEMA	National Environment Management Authority
NGO	Non-Governmental Organizations
OHS	Occupational Health Safety
OHSAS	Occupational Health and Safety Standards
OP	World Bank Operational Policy
PAP	Project Affected Persons
PPE	Personal Protective Equipment
SDG	Sustainable development goal
WB	World Bank Group
WRA	Water Resources Authority
WSBs	Water Service Boards
WASREB	Water Services Regulatory Board
WSP	Water Service Providers
WSTF	Water Service Trust Fund

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

NON-TECHNICAL SUMMARY

Project overview

The proponent, Athi Water Works Development Agency (AWWDA), proposes constructing a dam along River Ndarugo. The proposed Ndarugo II dam will increase the bulk water supply by 50,000m^3 per day to serve Nairobi, Ruiru and Juja area residents, thus reducing the current and projected water demand. Ndarugu Dam is located at the upstream of Ndarugu River, about 40km from the junction of Athi River, with a controlled drainage area of 67km^2, an effective storage capacity of 16.249 million m^3, and an average annual water supply of 16.62 million m^3. Under the 90% guarantee rate, the water supply of the water treatment plant is 50,000 m^3/d. The structures of the head project include dam, spillway, water intake, bottom outlet, etc. The water supply project includes one pump station, one water treatment plant, 37.7km water transmission pipeline and two pools.

The proposed project is in line with Kenya's constitution and policy objectives regarding clean water access and sanitation. Kenya ratified the sustainable development goals in 2015, committing to ensure the availability and sustainable management of water and sanitation for all by the year 2030. Specifically, target 6.1 of SDG 6 is to achieve universal and equitable access to safe and affordable drinking water for all by the year 2030. SDG 6 is in tandem with Kenya's Vision 2030. Under section 5.3 –water and sanitation- the vision is to ensure that improved water and sanitation are available for all (GOK, 2007). The Kenyan constitution guarantees every citizen access to safe and clean water under article 43.

The proponent undertook public consultation in the project area holding public meetings in i) Gatie, ii) Gathaite, iii) Kanjiku, and Muimuto sub-locations. From the consultation forums, it emerged that residents were fearful of having a third dam constructed in their neighborhood for various reasons. These included i) the government was yet to conclude compensating residents that ceded land for the other dams, ii) the dam will change the micro-climate of the area, iii) the primary beneficiaries of water from the project are urban dwellers in Nairobi, Ruiru and Juja and not the locals, v) the dam would, as a barrier, divide the community into two halves hindering their social cohesion.

Table 1: Summary of impacts and mitigation measures

#	Environmental Impact	Mitigation Measures
1	Conflicts arising due to loss of land, developments e.g., houses and crops	Compensation of affected persons; Creating awareness, informing all community members along the pipeline routes. Incorporating community input; creation of a community liaison office.
2.	Loss of Vegetation	Retention of vegetation where possible. Care will be taken to minimize damage of vegetation cover along the pipeline route.
3.	Soil erosion	Loose soils to be used to fill back excavated/disturbed areas. Loose soils to be compacted with a mechanical roller to avoid erosion by wind or water.
4.	Noise & air quality concerns	Provision of mufflers on exhausts and standard restrictions to hours of site works. Water spraying on dusty sites during strong wind. Covering wetting of materials and wastes, during transportation. Use of ear plugs by construction workers
5.	Increased generation of waste	Dispose waste at licensed waste treatment sites. Adhere to waste management regulations of 2006

#	Environmental Impact	Mitigation Measures
6	Road traffic disruption	No overloading of trucks and good driving practices to be practiced. Suitable junction/access point to be provided. Use of appropriate & legible signage. Employment of formal flagmen / women to ensure the public safety.
7.	Impacts on Cultural, religious, and sensitive sites	Mapping of cultural, religious, and sensitive sites. Rerouting the pipeline to less sensitive sites. Consulting the local elders and compensation for any damages caused.
8.	Loss of land[1] and farm crops	Restrict pipelines construction along the shoulders of roads and compensate for lost land and crops where applicable
9.	Air Quality concerns	Limit levels of dust through good practice such as watering of access routes, construction sites, deviations and other disturbed sites and cover lorries transporting construction materials. Provide workers with appropriate dust protective gear including masks and overalls.
10.	Noise and vibration	Standard restrictions to hours of site works (8:00am – 5:00pm) and the fitting of mufflers on construction equipment. Use of protective hearing devices such as ear plugs and earmuffs among workers when noise levels exceed 85-90dBA. Selection of appropriate machinery and regular servicing of machinery and vehicles
11.	Health and safety risks	Design and implement safety measures and emergency plans to contain accidents risks. Install appropriate road traffic signs, markings, and road furniture. Provide workers with protective clothing (nose and mouth masks, earmuffs, overalls, industrial boots, and gloves) and helmets
12.	Water loss	Geological profiles proposed for inundation should be established to identified areas of weaknesses and appropriate strengthening measures incorporated. Sub-surface water infiltration trends on affected areas should be established and monitored over a period with respect to effects on houses and other structures. Plant indigenous trees and shrubs around the dam buffer zone to minimize loss of water through evapotranspiration processes
13.	Exhaust and gaseous emissions	Reduce gaseous emissions by selection of appropriate machinery and regular servicing of vehicles. Provide workers with appropriate protective gear including masks to cut down on gaseous emissions inhaled. All workers involved in construction activities to wear face masks.
14.	Increased wastewater production	Ensure that all households, institutions, and businesses connected to the new water pipeline network are also connected to the proposed new municipal sewer line. The wastewater should eventually be treated before being disposed. In addition to this measure, the proponent is advised to explore wastewater treatment measures that will ensure nutrient and energy recovery from wastewater.

Conclusions

It is also concluded that the project magnitude will be significant such as to impose impacts to the physical and biological environment as well as the social, cultural, and economic setting of the area. The negative impacts, however, are identifiable and can be mitigated through design and administrative measures. However, the overall positive impacts of the project far outweigh the negative projects through the mitigation measures outlined for the project.

[1] Land here includes all developments therein

Recommendations

a. Continuous engagement of the area residents to reach a consensus on how they could benefit from the project and allow it to be implemented.
b. Implementation of the proposed environmental management plan to enhance the positive impacts and mitigate negative impacts.
c. Prepare a risk and hazard management plan for the operational phase of the project.

I. INTRODUCTION

1.1. Background

Kenya is a water-scarce country with less than 1,000m^3 per capita of renewable freshwater supplies, with 80% of the country being arid (USAID, 2009). Kenya ratified the sustainable development goals in 2015, committing to ensure the availability and sustainable management of water and sanitation for all by the year 2030. Specifically, target 6.1 of SDG 6 is to achieve universal and equitable access to safe and affordable drinking water for all by the year 2030. SDG 6 is in tandem with Kenya's Vision 2030. Under section 5.3 –water and sanitation- the vision is to ensure that improved water and sanitation are available for all (GOK, 2007). The Kenyan constitution guarantees every citizen access to safe and clean water under article 43.

Although the generalized reported percentages for water and sanitation access look good, inequalities still exist when regions are considered separately. Regions that receive minimal amounts of rainfall have low levels of access to water and sanitation. Data on access to safe drinking water by County indicates that Kiambu (86%) is one of the counties with access to clean drinking.[2] The Counties with the least access to improved water sources are Bomet at 23.6%, Baringo at 23.4% and Narok at 20.1% (KNBS, 2013). It can be deduced from the foregoing that urban areas have the highest accessibility to water when compared to rural areas.

1.2. Need for the project

Implementation of the proposed project will help solve the current water and sanitation problem emanating from the inconsistent supply with increasing demand. The project will have the following benefits.

a. Increased access and reliability to clean drinking water for the Nairobi, Ruiru and Juja residents, thus improving their hygiene and sanitation conditions.
b. The project will be a major boost to realizing vision 2030 and the achievement of the SDG6 and article 43 of the constitution by ensuring the availability and sustainable management of water and sanitation for the Nairobi, Ruiru and Juja residents.
c. Provision of water has the potential to enhance the development and growth of local markets as more economic and social interests arise. More important is the opportunity to improve sanitation and hygiene in these markets as opposed to the current potential threat of diseases in almost all the markets.
d. Revenue generation to the local and national governments – More people will be supplied with water which they will pay for. This will increase revenue collected by water service providers through payment of water bills by the increased number of people supplied with water
e. Employment opportunities for the local community during the construction and operation phases of the project (e.g., masons, carpenters, cooks and indirect spins-off, such as livestock and fish trade etc.);
f. The project will help develop the human capital in the country through the transfer of skills to young engineers, environmental specialists, and plumbers, among others.

[2] Commission on Revenue Allocation (2022). Kenya County fact sheets

1.3. Scope and objectives

1.3.1. Scope

The consultants used conventional and participatory approaches to identify the potential environmental impact and mitigating measures for the proposed dam development.
In pursuing the exercise, the consultant :

- Reviewed the preliminary designs for the proposed development project to get acquainted to environmental issues in respective facilities on the site.
- Planned and prepared a time schedule for the activities to be undertaken in ESIA.
- Assessed the project site and consulted widely with the affected persons, local leaders, and other relevant key stakeholders.
- Undertook a comprehensive assessment ensuring all environmental concerns and views of all parties/persons likely to be affected by the project are considered.
- Developed an Environmental Management Plan (EMP) with mechanisms for monitoring and evaluating compliance and environmental performance, including the cost of mitigation measures and the timeframe for implementing the measures.
- Publicized the project and its anticipated effects by publishing a notice in both official and local languages in the project area
- Liaised with NEMA for compliance with all mandatory and regulatory requirements relating to the ESIA.

1.4.2. Study Objectives

The main objective was to identify the possible positive and negative environmental impacts expected during the establishment and operation of the proposed project with the aim of proposing mitigation measures. The reasons for this were in line with ensuring that such a development does not negatively impact the biological, physical, and socio-economic environment. The study shall identify the possible environmental impacts during the implementation and operational phases. The assignment shall be guided by EIA regulations as well as safeguards developed by financing institutions such as the World Bank and International Monitory Fund.

Other objectives were:

- To predict and evaluate potential environmental impacts of the project and propose appropriate mitigation measures for the negative impacts.
- To facilitate consultative public participation and incorporate views expressed into the study.
- To prepare an Environmental Management and Monitoring Plan for the proposed project.

1.4.3. Responsibilities and undertaking

The consultant undertook the ESIA study as proposed in the TORs. The proponent provided site plan(s) showing roads, service lines, projects layout and the actual sizes of the sites, details of construction materials, proposed process outline and anticipated operational impacts, future

development plans, operation permits and conditions, land-ownership documents, and site history.

1.4.4. Terms of reference

The consultants prepared and submitted the terms of reference to the Authority and subsequently received approval to undertake the study. Accordingly, the terms of reference are appended to this report.

1.5. Methodology

1.5.1. Review of literature

Various relevant documents were reviewed for a clear understanding of the terms of reference, environmental status of the project area, data on demographic trends, land use practices in the affected areas, development strategies and plans (local and national), and the policy, legal and institutional documents. A list of references for all documents reviewed is provided at the end of this report (see List of References).

1.5.2. Screening and Scoping

Environmental screening and scoping are meant to determine whether an ESIA was required and what level of assessment was necessary. This was done in reference to requirements of the EMCA, chapter 387, and precisely the second schedule. Issues considered included the physical location, sensitive issues and project activities, nature of anticipated impacts.

1.5.3. Data collection and analysis

The data collection was carried out through questionnaires/standard interview schedules, key stakeholder's meetings, use of checklists, observations and photography, maps, satellite imagery, site visits and desktop environmental studies, where necessary, in the manner specified in Part III and IV (refer to Section 16-18) of the Environmental (Impact Assessment and Audit) Regulations, 2003. During the field trips, the team made relevant observations and conducted a detailed assessment of appropriate attributes of the project area, including physical and biological parameters. Photographs of interesting characteristics of the project area were taken where applicable. The environmental attributes of the project area captured during the field study are presented in a series of photographic plates in Annex 1-Photographic Plates Showing the Salient Features of the Project Area. Specific objectives of the field survey included.

a) Evaluating the environmental setting around the proposed project site. General observations were focused on the topography, land use trends, surface water sources, public amenities, land cover, climate, settlements, forests, soils, etc.
b) Comprehensive consultative public participation exercises through public forums

1.5.3. Public consultation

The proponent conducted public consultation forums on 13th January 2023 in Gatei, Gathaite, Kanjuku, and Muimuto sub-locations. The purpose of consulting the public was to i) enhance public buy-in, ii) introduce the project to the public, iii) disseminate information on the project's impacts, and iv) gather comments, among other aspects. The outcome of the consultation is presented in section 7 of this report.

1.5.4. Reporting

The ESIA Study Report comprises the final analysis of the field and desktop assessment as guided by the EIA regulations. It was submitted to NEMA after reviewing by the proponent. In addition, appropriate photographs, sketches, maps, and architectural drawings shall be attached to explain the project's components and other aspects in detail.

II. BASELINE ENVIRONMENTAL AND SOCIO-ECONOMIC INFORMATION

2.1. Overview

Kiambu County is one of the 47 counties in the Republic of Kenya. It is located in the central region and covers a total area of 2,543.5 Km^2.[3] Kiambu County borders Nairobi and Kajiado Counties to the South, Machakos to the East, Murang'a to the North and North East, Nyandarua to the North West, and Nakuru to the West. The County lies between latitudes 00 25' and 10 20' South of the equator and longitude 360 31' and 370 15' East. Kiambu County is divided into four broad topographical zones; Upper Highland, Lower Highland, Upper Midland and Lower Midland Zone. The Upper Highland Zone is found in Lari constituency and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 metres above sea level.[4]

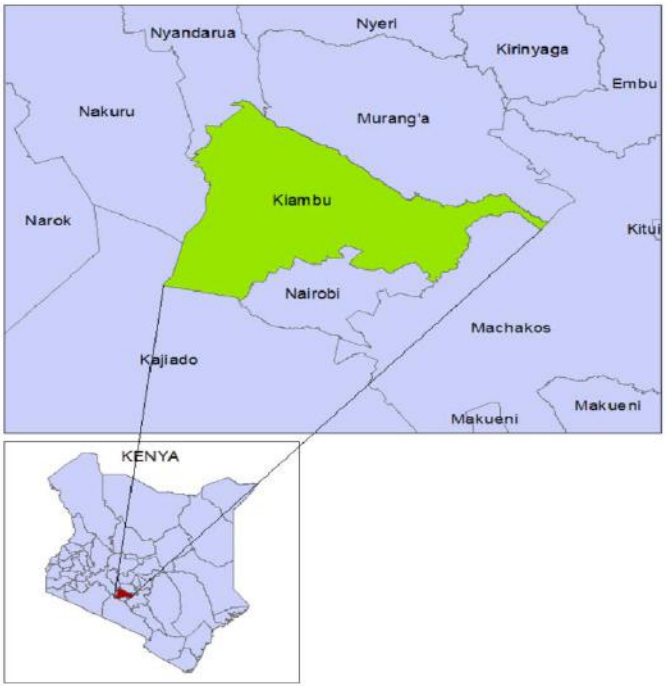


Figure 1: Location of Kiambu county

Table 2: Primary socio-economic indicators for Kiambu County[5]

#	Indicator	Value
1	Population 2019	2,417,735
2	Households 2019	795,281
	Urban households	587,631
	Rural households	207,710
3	Sub counties	13
4	Constituencies	12
5	Dominant economic activity	Agriculture, forestry, fishing, avocado, coffee and tea
6	Poverty headcount (2015/2016)	23.3
7	Households accessing safe drinking water % (2019)	86
8	Households accessing improved sanitation % (2019)	96.2
9	Electricity access % (2019)	91.9

[3] County government of Kiambu (2019). Kiambu county integrated county development plan (CIDP)
[4] Ibid
[5] Commission on Revenue Allocation (2022). Kenya County fact sheets. Third edition

2.2. Physical environment

2.2.1. Geology and soils

The geology of the area is part of the eastern border zone of the Rift Valley, filled with Kainozonic volcanic and sediments underlying the Upper Athi, generating suitable aquifers. Conversely, soils develop from weathering volcanic rock activities and are highly fertile with high levels of perforation. The project area is generally hilly, with steep slopes and deep valleys in most locations. The Aberdares influence the surface physiography to the Northwest and western direction, constituting the primary water catchment. The slope is generally to the southeast, and the eastern tip gets gentle towards the east, influenced by the flat, low-lying Yatta plains. The dam may not necessarily change the local topography, but the general aesthetic conditions of the project will slightly change. The transmission corridor, however, will not be affected.

Soils in Kiambu County develop from weathering activities of the volcanic rocks and are highly fertile with high levels of perforation. Soils in the area are developed from weathered volcanic rocks and are moderate to high fertility, well-drained clay loams. This explains the suitability of the soils for major crops such as cabbages, kales, carrots, and potatoes in addition to tea, coffee and pyrethrum. Sediment release from specific plants' land cover is determined and depends on the root mass per unit area as well as the duration of growth. Bamboo has the lowest with 15t/km2/yr though its presence in the project is very low while maize has the highest with 2,000t/km^2/yr (it is present around the project area but in low quantities). Tea is at 220t/km^2/yr, while forest cover allows only 20t/km^2/yr associated with the associated undergrowth that hold soil together. The project area has more tea bushes, medium ar
eas coverage for forest and limited maize growing areas.

2.2.2. Climate

The County experiences a bi-modal type of rainfall. The long rains fall between Mid-March to May, followed by a cold season, usually with drizzles and frost from June to August and the short rains between mid-October to November. The annual rainfall varies with altitude, with higher areas receiving as high as 2,000 mm and lower areas of the Thika Town constituency receiving as low as 600 mm. The average rainfall received by the County is 1,200 mm.

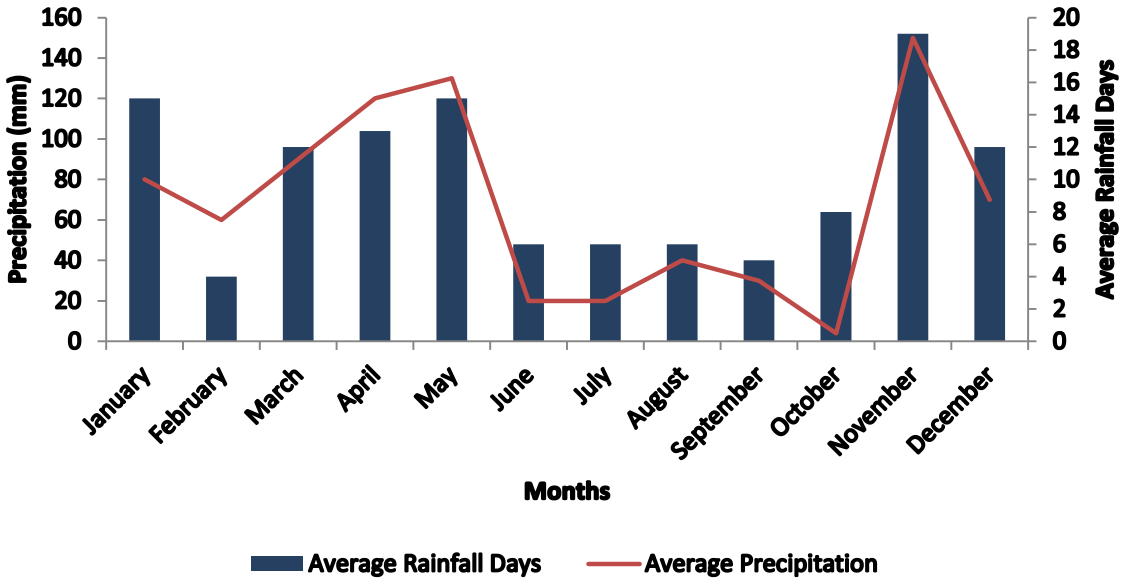


Figure 2: Average rainfall and precipitation in Kiambu County

The mean temperature in the County is 26°C with temperatures ranging from 7°C in the upper highlands areas of Limuru and some parts of Gatundu North, Gatundu South, Githunguri, and Kabete constituencies to 34°C in the lower midland zone found partly in Thika Town constituency (Gatuanyaga), Kikuyu, Limuru and Kabete constituencies (Ndeiya and Karai). July and August are the months during which the lowest temperatures are experienced, whereas January to March is the hottest. The County's average relative humidity ranges from 54% in the dry months and
300% in the wet months of March up to August

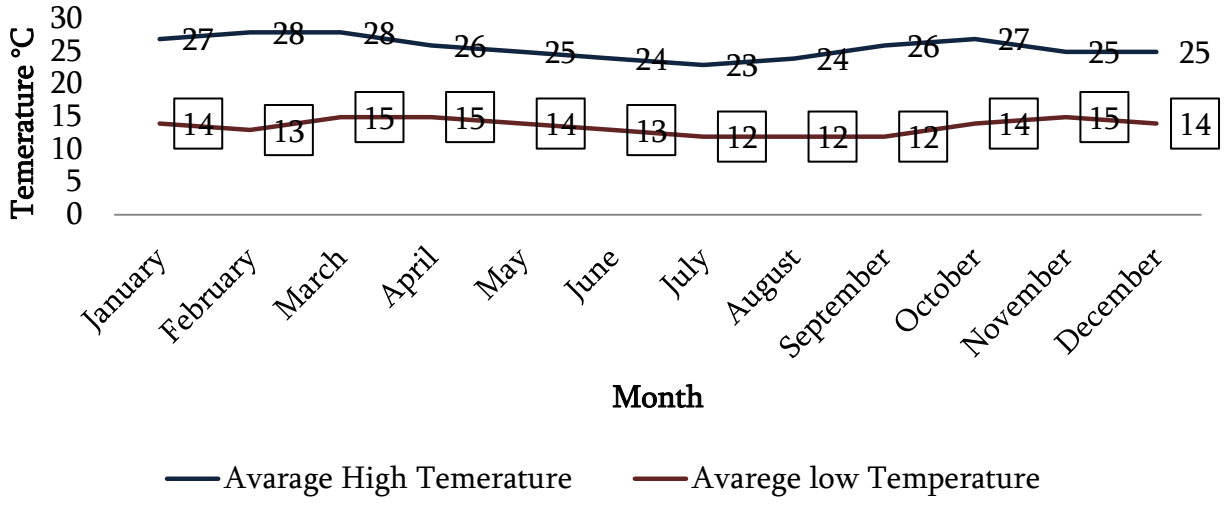


Figure 3: Average monthly low and high temperature

2.2.3. Hydrology

Generally, Kiambu County has numerous springs and streams that constitute the Ndarugu River that serves the project area. Among other rivers in the project area are Chania and Thika Rivers to the north, Ndarugu River, Ruiru River, Komu River, and numerous other streams. Other regional water sources are multiple boreholes with an average yield of $7m^3$/hr and pumps set at an average depth of 200 to 300m deep. However, due to the steep terrain, it is rare to find wetlands around the project area. As a result, surface water quality is generally fresh and clear. However, with increasing agricultural activities, settlements and urban expansion, the water sources are potentially faced with pollution threats. There has not been consistent water quality monitoring from surface sources in the area, particularly the smaller streams and tributaries to the main rivers. However, surface water looks physically clean, a situation attributed to the proximity of sources (the Aberdare slopes and springs), while the conditions progressively change downstream as the sources interact with varying land use activities, including agriculture, urban development, and settlements. Among the key pollutants in surface water sources within the dam project location may include agrochemical residuals (from agricultural activities), nutrients arising from livestock keeping an application of the manure on the steep slopes, and domestic wastes. Among the potential pollutants observed are agrochemical residuals (pesticides, herbicides, and fertilizers), infiltration from cattle pens and pit latrines, and contaminated runoff from markets.

2.3. Biological environment

2.3.1. Fauna

The project area is predominantly under farming and human settlements, as well as the notable institutional presence and market centres. For this reason, no terrestrial wildlife is observed in the project areas since most land is under agricultural use for many years, pushing the animals into the Aberdare Forest. However, there are rodents such as squirrels, moles and snakes, and various bird species. Livestock rearing is predominant, with the primary animals being dairy cows, sheep, goats and poultry.

2.3.2. Flora

The project area vegetation cover is primarily influenced by the Aberdares but has been altered significantly through human activities, specifically for agricultural purposes. (Kariminu river sub-catchment is in the farming zone (IV) hence its viability for agricultural production). Some of the notable flora species include: Grass species (Kikuyu grass, ferns, nappier grass), Tree species (wattle tree, bamboo, gravellia, blue gum), farm crops (macadamia, mangoes, tea, avocado, banana, yams, cassava, sugar cane, maize, pineapple, arrowroots and coffee) and some riverine vegetation

2.4. Socio-economic environment

2.4.1. Population

The Kiambu population increased from 1,623,282 in 2009 to 2,417,735 in 2019. The average household size was 3.1, while the total number of households was 795,241 in 2019. Based on the

2019 population and housing census, most (587,531) families resided in urban areas, as shown in Table 2 above.

2.4.2. Agriculture

Agriculture is predominantly the main economic activity and main source of livelihood for most of the population. It is the leading sector employing over 80% of the people directly and indirectly. However, the agricultural sector in the area is faced with many challenges that include erratic weather, fluctuating commodity prices, high cost of inputs and unexploited potential in trade and industry. The main crops grown include tea, coffee and pineapples, maize, beans, and Irish potatoes. Other crops grown include mangoes, cabbages and flowers, bananas, avocado, tree tomatoes, sugarcane, arrow roots and sweet potatoes.

The principal livestock enterprises are dairy cattle, poultry, pigs, and sheep. Production trends for livestock and livestock products have been increasing over time. This sub-sector has been encouraged by a ready urban market in Thika, Ruriu, Kiambu and Nairobi and the availability of local food processing factories such as Farmers´ Choice Ltd, Ken chic Co. Ltd, and Brookside dairies, among others.

Plate 1: Tea and pineapple plantations in the project area

2.4.3. Trade

Trading is one of the main economic activities in the area and is a major source of employment and market outlet for agricultural products. Kamwangi market, located along Thika – Naivasha road is the main town. Pineapples which are major economic activity in the area are sold in retail; there are no organized societies for fear of loss as it has been the case of coffee and tea. This centre has a very busy market conducted twice in a week, Tuesday and Friday. There are four main markets in the project dam area namely Buchana, Gituamba, Kanyoni and Kiriko markets. Neighboring the water transmission line are several markets ad scattered kiosks (some located in homestead compounds). The water distribution areas of Ruiru, Juja and Thika are awash with trading activities including wholesale/retail trade, banking and financial services and industrial production. Trade in these urban centres includes wholesale and retail shops, hardware shops, welding, financial institutions, Mpesa shops, butcheries, cereals and vegetables/ fruits, hotels, garages, Transport business, hawking, furniture shops, supermarkets, petrol stations, car washing sheds, small kiosks, farming of vegetables, maize and beans. There are two coffee

factories (Kariko Coffee factory and Buchana Coffee factory) within the proximity of the dam area. Gacheche Tea Factory that serves tea farmers around the project area.

Plate 2: Gacheche tea factory

III. POLICY, LEGAL, AND INSTITUTIONAL FRAMEWORK

3.1. Introduction

Today Kenya is faced with grave environmental problems and challenges that include land degradation, loss of biodiversity, environmental pollution, water management and desertification among other challenges. There is a growing concern that many forms of development activities cause damage to the environment and the natural resources upon which the bulk of national economy is based. A major national challenge today is how to maintain sustainable development without damaging the environment. It is now accepted both nationally and globally that development projects must be economically viable, socially acceptable, and environmentally sound. To protect the environment from the negative impacts of development, it is a condition of the Kenya Government for the developers and proponents of projects to conduct an environmental impact assessment on the proposed development projects and environmental audits for the ongoing projects.

Until recently, Kenya did not have consolidated legislation for the protection and management of the environment. The legal provisions on environmental protection were scattered in 77 statutes, which touched on various aspects of environment. This set-up did not offer adequate protection of the environment mainly due to weak legal and institutional frameworks. Significant progress has, however, been accomplished towards arresting this situation. The turn of events commenced with the finalization of the National Environmental Action Plan (NEAP) in 1993.

3.2. The national environment action plan

In 1993, National Environment Environmental Action Plan (NEAP) was finalized under the Ministry of Environment and Natural Resources (MoENR). NEAP addressed environment and conservation challenges, through appropriate legislative and institutional mechanisms. It provided a strategy for achieving sustainable development in Kenya and served as a basis for domesticating Agenda 21 – the Global Program of Action on Environment and Development. NEAP's main objectives were to coordinate stakeholders in the preparation of national environmental legislation and establish a single institution with legal Authority to coordinate the management of environmental resources that were managed by different sectoral statutes at that time. Adopting the NEAP in 1994 marked an important step towards integrating ecological matters in the development planning process. The proposed Ndarugu II dam project will be implemented in line with the NEAP principle of sustainable use of natural resources. The project recognizes the needs of downstream users and has incorporated spillways to ensure uninterrupted water flow. The dam has been designed and will be constructed in compliance with international best practices to ensure the stability of people around the dam and downstream. Following the adoption of NEAP, the Environmental Management and Coordination Act (EMCA) chapter 387 was enacted.

3.3. The national environment management and coordination act (EMCA)

The primary purpose Environmental Management and Coordination Act (EMCA) main objective is to establish an appropriate legal and institutional framework for managing the environment in

Kenya. EMCA further aims to improve the legal and administrative coordination of the diverse sectoral initiatives in the field of the environment to enhance the national capacity for effective environmental management. In addition, the Act is set to harmonize the 77 sector-specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with national objectives. The ultimate objective is to provide a framework for integrating environmental considerations into the Country's overall economic and social development. The major institution established to implement and operationalize the objectives of EMCA is the National Environmental Management Authority (NEMA).

3.4. National Environment Management Authority

In July 2002, the Government established the National Environmental Management Authority (NEMA), a body corporate under the Ministry of Environment and Natural Resources to administrate EMCA. The NEMA is headed by a Director General appointed by the President. Its functions include coordinating various environmental management activities, initiating legislative proposals, and submitting such proposals to the Attorney General. In addition, NEMA is involved in conducting research, investigations, and surveys in the field of environment. In addition, NEMA has instituted EIAs and Environmental Audits EAs as normal practices in Kenya.

3.5. Environmental impact assessment

The EMCA makes it mandatory for any project proponent to submit a project report to NEMA in a prescribed format. Of immediate relevance concerning conducting EIA are Part VIII, Section 58 (1&2) and the Second Schedule of the EMCA. Section 58 (1) states that: "Notwithstanding any approval, permit of the license granted under this Act or any other law in force in Kenya, any person, being a proponent of the project, shall before financing, commencing, proceeding with, carrying out, executing or conducting or causing to be financed, commenced, proceeding with, carried out, executed or conducted by another person any undertaking specified in the Second Schedule to this Act, submit a project report to the Authority in the prescribed form, giving the prescribed information and which shall be accompanied by the prescribed fees".

Section 58(2) states that the proponent of a project shall undertake or cause to be undertaken at his own expense an environmental impact assessment study and prepare a report thereof. In accordance to Section 147 of the above Act, Environmental and (Impact Assessment and Audit) Regulations, 2003 have now been formulated and gazetted in Kenya. Gazette Supplement No. 56. Part IV, Section 18 (1) states that a proponent shall submit an environmental impact assessment study to the Authority.

3.6. The water Act 2016

The Water Act 2016 proposes establishment of Water Works Development
Agencies whose functions shall include: -

a. Undertake the development, maintenance and management of the national public water works within its area of jurisdiction including water storage; water works for bulk distribution and provision of water services; inter basin water transfer facilities; and

reservoirs for impounding surface run off and for regulating stream flows to synchronize them with water demand patterns which are of strategic or national importance.

b. Operate the waterworks and provide water services as a water service provider, until the responsibility for the operation and management of the water works are handed over to the county governments, joint committee, authority of county governments or water service provider within whose area of jurisdiction or supply the water works is located;
c. Provide reserve capacity for purposes of providing water services where pursuant to section 103,the Regulatory Board orders the transfer of water service functions from a defaulting water service provider to another licensee;
d. Provide technical services and capacity building to county governments and water service providers within its area as may be requested; and
e. Provide to the Cabinet Secretary technical support in the discharge of his or her Functions under the Constitution and the Water Act, 2016.

The Water Act 2016 further states that the water works development agencies shall hand over the assets referred to the county water services providers or cross county water services providers for purposes of use and not the handing over of ownership once the development of such assets is completed.

3.7. Summary of the policy, regulatory and legal frameworks, and interconnection with the proposed project

Table 3 below summarizes the policy, regulatory and legislative frameworks associated with the proposed project.

Table 3: Summary of legal, policy, regulatory frameworks and MEAs for the proposed Ndarugu II dam

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
Legislative frameworks			
1	The constitution of Kenya	Article 42 – Supporting public involvement in ensuring the rights to a clean and healthy environment; Article 43 – Supporting public involvement in ensuring the need for every person to have access to clean and safe water in adequate quantities; Article 69 - Environment and natural resources (1) (d) Encouraging public participation in the management, protection and conservation of the environment (f) Supporting environmental impact assessment, environmental audit and monitoring of the environment (g) Eliminating processes and activities that are likely to endanger the environment; and; Article 66 – Regulating use of any land or any interest or right over any land, in the interest of public health or public planning Article 185: 22 - Protection of the environment and natural resources with a view to establishing a durable and sustainable system of development	The proposed project will, among other benefits: 1) Enhance access to clean water for more than one million residents of Gatundu, Juja and Ruiru 2) The project is in line with article 43 of the constitution by ensuring the availability and sustainable management of water and sanitation.
2.	Environmental Management and Coordination Act (EMCA), chapter 387	Prohibiting and controlling the introduction of alien species into natural habitats; Controlling and preventing environmental pollution; Carrying out EIA for all proposed projects with a potential for adverse impacts; Carrying out environmental audit and monitoring of all activities that are	The proponent has undertaken the ESIA with wide public consultation. An environment management plan (EMP) has been prepared to aid the sustainable implementation of the project
3.	The water act 2016	Athi Water Works Development Agency (AWWDA) is one of the nine (9) Water Works Development Agencies established under the	AWWDA is responsible for planning, developing, maintaining, and managing water and sewerage infrastructure in the counties of

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
		Water Act 2016 vide Legal Notice No. 28 of 26th April 2019 under the Ministry of Water, Sanitation, and Irrigation.	Nairobi, Kiambu and Muranga Counties covering 5,800.4 km^2 with a total population of 9,320,287 people. One of the proposed priority water sources for Gatundu, Ruiru and Juja areas is the development of the Ndarugu II Dam. The main development objective of the project is to increase the bulk water supply by 50,000m^3/day to serve residents of Ruiru and Juja areas and reduce the projected water demand.
4.	Public Health Act, Cap 242, 1986	Article 129: Supporting the protection of public water supplies; Article 117: Supporting the prevention or remedy danger to health from unsuitable activities including dust and noise	The proponent should ensure that all construction operation activities do not interfere with public water supply systems and remedy project effects that may impact public health.
5.	The Occupational Health and Safety Act, 2007	This Act aims to secure the safety, health, and welfare of persons at work, and protect persons other than persons at work against risks to safety and health arising out of, or in connection with, the activities of persons at work. It applies to all workplaces where any person is at work, whether temporarily or permanently.	Failure to comply with the OSHA, 2007 attracts penalties of up to KES 300,000- or 3-months jail term or both or penalties of KES 1,000,000- or 12-months jail term or both for cases where death occurs and is in consequence of the employer
6.	The Land Act, 2010	Part viii: Provides procedures for compulsory acquisition of interests in land. Section 111 (1): States that if the land is acquired compulsorily under this Act, just compensation shall be paid promptly in full to all persons whose interests in the land have been determined.	The proponent, through the National Land Commission, will prepare a resettlement action plan (RAP) before the commencement of construction
7.	National Land Commission Act, 2012 (No. 5 of 2012)	Section 5: Mandates the Commission to:- a) Initiate investigations, on its own initiative .or on a complaint, into present or historical land injustices, and recommend appropriate redress;	

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
		b) Encourage the application of traditional dispute resolution mechanisms in land conflicts; c) Assess tax on land and premiums on immovable property in any area designated by law	
8..	Land Adjudication Act, 2010	The Act applies to any area of Trust land where the County Council in whom the land is vested so requests; and the Minister considers it expedient that the rights and interests of persons in the land should be ascertained and registered	
9.	The Trust Lands Act, 2012 (Chapter288)	Section 38:, Way leave license may be granted to any person empowering him and his servants and agents to enter upon Trust land vested in the Council and to lay pipes, make canals, aqueducts, weirs and dams and execute any other works required for the supply and use of water, to set up electric power or telephone lines, cables or aerial ropeways and erect poles and pylons therefore, and to make such excavations as may be necessary	
10.	The Physical Planning Act, Chapter 286	Section 29: Ensuring that developers to ensure proper execution and implementation of approved physical development plans. Other legal obligations are among others, (a) Ensuring that subsidiary area plans are recognized and integrated in the County Physical Development Plans (b) The local Authority concerned shall require the developer to restore the land on which such development has taken place to its original condition within a period of not more than ninety days	The proposed project is in line with both national and county government goals of providing clean and affordable energy to citizens. It is also in line with the sustainable development goals that Kenya ratified in 2015 and have been adopted into county government development plans. The proponent will further ensure that all disturbed areas are immediately restored after decommissioning of construction activities and that the developmental footprint does not exceed 75%.

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
11.	The Antiquities and Monuments Act Chapter 215	The Act aims to preserve Kenya‘s national heritage. Kenya is rich in its antiquities, monuments and cultural and natural sites which are spread all over the Country. The National Museums of Kenya is the custodian of the Country‘s cultural heritage	There are no monuments or cultural sites within in the project’s site proximity.
12.	The penal Code Chapter 63	Section 191 - States that if any person or institution that voluntarily corrupts or foils water from public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence; Section 192 – States that a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution, dwelling or business premises in the neighbourhood or those passing along public way, commit an offence.	The proponent will implement the proposed environment management and monitoring plan as well as the licensing conditions and any other improvement notices issued by NEMA during implementing the proposed project
13.	The Explosives Act Chapter 115	Section 7(1) - Stipulates that No person shall keep, store or be in possession of any unauthorized explosive in or on any premises except in an explosives factory or explosives magazine or unless the explosive is kept for private use, and not for sale or other disposal, and in accordance with rules or unless the explosive is kept for use in the construction of railway, road or other public work, in quantities not exceeding two thousand five hundred kilograms in weight and is stored in a temporary magazine approved by an inspector and under conditions specified in writing by an inspector	Blasting and use of explosives is not foreseen during construction and operation of the project. However, the proponent tis advised to obtain materials such as ballast from sites that area adhering to this Act.
Policy and regulatory frameworks			
14.	The EMCA (water quality)	These regulations are aimed at protecting water	The proponent shall acquire or lease portable

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
	regulations, 2006	resources from pollution. It requires that proponents of projects in areas with no municipal sewers to deploy adequate measures that will ensures safe disposal of wastewater from their activities.	toilets that construction workers will use. They are further advised to install a wastewater treatment plant (preferably a bio-digester) and obtain an effluent discharge license before the commencement of operations
15.	The EMCA (Noise and excessive vibrations pollution control) regulations 2009	Section 13(1) states that 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 to emit noise in excess of the permissible levels as set out in the Second Schedule to these Regulations	The proponent shall ensure that equipment used during construction and operation is muffled to control noise and vibrations.
16.	The Waste management regulations of 2006	The regulations require a waste generator to collect, segregate and dispose each waste category in such manners and facilities as relevant authorities provide.	Proponent shall apply an integrated solid waste management protocol and ensure that generated waste is disposed in a manner prescribed under these regulations.
17.	The EMCA (air quality regulations) 2014	Part VII, section 29. (1) The occupier or operator of premises shall ensure that exposure of indoor air pollutants does not exceed the exposure limits stipulated under the Factories and Other Places of Work (Hazardous Substances) Rules or under any other relevant law	The proponent is advised to undertake air quality audits for their premises covering ambient and stack emissions (generators) and submit the reports to NEMA for review. They are further advised to ensure that their transportation fleet meets the highest air quality standards
19.	Sessional Paper No. 6 of 1999 on Environment and Development	Regulating urban development to only those areas which are suitable, avoiding ecologically fragile areas; Encouraging sustainable use of resources and ecosystems; Undertaking EIA for all private and public projects to increase public awareness on the environment	Public consultation will be a key facet of the project in all its phases of construction, operation and decommissioning.
20.	The National Policy for Disaster Management, 2009	Promoting the mainstreaming of disaster management and climate change into	The proponent has integrated climate change impacts such as extreme heat and flooding into

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
		development planning and management for sustainability Providing for well-structured participation of society in disaster management by integrating traditional coping strategies into the disaster management systems and Supporting climate change disaster risk reduction initiatives among others	the project's design. Workers will be provided with adequate facilities and PPEs to improve comfort in case of extreme heat. The premises will also be constructed with adequate drainage systems to control flooding. The proponent is further advised to construct premises and facilities that can with stand earthquakes (seek further advice from the state department of geology).
21.	The National gender and development policy of 2000	Considering the needs and aspirations of all Kenyan men, women, boys and girls across economic, social and cultural lines and ensuring the empowerment of women	Implementation of the proposed project will create employment and business opportunities. Where such opportunities are directly linked to the proponent and the contractor (especially during construction and operation) the proponent is advised to ensure equal opportunity across gender. They are further advised (applying the principles of sustainable development) not to discriminate against people with disabilities.
22.	The National HIV Policy (GoK, 1997)	Ensuring that new development projects encourage preventive and responsible behaviour both for the workers involved in such projects and also the local people within which projects are taking place as a goal towards curtailing the spread of the disease	The proponent is advised to put in place adequate measures so as to ensure that implementation of the proposed projects does not heighten the spreads of HIV and AIDS
23.	The National Environmental Sanitation and Hygiene Policy (2007)	4.3: Sanitation and the environment Protection of the environment from pollution and its negative effect on human health; Ensuring use of technologies that uphold the right of present and future generations to a healthy and pollution-free environment; Ensuring the use of sanitation systems that are environmentally	The proponent is advised to ensure that high standards of hygiene and sanitation are maintained throughout the proposed project' cycle.

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
		sound; Preventing environmental pollution from liquid and solid waste; Setting of clear standards and guidelines for environmental sanitation; Increasing environmental sanitation awareness across the Country	
Key National Strategic Plans			
24.	The National Climate Change Response Strategy, 2012	The first of its kind in Kenya and sets out an ambitious plan for climate change mitigation and adaptation. Among the plans is to improve transportation to reduce resultant GHG emissions and supporting communities to adopt to the effects of climate change e.g., drought	The proposed project will emit Greenhouse gases to the atmosphere during construction and operation. The actual impact would be equivalent to the quantity of fossil fuels used during construction and electricity consumed during the operation phase (multiplied by the grid emission factor). Using diesel generators would further compound the GHG emission. Additionally, clearing vegetation from the site will reduce the capacity to sequester CO_2 from the atmosphere. Thus, the proponent is advised to plant and replant and equivalent number of trees to sequester carbon and reduce GHG emissions as much as possible
25.	The Kenya Vision 2030 of 2008	Kenya's economic blueprint for the year 2008 - 2030. Sets out an ambitious strategy to improve infrastructure and foster economic development.	The proposed project is in line with the Vision 2030 policy as it will contribute to improving access to water and sanitation
26.	The National Environmental Action Plan 2009 - 2013	Enhancing the protection of wildlife resources; Protection of flora & fauna; Supporting soil erosion and siltation control; Management of invasive alien species among others	Implementation of the proposed project should not introduce nor increase the spread of invasive species in the project area
27.	The National Biodiversity Strategy and Action Plan, 2000	Protection of sites of high biological diversity outside the protected area system because they may be habitats for unique endemics, Adopting best practices in conservation and management	The developmental footprint of the proposed project should be less than 75% and the disturbed areas restored.

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
		of natural resources	
Key Multilateral Environmental Agreements			
28.	The EAC Climate Change Policy (EACCCP) (EAC,2011)	Among other obligations, the EACCP requires that climate change be integrated in all planning, design, and implementation of projects across the region. This will not only enhance adaptation to effects of climate change but also mitigation.	The proposed project will emit Greenhouse gases to the atmosphere during construction and operation. The actual impact would be equivalent to the quantity of fossil fuels used during construction and electricity consumed during the operation phase (multiplied by the grid emission factor). Using diesel generators would further compound the GHG emission. Additionally, clearing vegetation from the site will reduce the capacity to sequester CO_2 from the atmosphere. Thus, the proponent is advised to plant and replant and equivalent number of trees to sequester carbon and reduce GHG emissions as much as possible
29.	The United Nations Convention on biological diversity (CBD), 19992	Article 8 - In-situ conservation (d) Promoting protection of ecosystems, natural habitats, and maintenance of viable populations of species in natural surroundings (j) Respecting, preserving, and maintaining knowledge, innovations, and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application; Article 13 - Public education and awareness; Promoting and encouraging understanding on the importance of and the measures required for, the conservation of biological diversity, as well as its propagation and Cooperating, as appropriate, with other States and international	Clearing of vegetation to create the dam would reduce the area covered by crops, trees and shrubs. However, it will not lead to extinction of these plants since there are no endangered species in the area. During operation, the dam will be a habitat for fish some of which may not have thrived in the river

No.	Legislation, policy, and regulations	Environmental requirements	Relationship with the proposed projects
		organizations in developing educational and public awareness programmes, with respect to conservation and sustainable use of biological diversity	
30.	The United Nations Framework Convention on Climate Change (UNFCCC), 1992	This convention set out the framework for combating climate change and is also a key guide in formulation of policies and agreements aimed at climate change mitigation and adaptation. Parties to the UNFCCC are required under Article 6, to foster education and awareness on climate change	The proposed project will emit Greenhouse gases to the atmosphere during construction and operation. The actual impact would be equivalent to the quantity of fossil fuels used during construction and electricity consumed during the operation phase (multiplied by the grid emission factor). Using diesel generators would further compound the GHG emission. Additionally, clearing vegetation from the site will reduce the capacity to sequester CO_2 from the atmosphere. Thus, the proponent is advised to plant and replant and equivalent number of trees to sequester carbon and reduce GHG emissions as much as possible
31.	Sustainable development goals (SDGs) and agenda 2063 in Africa	By 2030, achieve universal and equitable access to safe and affordable drinking water for all. By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	The project aligns with Kenya's commitment to achieving sustainable development goal 6 by ensuring universal access to clean water by 2030.

3.8. Institutional structure of the water sector

The National Policy on Water Resources Management and Development and the Water Act 2016 guides water resources management. 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. This policy separates policy formulation, regulation, and services provision, defines clear roles for sector actors within a decentralized institutional framework, and includes private sector participation and increased community development. Under the policy, the Ministry of Water, Sanitation, and Irrigation is responsible for policy development, sector coordination, 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 fulfils its mandate through the institutions shown in Figure 4 below. The responsibilities of each institution are discussed in the sections below.

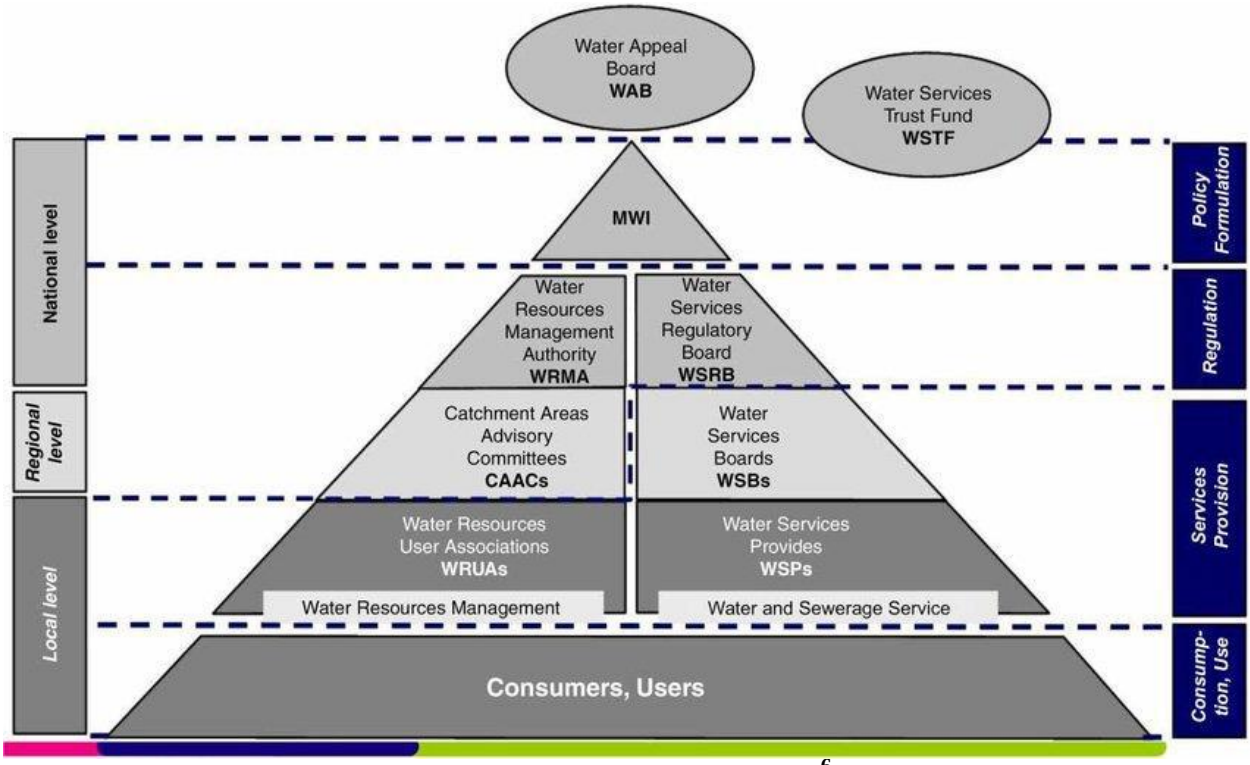


Figure 4: Institutional framework of the water sector (2015)[6]

3.8.1. The Water Services Regulatory Board (WASREB)

The regulatory Board is responsible for regulating 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.

[6] Ndirangu, N., Ng'ang'a, J., Chege, A., de Blois, R. J., & Mels, A. (2013). Local solutions in non-revenue water management through North–South water operator partnerships: The case of Nakuru. Water Policy, 15(S2), 137-164

ii. Overseeing the implementation of policies and strategies relating to provision of water services licensing of Water Services Boards and approving their appointed Water Services Providers,
iii. Monitoring the performance of the Water Services Boards 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

3.8.2. Water Resources Authority (WRA)

The Authority is responsible for the sustainable management of the nation's Water Resources;

i. Implementation of policies and strategies relating to the 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 impacts,
v. Classify, monitor and allocate water resources.

3.8.3. Water Service 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 services

3.7.4. Water Service Boards (WSBs)

The WSBs are responsible for the efficient and economical provision of water and sewerage services in their areas of jurisdiction. The primary functions of the water service boards include;

i. Develop the facilities, prepare business plans and performance targets
ii. Planning for efficient and economical provision of Water and sewerage services within their areas of jurisdiction;
iii. Appointing and contracting Water Service Provider
iv. Asset holding of Central Government facilities

3.7.5. Water Service Providers (WSP)

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

3.7.6. Athi Water Works Development Agency

Athi Water Works Development Agency (AWWDA) is one of the nine (9) Water Works Development Agencies (WWDA) established under the Ministry of Water, Sanitation & Irrigation. It was established under the Water Act 2016 vide Legal Notice No. 28 of 26th April 2019. The agency is responsible for developing, maintaining, and managing water and sewerage infrastructure in the counties of Nairobi, Kiambu and Muranga Counties covering 5,800.4km^2 with a total population of 8,012,390 people. Currently, the agency has a bulk water production capacity of 664,337m^3/day and a wastewater treatment capacity of 210,500 m^3/day.

3.8. The IFC Environmental Safeguards

3.8.1. OP/BP 4.01 (Environmental Assessment)

The World Bank has well-recognized environmental assessment processes, which apply to its lending activities and the projects undertaken by borrowing countries to ensure that development projects are sustainable and environmentally sound. Although its operational policies and requirements vary in certain respects, the World Bank follows a relatively standard procedure for the preparation and approval of an environmental assessment study, which:

i. Identifies and assesses potential risks and benefits based on proposed activities, relevant site features, consideration of natural/human environment, social and transboundary issues
ii. Compares environmental pros and cons of feasible alternatives
iii. Recommends measures to eliminate, offset, or reduce adverse environmental impacts to acceptable levels (sitting, design, technology offsets)
iv. Proposes monitoring indicators to implement mitigation measures
v. Describes institutional framework for environmental management and proposes relevant capacity-building needs.

The environmental assessment evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The assessment takes into account: the natural environment (air, water, and land); human health and safety) social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); and transboundary and global environmental aspects. Preventive measures are favoured over mitigation or compensatory measures, whenever feasible. This approach is universally applied in many institutional projects[7].

The World Bank considers environmental impact assessment (EIA) as one among a range of instruments for environmental assessment. Other instruments used by the World Bank include regional or sectoral environmental assessment, strategic environmental and social assessment (SESA), environmental audit, hazard or risk assessment, environmental management plan (EMP) and environmental and social management framework (ESMF). The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of

[7] www.worldbank.org/safeguards

environmental assessment. Proposed projects are classified into one of three categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts:

- **Category A:** the proposed project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. For a Category A project, the proponent is responsible for preparing an EIA report.
- **Category B:** the proposed project has potential adverse environmental impacts on human populations or environmentally important areas such as wetlands, forests, grasslands, and other natural habitats - but these are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases, mitigation measures can be designed more readily than for Category A projects. Like Category A the environmental assessment examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.
- **Category C:** the proposed project is likely to have minimal or no adverse environmental impacts. Beyond screening, no further environmental assessment action is required for a Category C project.

Environmental Assessment is used in the World Bank to identify, avoid, and mitigate the potential negative environmental associated with Bank lending operations. Environmental Assessment aims to improve decision-making, ensure that project options under consideration are sound and sustainable, and that potentially affected people have been properly consulted.

3.8.2. OP/BP 4.04 (Natural Habitats)

The policy is designed to promote environmentally sustainable development by supporting the protection, conservation, maintenance and rehabilitation of natural habitats and their functions. The policy seeks to ensure that World Bank-supported infrastructure and other development projects consider the preservation of biodiversity and the numerous environmental services and products that natural habitats provide to human society. The policy strictly limits the circumstances under which any Bank-supported project can damage natural habitats (land and water area where most of the native plant and animal species are still present).

3.8.3. OP/BP 4.11 (Physical Cultural Resources)

This policy is meant to assist in preserving physical, cultural resources, including the movable or immovable (above or below ground, or under water) objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance including sites and unique natural values. Physical cultural resources are important as sources of valuable scientific and historical information, as assets for economic and social development, and as integral parts of a people’s cultural identity and practices.

3.8.4. OP/BP 4.10 (Indigenous Peoples)

This policy contributes to the Bank's poverty and sustainable development mission by ensuring that the development process fully respects the dignity, human rights, economies, and cultures of indigenous peoples. For all projects proposed for Bank financing and affecting indigenous peoples, the Bank requires the borrower to engage in the process of free, prior, and informed consultation. The broad support of the project by the affected Indigenous Peoples, such as Bank-financed projects, includes.

i. Preventive measures to adverse effects the indigenous cultures and practices,
ii. Avoid potential adverse effects on the indigenous peoples' communities.
iii. When avoidance is not feasible, minimize, mitigate, or compensate for such effects.

Bank-financed projects are also designed to ensure that the Indigenous peoples receive social and economic benefits that are culturally appropriate and gender and inter-generationally inclusive.

This policy aims to design and implement projects that foster full respect for Indigenous peoples' dignity, human rights and cultural uniqueness so that they receive culturally compatible social and economic benefits and do not suffer adverse effects during the development process. Space-intensive sub-projects such as solid waste dumping sites, wastewater disposal areas and commuter rail stations can potentially disrupt indigenous people. Improved Social and economic systems across the metropolitan leads to potential intrusion to existing cultures.

3.8.5. OP/BP 4.12 (Involuntary Resettlement)

The policy states, " Where large-scale population displacement is unavoidable, a detailed resettlement plan, timetable, and budget are required. Resettlement plans should be built around a development strategy and package aimed at improving or at least restoring the economic base for those relocated. Experience indicates that cash compensation alone is normally inadequate. Voluntary settlement may form part of a resettlement plan, provided measures to address the special circumstances of involuntary resettlement are included. Preference should be given to land-based resettlement strategies for people dislocated from agricultural settings. If suitable land is unavailable, non-land-based strategies built around opportunities for employment or self-employment may be used".

3.8.6. Project activities triggering World Bank safeguards.

The table below justifies the degree to which the World Bank safeguards relate to the execution of the proposed project.

Table 4: WB safeguards triggering matrix.

Policy	Criteria (yes/no)	Comments
OP/BP 4.01 (Environmental Assessment)	YES	The project components will trigger EA safeguards and is Category B since adverse impacts are site-specific and mitigation measures can be designed more readily

Policy	Criteria (yes/no)	Comments
OP/BP 4.04 (Natural Habitats)	YES	Natural habitats for birds and worms among others may be lost, especially when new ground is broken, and vegetation is cleared.
OP/BP 4.10 (Indigenous Peoples)	YES	The inhabitants in the project area may have high cultural values that may conflict with the proposed project. Another source of conflict may be caused by the exclusion of indigenous people in employment opportunities that may arise during the project's construction phase. These cultural and employment opportunity considerations will be fully addressed and integrated into the project implementation and operations.
OP/BP 4.12 (Involuntary Resettlement)	YES	The proponent, through the National Land Commission, will prepare a resettlement action plan (RAP) before implementing the project

3.9. Project environmental management responsibility interrelationship

The overall responsibility of the project implementation is the AWWDA through their project manager, with the environment and social function being among the various components of the management structure. Therefore, we also propose two environmental and social integration triads into the project implementation focused on the environment function, each with specified responsibilities. The implementation triads will encompass the following (Figure 5 below).

a. The implementation team consists of the contractor (who should appoint a competent environmentalist and a social expert), and the project supervisor (who should also appoint an environmentalist to ensure prompt attention to environmental and social linkages). The third element of the triad shall be the ecological function at AWWDA, from where EMP implementation will be coordinated.
b. The regulatory triad will comprise NEMA and other relevant Lead Agencies overseeing compliance with the established national and sectoral policies and regulations. The public and stakeholders will also play a major role in ensuring that the project meets the expectations of the communities. In this regard, AWWDA will open communication channels through which the community can report any arising concerns during project implementation. Again, the third component of the triad is the environmental function, where complaints and opinions will be received for onward attention by the supervisor and the contractor (Figure 5).

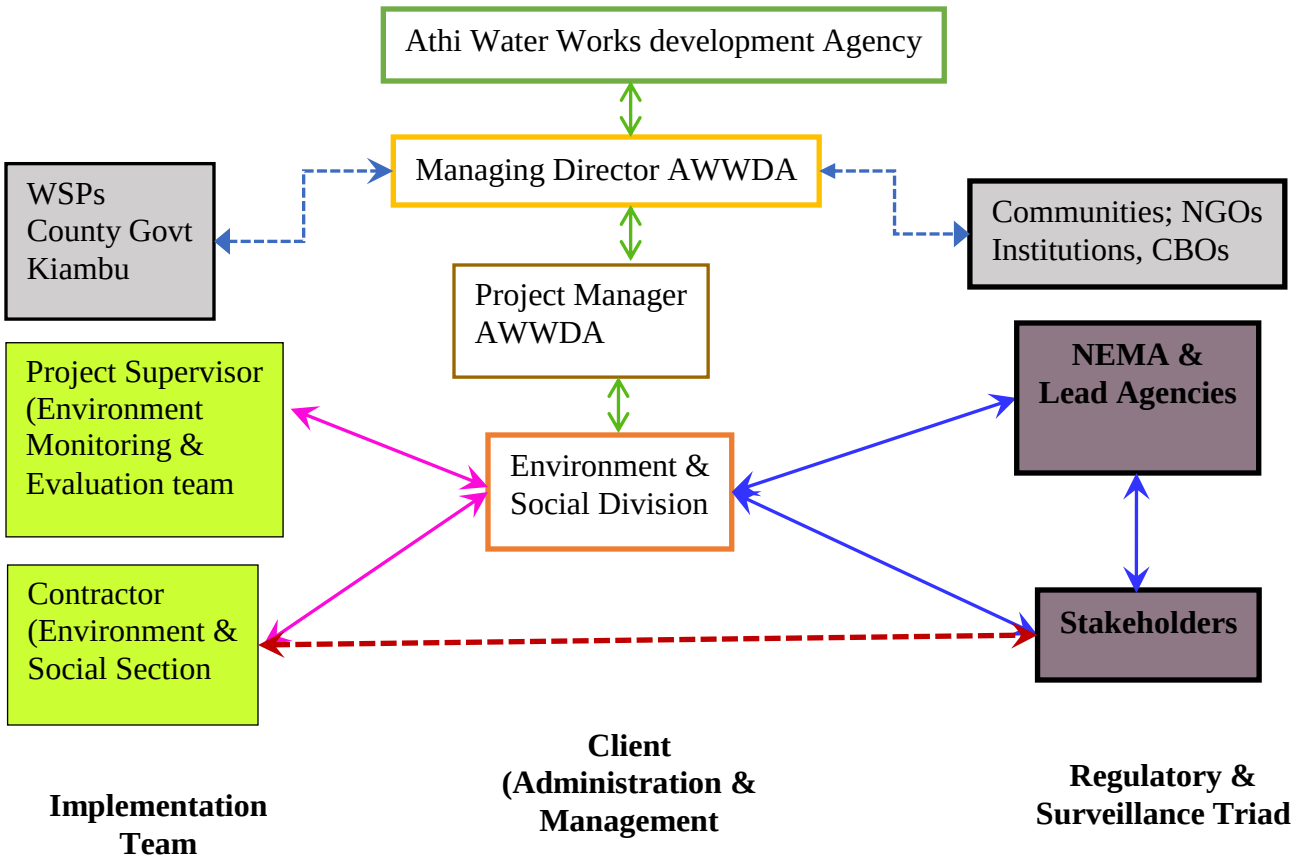


Figure 5: Proposed Project Management Framework

IV. PROJECT DESCRIPTION

4.1. Location

The proposed site is within Thenge-ini area at -0.952197°, 36.882962° off Thenge-ini Road, Kiambu county, as shown in Figure 6 and Figure 7 below. The proposed Ndarugo II dam will be set on Ndarugo river as shown in Figure 7 below.

Figure 6: Proposed project location is shown by the dropped pin

4.2. Project components

4.2.1. Overview

The structures of the head project will include the following:

a. dam, spillway, water intake, bottom outlet and associated facilities
b. water supply pipeline
c. water treatment plant

The water supply project will include a diversion pipeline, water treatment plant, water transmission pipeline, reservoir, and associated facilities. The dam will be a roller-compacted

concrete gravity dam with a crest elevation of 1800.00 m, a crest width of 8 m, a maximum dam height of about 52 m and a total crest length of 300 m.

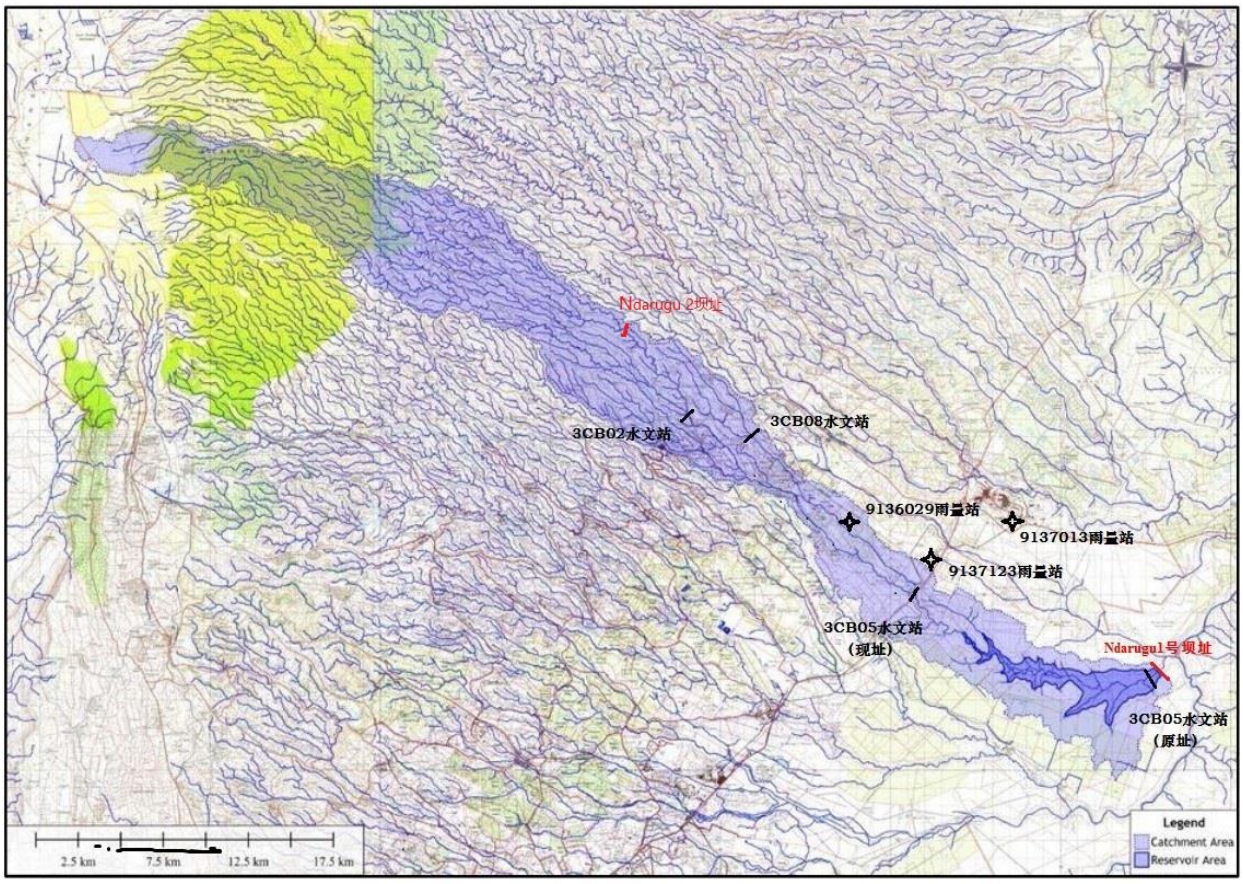


Figure 7: Project location (Source: AWWDA 2023)

4.2.2. Project layout

Ndarugu Dam is located at the upstream of Ndarugu River, about 40km from the junction of Athi River, with a controlled drainage area of 67 km^2, an effective storage capacity of 16.249 million m^3, and an average annual water supply of 16.62 million m^3. Under the 90% guarantee rate, the water supply of the water treatment plant is 50,000 m^3/d. The structures of the head project include dam, spillway, water intake, bottom outlet, etc.

The water supply project includes one pump station, one water treatment plant, 37.7km water transmission pipeline and two pools. The raw water transmission system from the dam water intake to the water treatment plant is composed of raw water pump station and water transmission pipeline. The length of the water transmission pipeline is about 220 m, and the design scale of the raw water pump station is 50,000m^3/d. Water purification plant, scale

50,000m^3/d. The clean water transmission pipe from the water purification plant to the water distribution center is 15.2 km long.

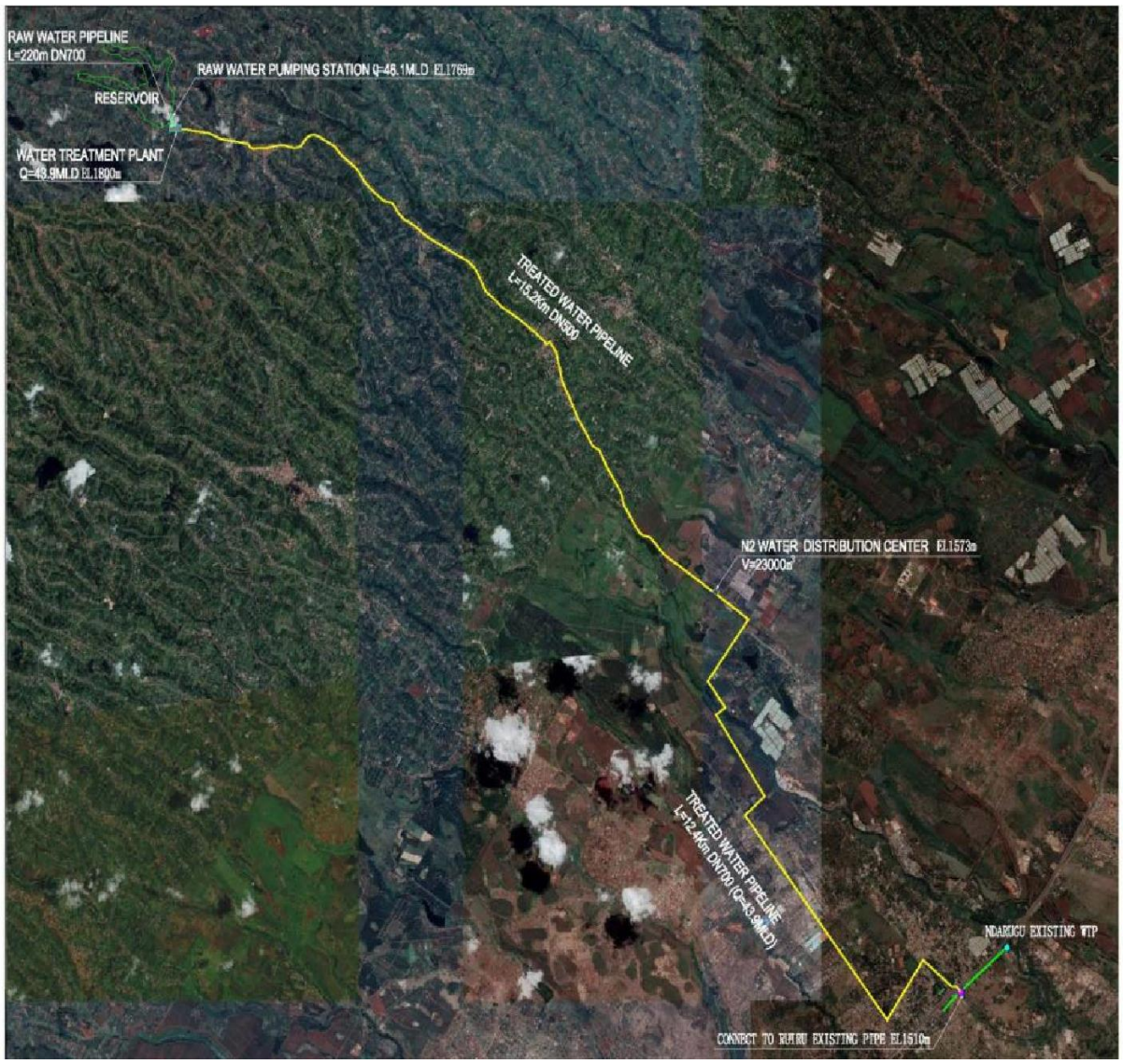


Figure 8: General layout of the proposed project (Source: AWWDA 2023)

4.2.3. Embankments

The embankment will have a slope of 1:2.5 on the upstream side. There will be a 15 m high cofferdam near the dam heel with a 4 m crest/bench. The downstream slope will be 1:3 with a berm at 1,835m a.s.l. The core top will be 1,858m a.s.l. and 10m wide. The core slopes at 1:0.5 giving a bottom width of 49 m that will be excavated to 7m depth. On either side of the core are 2.4 m thick filters. The downstream filter extends along the embankment bottom all the way up to the dam toe where there will be a toe drain.

A toe drain will be provided on the downstream side of the dam. Its materials can be developed from the rock deposits within the potential cuts or potential borrow areas. Rip- rap erosion protection is required. A source of riprap will be identified within the site and therefore rip-rap will be from the reservoir area or very near the reservoir area. It is also recommended that additional rip-rap material be sourced in the vicinity of the dam site because more quantities of coarse boulders that could serve as riprap will be needed. It will be necessary to provide a grout curtain under the core trench depending on results obtained from the drilling and permeability testing.

The purpose of this grout curtain would primarily be to address the potential for seepage through fractured zones oriented roughly parallel to the valley wall along with zones oriented roughly parallel to bedding if any. Depending on the effectiveness of the seepage cut-off efforts, it may also be necessary to install drainage tunnels below the spillway structure and within the left abutment upstream of the diversion channel excavation. An estimate of the cost of these tunnels has been included in the overall estimate developed for this study, however, the actual location and configuration of these tunnels should be determined during subsequent stages of the design.

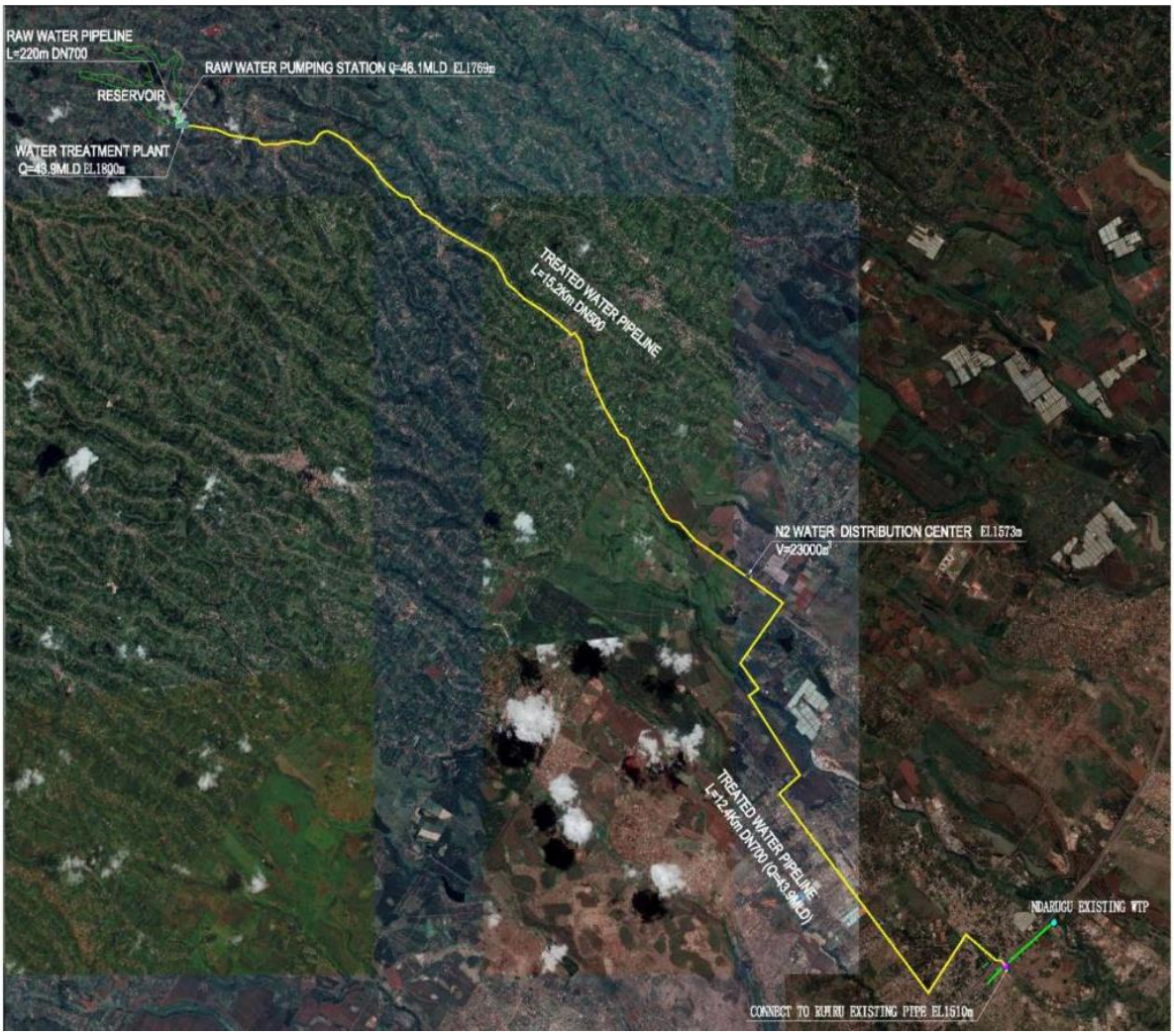


Figure 9: General project layout

4.2.3. Diversion culverts

The diversion culvert is required to pass diversion flow during construction, regulate flood flows, empty reservoir in case of emergency, allow for reservoir lowering for inspection and repairs and for routine de-sludging of reservoir bottom. The approach channel will be aligned straight to the diversion culvert to allow equal distribution of flow though it and in a way to avoid excavation, thus lowering the cost.

The diversion culvert will be 373m long, mostly straight in alignment, with a gentle bend at about 115 m from the downstream end. An adequate slope for drainage will be ensured. At win rectangular cross-section for the culvert with a top semi - circular dome will be adopted. One of the culverts will be blocked at the upstream side of the tower to form a dry culvert where the supply pipe size dn 1,200 mm will pass and will also be the access to the intake tower. The second culvert will be closed at the tower and incorporate a gate to control the release of some of the flood waters through it and flushing the bottom of the reservoir during the flooding period. The control gate chamber for this second culvert will be located at the tower. The control valve for the supply pipe will be located at the downstream end of the first culvert to enable dewatering of the conduit for inspection purposes.

A cut and cover construction in concrete will be preferred to a tunnel cutting for ease of construction and topographical considerations which would otherwise require a much longer tunnel. The culvert will be placed on the rock bed to the right of the river channel facing downstream. The proposed diversion culvert will be twin culverts square in cross-section of 2x4m wide x 4m high with a semi-circular dome on top. The walling will be reinforced concrete of 1.0 m thickness to resist the heavy embankment loads as per preliminary design.

4.2.4. The Spillway

A spillway is a structure used to provide the controlled release of flows from a dam or levee into a downstream area, typically being the river that was dammed. Spillways may also be known as overflow channels. Spillways release floods so that the water does not overtop and damage or even destroy the dam. Except during flood periods, water does not normally flow over a spillway. Floodgates and fuse plugs may be designed into spillways to regulate water flow and dam height. Other uses of the term "spillway" include bypasses of dams or outlets of a channels used during high-water, and outlet channels carved through natural dams such as moraines.

4.2.5. Off-Take Tower

The off-take structure will serve the following purposes:

(i) Water inlet into the supply system
(ii) Block debris and fish
(iii) Provide multilevel weirs for temperature control
(iv) Provide temporary diversion openings

(v) Provide bulkheads for closure

(vi) Provide control gates and measurement devices

An off-take tower structure is preferred to a central control shaft. The of-take tower has a long downstream conduit, thus higher frictional losses and lower possibilities of cavitation. With gates at the tower's upstream end of the diversion culvert, danger from leakage into or out of the abutment is reduced and it is possible to dewater the culvert for inspection. The central shaft has the advantage of protection from freezing and thawing, but these ice action forces are not expected in this region. A central shaft does not require a bridge; however, the tower can be accessed via the tunnel or a surface boat. The of-take tower will be a 46 m high free-standing circular tower in concrete. A free-standing structure will allow flexibility in locating on-site. It is easier to construct and allows the better arrangement of conduits, openings, access structures and instruments than an inclined tower. The circular shape is to take advantage of its superior hydraulic characteristics. The internal diameter will be 10 m with a wall thickness of 1.0 m at the bottom.

4.2.6. Water treatment

Figure 10 below presents the overall water treatment process. The design capacity of the water treatment plant is 50,000 m^3/d. The raw water from Ndaragu River was tested (see Annex A) and met the requirements of the surface water environmental quality and can be utilized as a source of raw water for domestic drinking water. The raw water pumping station will convey the raw water to the water distribution chamber in the WTP, and then enters the folded plate flocculation and horizontal sedimentation tank for flocculation and sedimentation, and then enters the sand filter tank for filtration for further reduction of the water turbidity, and then is disinfected in the clear water reservoir to the standard. Then, the clear water flows under gravity to the Water Distribution Center, where it is supplementary chlorinated and then gravity fed to the existing water distribution network at the connection point. Calcium hypochlorite will be used for disinfection.

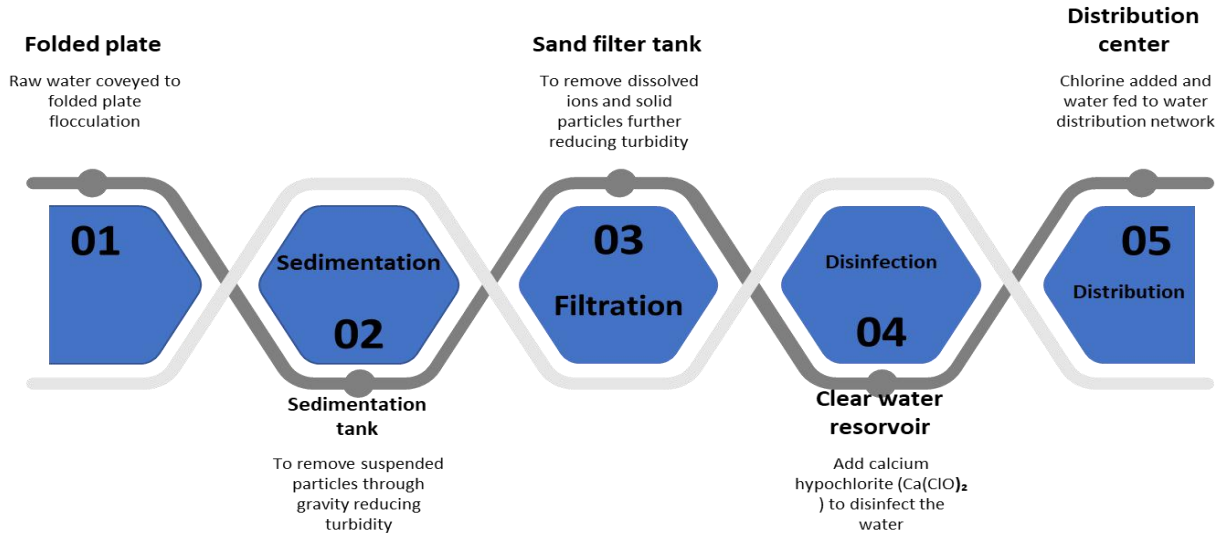


Figure 10: Water treatment process

4.2.7. Water Pipeline

a. From water treatment plant to water distribution centre
The 50,000 m^3/d treated water exits the clear water tank in the water treatment plant via a DN500 mm pipeline. The pipeline is laid out southeastward along the northwest side of the valley on the eastern side of the slope where the water treatment plant is located. And turns to the existing road at about 1.4km. The pipeline will be laid southeast along the pipeline route until it reaches the tank in the water distribution Centre. The section length is approximately 15.2km long and involves one river crossing, which adopts the truss bridge form scheme. The Yellow Line in Figure 9 above is the pipeline route from the water treatment plant to the water distribution centre.

b. From Water Distribution Center to Ruiru-Juja Junction
The 50,000 m^3/d treated water is transmitted from the water distribution to the junction of the existing Ruiru-Juja water supply pipe via a DN700mm pipeline. After the channel exits the water distribution centre, it is laid along the road route to the southeast, then turned to the southwest. After the pipeline passes through the river, the pipeline will be laid southeast along the road route until it is connected to the junction. The section length is about 12.4km long and involves one river crossing, which adopts the truss bridge form scheme. The Yellow Line in Figure 11 below is the pipeline route from the water distribution centre to Ruiru-Juja junction.

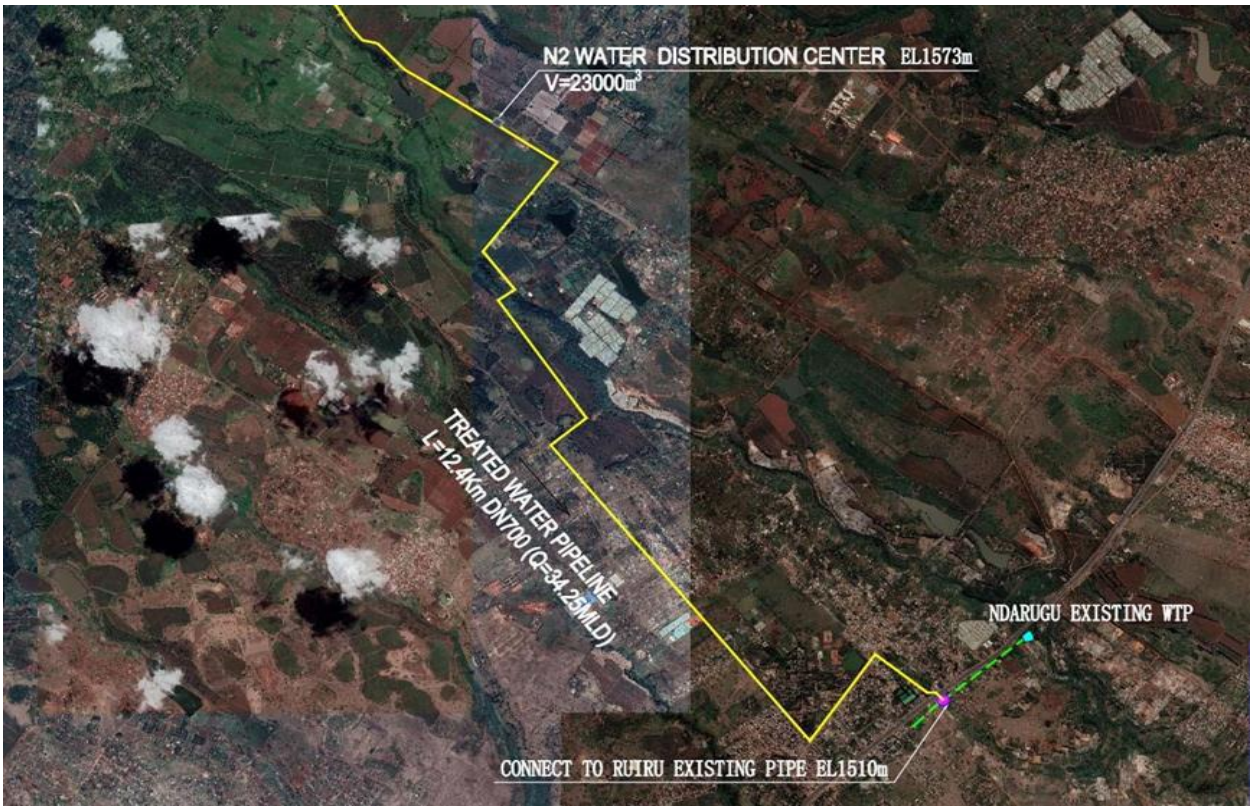


Figure 11: Pipeline Route from Water Distribution Center to Ruiru-juja Junction (Source: AWWDA 2023)

4.3. Project implementation activities

4.3.1 Construction Phase

During the construction phase of a dam, several project activities will be undertaken by the contractor and proponent These will include;

a) Resettlement Activities - There will only be limited displacement of households though with notable land take from the dam area. This follows that residents prefer settling on the elevated grounds while undertaking heavy cultivation on the lower zones. The area is characterized with semi-permanent and permanent homesteads on family-owned land parcels. The process of land acquisition and appropriate compensation is ongoing and appropriate compensation will be undertaken before the project commences.
   The water treatment works requires ~4ha. This land will be acquired about 700m downstream the dam embankment wall. In addition the works will be accessed by a dedicated road running from the main public road. Alongside the treatment works, the 5.5km link treated water rising main to the Northern Collector will also be acquired whose width measures 6m wide leading to ~3.3ha. The area is habited with settlements and agricultural activities; hence, like the dam area, appropriate compensation of livelihoods will be necessary before construction commences.
b) Site Clearing - vegetation clearing of the area covered to pave the way for campsites establishment, parking yards for the contractors machinery and the construction site of for the proposed dam. In the proposed location the predominant vegetation is plantations of tea, coffee and pineapples. There are also a significant number of trees, mainly Eucalyptus ssp., Graveria, wattle tree, fruit trees, and a large volume of ground covering shrubs and grasses. A record of the biomass removed, particularly the trees will have to be kept to facilitate environmental compensation and monetary payments to the landowners. In addition to the clearance of vegetation, there site clearance will generate huge volumes of top soil rich in organic and humic content for disposal.
c) Sanitation Management - It is suspected that there are graves and pit toilets in some parts of the areas targeted for inundation. These features will not be buried under the water due to water quality as well as cultural reasons. For this reason, any graves and pit latrines will be decommissioned and removed under supervision in collaboration with the landowners, local leaders and the security agents.
d) Public Amenities - disruption of access roads, power lines and water abstraction points are likely to be disrupted during the construction process. The project will be responsible of services relocation, provision for alternative amenities (access roads, bridges/crossings), public water access points (water pumps, transmission pipelines and public abstraction points). This will be undertaken in collaboration with the relevant services providers and authorities.
e) Material Sourcing and Haulage - It is expected that materials will be obtained from with, including gravel and hard stone quarries. Ideally, the entire earth fill should be drawn from within the reservoir area and, if required, from the cut spillway area. Therefore borrow areas within the reservoir area should be given first preference, followed by those located on the valley sides close to the proposed embankment. Borrow pits in the reservoir have the added advantage of increasing the upstream storage capacity. Results

indicate that adequate suitable borrow material of low permeability and non-dispersive can be obtained from the reservoir area. The required borrow material for the embankment is 1.477Mm^3. Based on an excavation depth of 3m, usable borrow area of 900,000m^2 will be enough for the earth-fill embankment.

f) Restoration Activities - upon completion of the project, it will be necessary to restore all sections damaged by the construction activities, including surface destruction, access roads, river banks and downstream flood plains. Other areas to be restored include material sources and spoil disposal areas. The dam surroundings will also require landscaping through re-vegetation for aesthetic purposes as well as conservation of the environment.

4.3.2 Operation phase

The very initial stage of the dam operation will be to ensure it is relieving water from the catchment through the rivers and runoff during the rains. This could take up to one year during which there will be strict river flow management to ensure that dependents and ecosystems downstream are sustained. Upon the dam filling, the water will be utilized in accordance to established guidelines and regulations agreeable to the Water Act and other regulatory authorities

V. PUBLIC CONSULTATION & ANALYSIS OF ALTERNATIVES

5.1. Public consultation

Public consultation was viewed as an important activity of this study since it would help the EIA study team to get the stakeholders' views on the perceived environmental and social effects of the project on the project area and their ideas on how the negative impacts can be mitigated. Participatory public consultation for this project was carried out with a wide range of stakeholders in the project area, relevant government institutions, Non-Governmental Organizations, Community Based Organizations, and other interested parties. It is expected that consultations for this project will continue throughout the project implementation phase. The basic objective of the consultations is to raise awareness, get feedback from the stakeholders and improve decision-making by tapping on local knowledge and information through the involvement of individuals, groups, and organizations with a stake in the proposed project.

Plate 3: A woman in Gatie gives her comments on the proposed project

5.2. Objectives of consultation and public participation

The objective of the consultation and public participation was to:

i. Disseminate and inform the stakeholders about the project with particular reference to its key components and location.
ii. Gather comments, suggestions, and concerns of the interested and affected parties.
iii. Incorporate the information collected in the EIA study.

In addition, the process enabled:

i. The establishment of a communication channel between the public, consultants, proponents and the project-affected persons

ii. The concerns of the stakeholders to be known to the decision-making bodies at an early phase of project development

Plate 4: An area chief calls the public meeting to order.

5.3. Methodology used in the CPP

The consultation and public participation (CPP) process is a policy requirement by the Government of Kenya and a mandatory procedure stipulated by EMCA chapter 387 section 58 on EIA to achieve the fundamental principles of sustainable development. Accordingly, the proponent publicized the consultative forums in the media (refer to Annex B) and locally through notices. Table 5 below shows the meeting locations, venues, and times. Minutes of the public consultation forums are appended in annexes C, D, E and F of this report.

Table 5: Location and time for public consultation forums

#	Sub locations	Venue	Time
1.	Gatei	Githigoni Coffee Factory	9.00am – 1.00pm
2.	Gathaite	Gathaite Chief's Camp	9.00am – 1.00pm
3.	Kanjuku	Kanjuku Primary School	9.00am – 1.00pm
4.	Muimuto	Muimuto Nursery School	9.00am – 1.00pm

5.4. Emerging issues

From the consultation forums, it emerged that residents were fearful of having a third dam constructed in their neighborhood for various reasons. These included:

i. the government was yet to conclude compensating residents that ceded land for the other dams,
ii. the dam will change the micro-climate of the area,
iii. the primary beneficiaries of water from the project are urban dwellers in Ruiru and Juja and not the locals,

These issues and other impacts are discussed in detail in section VI and VII below.

5.5. Analysis of alternatives

5.5.1. Alternative sites

According to the AWWDA, the Ndarugu dam project site is generally suitable with exceptional river water resources. The proposed site was selected following extensive studies taking cognizance of each of the various site attributes, namely environmental, social and sustainability, technology, and commercial consideration, including the strength and stability of the water flows in the area, proven technology, benign environmental setting, low population density, security of the area, water availability and road accessibility. Consequently, sound justification and analysis conclude that the current proposed location of the dam appears to be the most suitable because of, e.g., low density of the population of the area and the steep vertical configuration of the banks of the river in the reservoir resulting in less impact than if the bank gradient was smooth.

5.5.2. Alternative ancillary facilities for Ndarugu dam

In addition to the previous alternative dam sites, the current feasibility investigation looks at alternative transmission line routes to Ruiru and Juja. The alternatives considered include controlled water releases from the dam. Besides the issues of costs and yield that led to the current choice, from the public health point of view, the analysis indicates that the water quality will be better with the water treatment works located at the project site and is consequently preferred. Further, the major health impacts concerning the location and construction of the dam, not so much the treatment works.

5.5.3. No project alternative

This option will negatively affect the water supply plans to meet the increasing demand in Ruiru and Juja. The dream of improving access to clean water will not be ably realized. This will also hamper efforts to achieve Vision 2030 and the Sustainable development goal 6. Thus it is prudent for the project to be implemented to achieve the policy objectives of providing clean water for all by 2030.

VI. IDENTIFICATION OF POTENTIAL IMPACTS

6.1. Introduction

Impact matrices for the site preparation and construction phases were created utilizing the following criteria.

Magnitude of Impact: This is defined by the severity of each potential impact and indicates whether the impact is irreversible or, reversible and estimated potential rate of recovery. The magnitude of an impact cannot be considered high if a major adverse impact can be mitigated.

Extent of Impact: The spatial extent or the zone of influence of the impact should always be determined. An impact can be site-specific or limited to the project area; a locally occurring impact within the locality of the proposed project; a regional impact that may extend beyond the local area and a national impact affecting resources on a national scale and sometimes trans-boundary impacts, which might be international.

Duration of Impact: Environmental impacts have a temporal dimension and needs to be considered in an EIA. Impacts arising at different phases of the project cycle may need to be considered.

Significance of the Impact: This refers to the value or amount of the impact. Once an impact has been predicted, its significance must be evaluated using an appropriate choice of criteria. The most important forms of criterion are:

a) Specific legal requirements e.g., national laws, standards, international agreements and conventions, relevant policies etc.
b) Public views and complaints
c) Threat to sensitive ecosystems and resources e.g., can lead to extinction of species and depletion of resources, which can result, into conflicts.
d) Geographical extent of the impact e.g., has trans- boundary implications.
e) Cost of mitigation
f) Duration (time over which they will occur)
g) Likelihood or probability of occurrence (very likely, unlikely, etc.)
h) Reversibility of impact (natural recovery or aided by human intervention)
i) Number (and characteristics) of people likely to be affected and their locations.
j) Cumulative impacts e.g., adding more impacts to existing ones.
k) Uncertainty in prediction due to lack of accurate data or complex systems. Precautionary principle is advocated in this scenario.

6.2. Site preparation and construction phase

The impact matrix for site preparation and construction phase is presented in Table 6 below.

Table 6: Impact matrix for site preparation and construction phases

No.		Activity/ Impact	Direction		Duration		Location		Magnitude			Extent			Significance		
			Positive	Negative	Long	Short	Direct	Indirect	High	Moderate	Low	National	Regional	Local	Large	Medium	Small
	A. Site preparation and construction																
1..		Loss of vegetation		x	x		x				x			x			x
2.		Excavation works		x		x	x				x			x		x	
3.		Soil erosion		x		x	x				x			x			x
4.		Solid waste generation		x		x	x	x									
5.		Air quality															
6.		Increased accidents potential		x		x	x				x			x			x
	B. Material transport and storage																
1.		Traffic congestion		x		x	x				x			x		x	
2.		Potential spillage		x		x	x				x			x			x
3.		Dust and suspended solids		x	x	x				x							x
	C. Construction crew																
1.		Waste water generation		x		x	x	x			x			x			x
2.		Solid waste Generation		x		x	x	x		x						x	
3.		Workers safety															
	D. Socio economics																
1.		Creation of employment	x		x	x	x	x		x			x			x	
2.		Improved road transport network	x		x		x	x		x			x			x	
3.		Increased commercial activity	x		x	x	x	x		x			x			x	
4.		Relocation		x	x		x				x			x		x	

6.2.1. Positive impacts during site preparation, construction, and operation phases

6.2.1.1. Creation of employment

Employment opportunities will be created during the project preparation and construction phases. Jobs created can be classified as direct, indirect, and induced. Indirect jobs are those held by workers in industries that supply road construction manufacturers with materials and by offsite construction industry workers such as administrative, clerical, and managerial workers. Supplying industry jobs include those supported in stone and clay mining and quarrying, petroleum refining, lumber, steel, concrete, and cement products, as well as in miscellaneous professional services. Induced jobs are jobs supported throughout the economy when road construction industry employees spend their wages. Expenditures by these workers on various goods and services stimulate demand for additional employees in these industries, resulting in jobs being supported throughout the general economy.

6.2.1.2. Increased commercial activity

During construction, there will be increased economic activity. This will be in form of supply of material, provision of services such as security and catering among others. The spill over effect will be promoting living standards especially for those directly employed during construction phase.

6.2.1.3. Increased business opportunities

The large number of project staff required will provide ready market for various goods and services, leading to several business opportunities for small-scale traders such as food vendors around the construction site. The project management will wish to reside in the neighborhood hence increased demand for accommodation and other resources.

6.2.1.4. Increased revenue generation

The project will generate revenue through payment of license fees and taxes to the national and county government before and during construction. These monies can then be used to improve service provision e.g. water supply elsewhere in the county.

6.2.2. Negative impacts during site preparation and construction phases

6.2.2.1. Soil erosion and siltation

The potential for land slippage is greatly increased because of vegetation removal. A plant's roots act as a mesh within the substrate, increasing its cohesiveness and improving drainage. Areas, where bare ground is exposed, tend to erode faster than areas inhabited by plants as they help percolate rainwater into the substrate below and underground aquifers. The substrate in the project areas is comprised mainly of black cotton soil, which readily succumbs to weathering over time by rainfall and flowing water. Soil erosion and siltation of nearby drainage channels could negatively impact storm water flow, causing flooding and ponding. Therefore, proper

soil/construction material management practices must be implemented during site clearance, site preparation and the construction phase of the project.

6.2.2.2. Solid waste generation

Under the oversight of the proponent, the construction contractor will be responsible for the proper characterization, collection, storage, and ultimate disposal of all construction-related waste materials, in compliance with waste management regulations and requirements.

The types, sources, and management of wastes anticipated to be generated during the construction of the proposed project facilities are as follows:

- Cleared vegetation: it is expected that the landowners, once compensated, will remove their lands of trees, shrubs, and crops, as these are valuable goods. However, if some vegetation is left at the site, the contractor will clear it and bunch it together at a designated spot where workers or people within the neighborhoods can collect it for their use.
- Excavated soils: After vegetation clearing, the contractor will undertake the deep excavation of soils to construct the dam. The excavated soil will be moved to the periphery of the dam and then backfilled behind the walls.
- Combustible wastes, such as scrap wood, cardboard, paper, and land-clearing wastes (shrubs, grass, etc.) will be generated during the site preparation, construction, and operational phases of the proposed project facilities.
- Special wastes, such as hazardous waste, industrial solvents and other chemical wastes, grease trap pumping and used oil, will be generated during the construction and operational phases of the proposed project. Special wastes could also include waste lubricants, paints, maintenance-related wastes and empty or partially full chemical containers. Special wastes will be segregated from other waste streams, collected, and stored in suitable containers within secondary containment and periodically transported off-site by barge for disposal at an approved location by an approved waste transporter.

6.2.2.3. Impact on air quality

Site preparation can potentially have a two-folded direct negative impact on air quality. The first impact is air pollution generated by construction equipment and transportation. The second is from fugitive dust from the proposed construction areas and raw materials stored on site. Fugitive dust has the potential to affect the health of construction workers, the resident population, and the vegetation. Particulate matter pollution is likely to occur during the site clearance, demolitions, excavation and loading and transportation of the construction waste..

6.2.2.4. Noise and excessive vibrations

Site clearance for the proposed development necessitates the use of heavy equipment to carry out the job. This equipment includes bulldozers, backhoes, jackhammers etc., additionally some demolitions will be carried out. The noise directly attributable to site clearance activity should not result in noise levels in the residential areas to exceed 55dBA during daytime (7am – 10 pm)

and 50dBA during nighttime (10 pm – 7 am). Where the baseline levels are above the stated levels, it should not increase the baseline levels by more than 3dBA.. The construction noise levels are a function of the scale of the project, the phase of the construction, the condition of the equipment and its operating cycles, the number of pieces of construction equipment operating concurrently. To gain a general insight into potential construction noise impacts that may result from the project, the typical noise levels associated with various types of construction equipment are identified in Table 7 below. The noisiest periods will typically be the ground clearing and earthwork phases.

Table 7: Typical noise levels from construction equipment[8]

No.	Type of equipment	Typical sound level at 15meters
1	Dump truck	88
2	Portable air compressor	81
3	Concrete mixer	85
4	Jackhammer	88
5	Scraper	88
6	Bulldozer	87
7.	Paver	89
8.	Generator	76
9.	Pile driver	101
10.	Rock drill	98
11.	Pump	76
12.	Pneumatic tools	85
13.	Backhoe	85

6.2.2.5. Storage of materials and equipment

Raw materials, for example sand and marl, used in the construction of the proposed development will be stored onsite. There will be a potential for them to become air or waterborne. Stored fuels and the repair of construction equipment has the potential to leak hydraulic fuels, oils etc. Plant growth and health can be significantly affected by dust, grime, and toxic emissions. Leaching from storage areas can disturb the pH balance in the soil and result in plant loss.

6.2.2.6. Transport of raw materials and equipment

The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along local roads.

6.2.2.7. Risk of accidents

During construction, it is expected that workers are likely to have accidental injuries because of accidental occurrences, handling hazardous waste, lack or neglect of the use of protective gear etc. All necessary health and safety guidelines should be adhered to to avoid such circumstances. Workers are also likely to be exposed to diseases from contact with potentially harmful building materials. It is therefore recommended that before the construction activities, materials should be thoroughly inspected and harmonized to the occupational health and safety standards.

6.2.2.8. Oil spills

The machines on site may contain moving parts that will require continuous oiling to minimize the usual corrosion or wear and tear. Possibilities of such oils spilling and contaminating the soil and water on site are real. Likewise, moving vehicles on site may require oil change. But these dangers are curbed by maintaining the machinery in specific areas designed for this purpose.

6.2.2.9. Increased energy consumption

The project will consume fossil fuels (mainly diesel) to run transport vehicles and construction machinery. Fossil fuel is non-renewable, and its excessive use may have serious environmental implications on its availability, price, and sustainability. The project will use electricity supplied by KPLC for construction. Electricity in Kenya is generated mainly through natural resources, namely, water and geothermal resources. Approximately32% of electricity in Kenya is generated from thermal sources[9]. Thus it should be prudently used e.g. by installing occupational sensing lights, use of energy saving bulbs and supplementing with solar PV and solar for water heating systems. Such initiatives will lower grid emissions and the overall project carbon footprint. The main sources of energy that will be required for construction of the project will include mains electricity and fossil fuels (especially diesel). Electricity will be used for welding, metal cutting/grinding and provision of light. Diesel will run material transport vehicles and building equipment/machinery. The proponent should promote efficient use of building materials and energy through proper planning to reduce economic and environmental costs of construction activities.

6.3. Impacts during the operational phase

The activities during the operations stage include daily operations and periodic maintenance of the dam facilities, including the management house, access road, intake valve, and spillway. The long-term benefits of the sub-projects would be realized during this stage. Table 8 below summarizes both the positive and negative impacts of the completed and operational sub-project.

9

6.3.1. Water quality

Water stored in a dam or reservoir must undergo certain physical, chemical and biological transformations. Ndarugu II dam location will face residual faecal and organic matter from pit latrines, graveyards and waste holding sites from the displaced homesteads and social locations. This would particularly impact the health of the consumers and their animals. Nutrients (nitrogen and phosphorous) are expected from the geological emissions, organic decompositions and surface runoff discharges from settlement areas and markets around the dam. This could create the potential for eutrophication of the dam water hence complicating treatment of the water. Turbidity and suspended matter from the entering flows, surface runoff discharges and organic reactions among other sources. This situation will lead to limited light penetration directly linked to the water's biological quality. Biomass accumulation in the dam area could render high humic (organic concentration) levels in the dam water and further downstream. It also has the potential to increase the nutrients and other minerals associated with plant decaying matter. Limited water mixing, aeration and light penetration reduce available oxygen resulting in anoxic conditions at the lower layers of the water. Anaerobic conditions in the lower layers of the water generate carbon dioxide, methane, and hydrogen sulphide and create low PH scenarios. Due to the lowered PH, geologically held iron, manganese, and other heavy metals will likely be released into the water, effectively changing the water quality. The water consumers would feel implications on water quality in the immediate location of the dam as well as social and ecological dependents of Ndarugu River downstream in terms of habitat pollution, people's health and cost of water treatment at various stages.

6.3.2. Water loss

The project could increase through exposure to weak geological points and increased surface area. In addition, the fractures and fissures can potentially infiltrate water into the sub-surface and possibly create springs in the lower areas. The water loss pathways effectively imply;

i. Unaccounted for water losses from the dam structures, such as fissures in the base rock and hence unachieved desired objectives,
ii. The scenario could also affect weaknesses to housing foundations downstream of the phenomena,
iii. Micro-climate moderation (lower temperatures and higher humidity) through increased atmospheric moisture arising from evaporation,
iv. Potential losses at consumer points through wastage and leakages

6.3.3. Hydrology

Depending on the dam design, the flow regime of Ndarugu River could change for a considerable distance downstream. Implications downstream will be;

i. Reduced average high-water levels downstream of the basin,
ii. Constant distribution of silt deposition (land fertility for downstream farmers) will be confined on a narrower flood plain since flood flows will be reduced,
iii. On the other hand, current sub-aquatic ecosystems will be compromised on the higher flood plain zones of the river basin thus slightly changing the basin characteristics (this change in trend has not been quantified at this stage),

iv. One advantage is the reduced channel erosion during high peak flows, reduced water quality (turbidity and suspended matter) and delta protection further downstream at the river mouth.

6.3.4. Other operational phase impacts

Table 8: Operational phase impacts

Impacts	Assessment	Description of Impact
Increased reliability of domestic water supply	High, Direct, Long term	Operation of the project will result in increased reliability of domestic water supply in the service area (Gatundu, Juja and Ruiru), which means enhanced access to safe drinking water and sanitation. There will also be reduced occurrence of water shortage during dry season.
Improved socioeconomic conditions in the sub-project areas and the region	High, Indirect, Long term	The increased reliability of water supply is expected to improve livelihoods of benefitting households contributing to improved socio-economic conditions in the area.
Solid waste, wastewater arising at the operation house during the reservoir regulation.	Negligible, Direct, Long-term	The volume of garbage, night soil and wastewater to be generated from the new Management House would be substantial. The building must be also provided with adequate toilets as required under the Ministry of Health's regulation.
Pathway to achieving SDG 6 and Vision 2030	High, Direct, Long term	Operation of the project will "ensure availability and sustainable management of water and sanitation for all". Specifically, target 1 of this goal reads–"By 2030, achieve universal and equitable access to safe and affordable drinking water for all. In addition, Kenya's Vision 2030's vision for water and sanitation is "to ensure that improved water and sanitation are available and accessible to all".
Increased revenue generation by the County government	High, Direct, Long term	The water service providers in Ruiru, Juja and Gatundu under the county government of Kiambu would experience increased revenues due to enhanced volumes of water sold to households.
Increased wastewater	High, Direct, Long term	Wastewater from households is bound to increase putting wastewater treatment plants under pressure. It will be necessary for the Kiambu county government to enhance the capacity of wastewater treatment and construct new facilities where applicable

Impacts	Assessment	Description of Impact
Water contamination through corrosion	Low, Direct, Long term	Internal corrosion protection for ductile iron pipes will adopt cement mortar lining and the related technical requirements shall comply with the ISO4179 and ISO6600 provisions in “Cement Mortar Inner Lining for Centrifugal Ductile Iron Pipes and Fittings” (CJ/T161-2002). External corrosion protection adopts zinc coating (refer to ISO8179“Ductile Iron Pipes – External Zinc Coating”) and high-chlorinated polyethylene finishing coating.
Sedimentation		Typically, dams and reservoirs intercept close to 90% of sediments from the catchments.

VII. MITIGATION MEASURES

7.1. Mitigation of construction Related Impacts

7.1.1. Air Quality

Controlling dust during construction is useful in minimizing nuisance conditions. It is recommended that a standard set of feasible dust control measures be implemented for all construction activities. Emissions of other contaminants (greenhouse gases, and diesel related particulate matter) that would occur in the exhaust from heavy equipment are also included. The proponent is committed to implementing measures that shall reduce air quality impacts associated with construction.

All personnel working on the project will be trained prior to starting construction on methods for minimizing air quality impacts during construction. This means that construction workers will be trained regarding the minimization of emissions during construction. Specific training will be focused on minimizing dust and exhaust gas emissions from heavy construction vehicles. Construction vehicles drivers will be under strict instructions to minimize unnecessary trips and minimize idling of engines.

Dust emissions will be controlled by the following measures:

- Watering all active construction areas as and when necessary to lay dust.
- Cover all trucks hauling soil, sand and other loose materials or require all trucks to maintain at least two feet of freeboard.
- Pave, apply water when necessary, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Sweep daily (with physical sweepers) all paved access roads, parking areas and staging areas at construction sites.

7.1.2. Minimize the Effects of Noise Emitted from the Site

Significance of noise impacts depends on whether the project would increase noise levels above the existing ambient levels by introducing new sources of noise. Noise impacts would be considered significant if the project would result in the following:

a) Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
b) Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels.
c) A substantial permanent increase in ambient noise levels (more than five decibels) in the project vicinity above levels existing without the project.
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

The proponents shall put in place several measures that will mitigate noise pollution arising during the construction phase. The following noise-suppression techniques will be employed to minimize the impact of temporary construction noise at the project site.

- Install portable barriers to shield compressors and other small stationary equipment where necessary.
- Establishment of noise buffer, for example waterfalls to mask the traffic noise.
- Use quiet equipment (i.e. equipment designed with noise control elements).
- Co-ordinate with relevant agencies regarding all substation construction activities in the residential areas.
- Install sound barriers for pile driving activity.
- Limit pickup trucks and other small equipment to a minimum idling time and observe a common-sense approach to vehicle use, and encourage workers to shut off vehicle engines whenever possible.
- Construction/Demolition works should be done during the day when people are away and also the outside environment is also noisy.
- Adhere to the provisions of Noise Prevention and Control Rules 2005, Legal notice no. 24 regarding noise limits at the workplace.

7.1.3. Minimize the Effects of Exhaust Emission

In order to control exhaust emissions the following measures shall be implemented during construction:

a) Vehicle idling time shall be minimized
b) Alternatively fueled construction equipment shall be used where feasible
c) Equipment shall be properly tuned and maintained

This will also be achieved through proper planning of transportation of materials to ensure that vehicle fills are increased in order to reduce the number of trips done or the number of vehicles on the road.

7.1.4. Hydrology and water quality degradation

Soil sampling and trial holes digging will be conducted before construction begins and soil information will be provided to construction crews to inform them about soil conditions and potential hazards. If hazardous substances are unexpectedly encountered during trenching, work will be stopped until the material is properly characterized, and appropriate measures are taken to protect human health and the environment. If excavation of hazardous materials is required, they will be handled in accordance with applicable regulations. If suspected contaminated groundwater is encountered in the depths of the proposed construction areas, samples will be collected and submitted for laboratory analysis of petroleum hydrocarbons, metals, volatile organic compounds and semi-volatile organic compounds. Appropriate personal protective equipment will be used and waste management will be done in accordance with applicable regulations. Oil absorbent material and storage drums will be used to contain and control any minor releases of engine and other equipment oil.

7.1.5. Worker accidents and hazards when handling hazardous wastes

Adequate collection and storage of waste on site and safe transportation to the disposal sites and disposal methods at designated area shall be provided. In addition the proponent is committed to adherence to the occupational health and safety rules and regulations stipulated in Occupational

Health and Safety Act, 2007. In this regard, the proponent is committed to provision of appropriate personal protective equipment, as well as ensuring a safe and healthy environment for construction workers as outlined in the EMP.

7.1.6. Increase of disease Vectors

Disease vectors such as rats, flies, and cockroaches increase where refuse is exposed or uncollected and can be a hazard. Complete refuse collection and handling service will be provided by the proponent so that this is not a hazard in compliance with the Public Health Act and as also required in the Occupational Safety and Health Act, 2007 regarding hygiene at the workplace.

7.1.7. Possible Exposure of Workers to Diseases

Possible exposure of workers to diseases from building materials at construction site shall be mitigated by occupational health and safety standards enforcement as required in the OSHA, 2007.

7.1.8. Worker Accidents during Construction and Operation

Workers accidents especially in deep trenching operations and from gas accumulation in sewers and other confined spaces shall be mitigated by enforcing adherence to safety procedures and preparing contingency plan for accident response in addition safety education and training shall be emphasized.

7.1.9. Reduction of Impacts at Extraction Sites and Efficient Use of Raw Materials

The proponent will source building materials such as sand, ballast and hard core from registered quarry and sand mining firms, whose projects have undergone satisfactory environmental impact assessment/audit and received NEMA approval. Since such firms are expected to apply acceptable environmental performance standards, the negative impacts of their activities at the extraction sites are considerably well mitigated.

To reduce the negative impacts on availability and sustainability of the materials, the proponent will only order for what will be required through accurate budgeting and estimation of actual construction requirements. This will ensure that materials are not extracted or purchased in excessive quantities. Moreover, the proponent will ensure that wastage, damage or loss (through run-off, wind, etc.) of materials at the construction site is kept minimal, as these would lead to additional demand for and extraction or purchase materials.

In addition to the above measures, the proponent shall consider reuse of building materials and use of recycled building materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites.

7.1.10. Minimization of Run-off and Soil Erosion

The proponent will put in place some measures aimed at minimizing soil erosion and associated sediment release from the project site during construction. These measures will include terracing and levelling the project site to reduce run-off velocity and increase infiltration of rain water into the soil. In addition, construction vehicles will be restricted to designated areas to avoid soil compaction within the project site, while any compacted areas will be ripped to reduce run-off.

7.1.11. Minimization of Construction Waste

It is recommended that demolition and construction waste be recycled or reused to ensure that materials that would otherwise be disposed as waste are diverted for productive uses. In this regard, the proponent is committed to ensuring that construction materials left over at the end of construction will be used in other projects rather than being disposed. Furthermore, damaged or wasted construction materials including cabinets, doors, plumbing and lighting fixtures, marbles and glass will be recovered for refurbishing and use in other projects. Such measures will involve the sale or donation of such recyclable/reusable materials to construction companies, local community groups, institutions and individual residents or home owners.

The proponent shall put in place measures to ensure that construction materials requirements are carefully budgeted and to ensure that the amount of construction materials left on site after construction is kept minimal. It is further recommended that the proponent should consider the use of recycled or refurbished construction materials. Purchasing and using once-used or recovered construction materials will lead to financial savings and reduction of the amount of construction debris disposed of as waste.

Additional recommendations for minimization of solid waste during construction of the project include:-

a) Use of durable, long- lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time
b) Provision of facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements
c) Purchase of perishable construction materials such as paints incrementally to ensure reduced spoilage of unused materials
d) Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste
e) Use of construction materials containing recycled content when possible and in accordance with accepted standards.

7.1.12. Reduction of energy consumption

The proponent shall ensure responsible electricity use at the construction site through sensitization of staff to conserve electricity by switching off electrical equipment or appliances when they are not being used. In addition, proper planning of transportation of materials will ensure that fossil fuels (diesel, petrol) are not consumed in excessive amounts. Complementary to these measures, the proponent shall monitor energy use during construction and set targets for reduction of energy use.

7.1.13. Minimization of Water Use

The proponent shall ensure that water is used efficiently at the site by sensitizing construction staff to avoid irresponsible water use. The proponent will install water-conserving automatic taps and toilets. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff.

7.1.14. Controlling Oil Spills

The proponent will control the dangers of oil, grease and fuel spills during construction by maintaining the machinery in specific areas designed for this purpose. Machinery site repair will be discouraged and repair work restricted to approved garages to avoid pollution from oil, grease and fuel.

7.1.15. Public Health, Safety and Awareness

a) The contractor should provide a small section of the construction site with a shed and a water stand where the food can be served to the construction workers to promote hygiene and health of the employees.
b) A fully equipped first aid kit should be provided at the site.
c) The contractor must have workmen's compensation cover as required by law (The Workmen's Compensation Act), as well as relevant ordinances, regulation and union's agreements.
d) The workers, immediate neighbor and other stakeholders should be sensitized on the dangers and risk associated with the construction works for enhanced self-responsibility on personal safety.
e) The proponent should ensure that the completed buildings are fitted with safety facilities including fire detectors, firefighting equipment, fire exits, adequate access and buffer between the residential premises.
f) Disabled access features and safety signage should be placed strategically around and within the buildings.
g) Appropriate sanitation conveniences should be provided at the site as required in the OSHA, 2007 and echoed in the Public Health Act.

7.2. Mitigation of Impacts during Operation Phase

7.2.1. Ensuring Efficient Solid Waste Management

The proponent will be responsible for efficient management of solid waste generated by the project during its operation. In this regard, the proponent will provide waste handling facilities such as waste bins and skips for temporarily holding domestic waste generated from the facility. Moreover, the proponent will ensure that such waste is regularly and appropriately disposed.

An integrated solid waste management system is recommended. First, the proponent will give priority to Reduction at Source of the materials. This option will demand a solid waste management awareness program in the management and the residents. Recycling, reuse and

compositing of the waste will be the second alternative in priority. This will call for a source separation program to be put in place. The recyclables will be sold to waste buyers within Nairobi City. The third priority in the hierarchy of options is combustion of the waste that is not recyclable in order to produce energy. Finally, sanitary land filling will be the last option for the proponent to consider. The proponent will adhere to the Environmental Management and Coordination (Waste Management), Regulations 2006.

7.2.2. Wastewater Management

The proponent will ensure that there are adequate means for handling the sewage generated from the facility. It is envisioned that a bio digester will be installed. Samples of the treated waste water shall be regularly analyzed pursuant to the fourth schedule of the water quality regulations 2006. It will also be important to ensure that sewage pipes are not blocked or damaged so that the waste can be directed to the sewer line since such vices can lead to release of the effluent, resulting in land and water contamination. Such blockages or damages will be fixed expeditiously. Waste water shall be disposed in compliance with the provisions of the Environmental Management and Coordination (Water Quality), Regulations 2006.

7.2.3. Ensure Efficient Energy Consumption

will be sensitized to ensure energy efficiency in their domestic operations. Hot water solar heating equipment will be installed. Use of solar will reduce the overall electricity consumption. Furthermore, security lights that have to be kept on throughout the night will be powered by solar. Incandescent bulbs will be highly discouraged.

7.2.4. Ensure General Safety

A competent security firm will be engaged to always ensure the general safety and security. A perimeter wall shall be constructed and enhanced by installation of electric fence.

7.2.5. Ensure Efficient Water Use

. Moreover, qualified staff will fix any water leaks through damaged pipes and faulty taps promptly. In addition, the occupants of the facility will be sensitized to use water efficiently.

7.2.5. Enhance water quality

Instituting a broad water quality monitoring system, clearing of vegetation materials (live and dead) at the dam site before the area is excavated and inundated, maintaining appropriate records on water quality as required by the law, avoiding inundation of pit latrines and graveyards, encouraging the proliferation of aquatic macro-fauna along the periphery of the dam to ensure natural aeration of the water, identifying specific point sources of water pollution (cattle pens, market centers, agrochemical use points, etc.) for isolation and management.

7.2.6. Control water loss

i. Geological profiles throughout the area proposed for inundation should be established to identify areas of weaknesses and appropriate strengthening measures incorporated,
ii. Sub-surface water infiltration trends in affected areas should be established and monitored over a period concerning effects on houses and other structures,
iii. Indigenous trees and shrubs that have low water dissipation capacity should be encouraged around the dam buffer zone to minimize loss of water through evapotranspiration processes,
iv. Ensure enhanced maintenance of the distribution pipelines,
v. Introduce economic and financial initiatives towards water saving and responsible utilization at consumer points.

7.2.7. Hydrology

Ensuring compliance with the water resources regulations. At least 30% of the base flow should always flow in the stream to sustain ecological and social requirements downstream, reactivating gauging stations around the dam and downstream to monitor the effects of the dam to the river basin over time.

7.3. Mitigation of Impacts during Decommissioning Phase

7.3.1. Efficient solid waste management

Solid waste resulting from demolition or dismantling works will be managed as described in Section 7.2.1.

7.3.2. Reduction of Dust Concentration

High levels of dust concentration resulting from demolition or dismantling works will be minimized as described in Section 7.1.1.

7.3.3. Minimization of Noise and Vibration

Significant impacts on the acoustic environment will be mitigated as described in Section 7.1.2.

7.4. Health and safety

The key health and safety concerns regarding Ndarugu II dam construction are as follows.

- The construction can cause accidents for communities if there is no restriction on the access to the construction site. In addition, wastes during the construction can also cause negative effects on health of residents if those are not properly treated.
- Residents, especially children could venture into areas of deep excavations, operating equipment, weak grounds or scaffolds.
- Construction workers may be at risk of accidents due to operating mechanical equipment and working at heights.

- Increase health and safety risks of workers and residents due to exposure of construction hazards, including vehicular traffic.
- Disease outbreaks due that could be from workers from within or outside the project area.

Thus, the contractor should implement the following measures to protect the safety and health of project affected persons.

- Assign or hire a qualified person to take in charge of occupational safety and health for workers to monitor and support related issues.
- Coordinate with the communal health centers, village health officials to timely update the disease situation in the localities or health problems of workers that may spread out.
- Coordinate with local authorities, health centers to inform on issues related to the safety of people in the site construction or along construction materials/ waste transport road.
- Installation of warning signs and notices of off limits.
- Fencing off dangerous areas e.g., the entire area under deep excavation

7.5. Dam safety

The central objectives and principles of the Ndarugu dams' safety and mitigation of its safety hazards during planning, design, construction phase, and operation, focus on minimizing any loss or damage downstream in the event of uncontrolled accident or failure. Thus the primary objectives of the dam's safety (adopted from Bowles et al., 2007 are as follows.

a. To control the release of damaging discharges downstream of the dam,
b. To restrict the likelihood of events that might lead to a loss of control over the stored volume and the spillway and other discharges,
c. To mitigate through on-site accident management and emergency planning the consequences of such events if they were to occur

Riprap will be employed to prevent erosion of the downstream face of dams during rainfall events. Often, it is expected to be able to protect the dam during small overtopping events. It is generally an inexpensive method proposed to provide stability while rehabilitating dams expected to overtop. Rock channels may also be used as spillways for releases from dams. From the resistivity survey carried out at Ndarugu dam site, the following conclusions are made:-

- The resistance variation in the area is related to the geology of the subsurface, revealing the stratigraphic layering and the rock characteristics in terms of weathering. It should, however, the shading does not indicate that the formations shaded is homogeneous, but it comprises intercalated lava flows with the same range of resistivity values.
- On the hillsides, the slightly weathered or un-weathered rock is relatively shallow, being less than 10m deep. However, within the valley the un-weathered rock is relatively deep, being more than 20m.
- No structural discontinuities have been positively identified in the profiles.
- From the results of trial pits and the associated soil tests;
    i. The regolith is thick enough to provide sufficient borrow material for the embankment.
    ii. The percentage of fines for the soils is suitable for constructing a homogeneous embankment and obtains a reasonable compacted density.
    iii. The permeability of the soil material at the site is sufficiently impermeable.

The following recommendations for further investigations have been made from the preliminary study done at the Dam site:-

- Drilling of exploratory holes is highly recommended to compare the geophysical results and results of actual drilling. About six boreholes, four along the dam axis (two on either side of the river) and two upstream, preferably at the location of the low resistivity sections to give a clear picture of the subsurface. This will indicate the depth of the solid rock
- Drilling should be done to a depth of about 30m on the hillsides and up to 50m within the valley where the un-weathered rock is relatively deep. This will be accompanied by sampling and appropriate logging.
- Standard penetration tests (SPT) on the soils should be done on-site during the core drilling. This will indicate the soil's stiffness level and estimate the shear strength.
- Permeability tests should also be carried out during the drilling to determine the rock permeability levels with depth. This will indicate the seepage characteristics of the underlying rock.
- Rock samples will be tested for petrology, porosity, density, uni-axial compression and point load tests. This will indicate the ultimate and allowable bearing capacity.

VII. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

7.1. Introduction

An environmental management/monitoring plan has been developed to assist the proponent in mitigating and managing environmental impacts associated with the project's life cycle. However, critical factors and processes may change throughout the project's life, and many provisions have been made for the dynamism and flexibility of the EMP. As such, the EMP will be subject to a regular regime of periodic review.

Table 9 forms the core of this EMP for the construction, operational and decommissioning phases of the proposed project. In general, the table outlines the potential safety, health and environmental risks associated with the project and details all the necessary mitigation measures, their financial costs, and the persons responsible for their implementation and monitoring. The EMP will be used as a checklist in future environmental audits.

7.2. Construction Phase Environmental Management Plan

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities about the prevention, minimization and monitoring of significant negative impacts and maximization of positive effects associated with the proposed project's construction phase are outlined in Table 9.

7.3. Cost of mitigation

The costs of the mitigation measures and the institutional and training requirements to implement them are with a ceiling budget of approximately **2.5% of the total project cost.** A comprehensive work program, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measure will be prepared based on this budget guideline.

7.4. EMP for the construction and operational phase

The necessary objectives, activities, mitigation measures, responsibilities and monitoring indicators for prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts associated with the construction and operational phase of the proposed project are outlined in Table 9 below

Table 9: EMP for the construction and operation of Ndarugu II Dam

No.	Environmental Impact	Mitigation Measures	Responsibility for Implementation	Site of Implementation	Cost (Ksh) comment	Responsibility for Monitoring	Monitoring Indicators
Objective: To reduce and mitigate impacts during Impacts during site clearance and preparation							
1.	Conflicts arising due to loss of land, developments e.g. houses and crops	Prepare a resettlement action plan (RAP) Compensation of affected persons Creating awareness, informing all community members along the pipeline routes. Incorporating community input; creation of a community liaison office.	AWWDA and County Government of Kiambu; NLC	Along the proposed water pipeline routes and borehole sites	Compensation cost as agreed by affected persons	Contractor, AWWDA. & EIA Consultant	No. of complaints received. No. of people compensated
2.	Loss of Vegetation	Retention of vegetation where possible. Care will be taken to minimize damage of vegetation cover along the pipeline route.	Contractor, AWWDA .	Along the proposed water pipeline routes and drilling sites	300,000	Contractor, AWWDA. & EIA Consultant	No. of sites landscaped and terraced; No and type of trees and shrubs and amount of grass planted.
4.	Soil erosion	Loose soils to be used to fill back excavated/disturbed areas. Loose soils to be compacted with a mechanical roller so as to avoid erosion by wind or water.	Contractor, AWWDA .	In disturbed sites where there are cuts and fills in the vicinity of bridges and culverts, around borrow pits and exposed slopes.	5,000,000	Contractor, AWWDA. & EIA Consultant	Levels of turbidity recorded in the receiving waters.
5.	Noise & air quality concerns	Provision of mufflers on exhausts and standard restrictions to hours of site works. Water spraying on dusty sites during strong wind. Covering wetting of materials and wastes, during transportation. Use of ear plugs by construction workers	Contractor, AWWDA .	Along the proposed water pipeline routes and during transportation of materials and wastes	200,000	Contractor, AWWDA. & EIA Consultant	No. of complaints from local residents; Noise Levels recorded; No. and type of protective hearing devices dispensed to workers
6.	Increased	Dispose waste at licensed waste	Contractor,	Along the	1,000,000	Contractor,	No of complaints from

No.	Environmental Impact	Mitigation Measures	Responsibility for Implementation	Site of Implementation	Cost (Ksh) comment	Responsibility for Monitoring	Monitoring Indicators
	generation of waste	treatment sites. Adhere to waste management regulations of 2006	AWWDA .	proposed water pipeline routes		AWWDA. & EIA Consultant	residents
7.	Visual impact	Take care to minimize destruction of vegetation. Replanting of vegetation after completion of works	Contractor, AWWDA .	Along the proposed water pipeline routes	400,000	Contractor, AWWDA. & EIA Consultant	No. of sites landscaped and terraced; No and type of trees and shrubs and amount of grass planted.
8.	Road traffic disruption	No overloading of trucks and. good driving practices to be practiced. Suitable junction/access point to be provided. Use of appropriate & legible signage. Employment of formal flagmen / women in order to ensure the public safety.	Contractor, AWWDA .	Where construction works and transport vehicles approach major roads and junctions	1,000,000	Contractor, AWWDA. & EIA Consultant	No. of accidents related to transport of materials. No. flagmen and women. No. of road signage & furniture related to construction works
9.	Impacts on Cultural, religious and sensitive sites	Mapping of cultural, religious and sensitive sites. Rerouting the pipeline to less sensitive sites. Consulting the local elders and compensation for any damages caused.	Contractor, AWWDA .	Along the proposed water pipeline routes	Compensation cost as agreed by proponent and affected persons	Contractor, AWWDA. & EIA Consultant	No. of cultural and religious sites along the proposed route e.g. no. of mosques
10.	Loss of land[10] and farm crops	Restrict pipelines construction along the shoulders of roads and compensate for lost land and crops where applicable	AWWDA and County Government	Along the proposed water pipeline routes	Compensation (where applicable) costs as agreed by affected persons	Contractor, AWWDA CG & EIA Consultant	Amount paid for compensation and number of people paid
Objective: To minimize, control and mitigate impacts during construction phase							
11.	Air Quality concerns	Limit levels of dust through good practice such as watering of access routes, construction sites, deviations and other disturbed sites and cover lorries	Contractor, AWWDA .	Along construction and pipeline rehabilitation routes and	3,000,000	Contractor, AWWDA. & EIA Consultant	Complaints from local residents; number of water bowsers used; number and type of dust protective gear

[10] Land here includes all developments therein

No.	Environmental Impact	Mitigation Measures	Responsibility for Implementation	Site of Implementation	Cost (Ksh) comment	Responsibility for Monitoring	Monitoring Indicators
		transporting construction materials. Provide workers with appropriate dust protective gear including masks and overalls.		material storage areas			supplied to the labor force.
12.	Noise and vibration	Standard restrictions to hours of site works (8:00am – 5:00pm) and the fitting of mufflers on construction equipment. Use of protective hearing devices such as ear plugs and ear muffs among workers when noise levels exceed 85-90dBA. Selection of appropriate machinery and regular servicing of machinery and vehicles	Contractor, AWWDA .	At construction sites along the water pipeline route and at concrete mixing sites	2,000,000	Contractor, AWWDA . & EIA Consultant	No. of complaints from local residents; Noise Levels recorded; No. and type of protective hearing devices dispensed to workers
13.	Health and safety risks	Design and implement safety measures and emergency plans to contain accidents risks Install appropriate road traffic signs, markings and road furniture. Provide workers with protective clothing (nose and mouth masks, ear muffs, overalls, industrial boots and gloves) and helmets	Contractor, AWWDA .	At construction sites along the water pipeline route, trenches and other sites where project activities will be taking place	300,000	Contractor, AWWDA . & EIA Consultant	No of complaints from workers and local community; No. of traffic accidents; No. and type of protective clothing and gear provided to workers
14.	Surface water runoff	Temporary drainage channels should be constructed to encourage dispersal of sudden waters. Storage and stockpiling of materials on the site should be away from drainage channels. Backfill of trenches in or near drains should be topped with rock fill to stop scour where drains have a	Contractor, AWWDA .	At construction sites along the water pipeline route, trenches and other sites where project activities will be taking place	2,000,000	Contractor, AWWDA . & EIA Consultant	Levels of turbidity recorded in the receiving waters. No. and size of galleys caused by water runoff

No.	Environmental Impact	Mitigation Measures	Responsibility for Implementation	Site of Implementation	Cost (Ksh) comment	Responsibility for Monitoring	Monitoring Indicators
		gradient of 5% or over.					
15.	Increased generation of solid waste	Adoption of waste minimization approach as part of the construction works. Monitoring the fate of disposed wastes to ensure they are being legally land filled at a recognized controlled site.	Contractor, AWWDA .	At construction sites and waste treatment sites	1,000,000	Contractor, AWWDA . & EIA Consultant	No. of complaints received from area residents. Volumes and nature of wastes produced.
16.	Increased use of local resources (sand, timber, gravel etc.)	The sources of all required materials should be inspected prior to acquisition to confirm that they are legitimate operations. In the case of sand, an EIA license should be produced by the dealer/quarry operator.	Contractor, AWWDA .	At source of construction materials e.g. sand quarry and material storage sites	No cost incurred only strict verification of sources of materials	Contractor, AWWDA & EIA Consultant	Derelict land caused by quarrying of sand and gravel. Quantity of material used for construction
17.	Visual impact	Care will be taken to avoid having open trenches in an area for a long period of time. Communication lines will be opened by the proponent for reporting of any concerns.	Contractor, AWWDA .	Along the pipeline routes and other construction sites	100,000	Contractor, AWWDA & EIA Consultant	No. of complaints from local residents. No. of days a open trenches stay open before being backfilled
18.	Increased ponding conditions	Improve impeded drainage through landscaping and filling in the created depressions and trenches. Schedule construction during the dry season.	Contractor, AWWDA .	Along the pipeline routes and other construction sites	1,000,000	Contractor, AWWDA & EIA Consultant	No. of drains and depressions , trenches rehabilitated and backfilled
19.	Exhaust and gaseous emissions	Reduce gaseous emissions by selection of appropriate machinery and regular servicing of vehicles. Provide workers with appropriate protective gear including masks to cut down on gaseous emissions inhaled. All workers involved in	Contractor, AWWDA .	Along the pipeline routes and other construction sites	500,000	Contractor, AWWDA & EIA Consultant	No. of complaints from local residents; Levels of nitrogen and Sulphur oxides; Carbon monoxide; Occurrence of smog

No.	Environmental Impact	Mitigation Measures	Responsibility for Implementation	Site of Implementation	Cost (Ksh) comment	Responsibility for Monitoring	Monitoring Indicators
		construction activities to wear face masks.					
Objective: To reduce, control and mitigate impacts during operation							
20.	Increased waste water production	Ensure that all households, institutions and businesses connected to the new water pipeline network will also be connected to the proposed municipal sewer line. The waste water should eventually be treated before being disposed. In addition to this measure, the proponent is advised to explore waste water treatment measures that will ensure nutrient and energy recovery from waste water.	AWWDA	At households, institutions and businesses connected to the rehabilitated and new water pipeline network. Also at waste water treatment sites	The cost of construction and connection of households to a proper waste water treatment system preferably anaerobic treatment.	AWWDA & EIA Consultant,	Quantity of waste water being produced, level of eutrophication in the receiving water bodies, No. of complaints from local residents.
21.	Leakages from water pipelines	Repairing water pipes and sealing leakages when they occur. A communication line and mechanisms (inclusive of use of social media) for reporting leakages must be put in place for quick repair. The proponent will have to liaise with the residents to report any water leakages in their area the same way they report electricity blackouts.	AWWDA	At specific sites where leakages are reported	500,000	AWWDA . & EIA Consultant	No. of reported leakages and estimated volumes of water lost through leakages
22.	Monitoring, Evaluation and Audits	Initiate an M & E during the project implementation to monitoring implementation of the EMP	AWWDA	At specific sites where leakages are reported	3,000,000	Environmental Consultants	No. of reported issues addressed
Objective: To enhance dam safety							
23	User safety and risks	Undertake a comprehensive risk assessment study or the	AWDA	Downstream	300,000,000 annually on safety	AWWDA	Injuries of the operators and visitors,

No.	Environmental Impact	Mitigation Measures	Responsibility for Implementation	Site of Implementation	Cost (Ksh) comment	Responsibility for Monitoring	Monitoring Indicators
	downstream	dam as part of the pre-commissioning stage, maintain a fence around the dam with provision for limited and controlled access to the dam water, Enhance close surveillance by the community, especially those living on risk prone areas, Sensitize the communities on dam safety issues associated with the dam. Provide clear emergency preparedness strategies.			and emergency preparedness		Safety risks of a dam break to downstream. aquatic ecosystems, social and economic features. Safety risks of settlements and farmlands along the transmission pipeline, Risks of drowning into the dam to children, the aged and livestock
Objective: To enhance catchment management							
24	Catchment management	Encourage immediate landowners to take responsibilities of the dam safety, Immediate landowners to be motivated into maintaining buffer zones along the river and the dam itself banks, Guide landowners in the catchment change their land use practices.	AWWDA Farmers	Downstream and upstream	No immediate cost estimate	AWWDA	Area (acres) of land in the catchment properly managed. Awareness and training sessions held by farmers in the catchment area

IX. CONCLUSIONS AND RECOMMENDATIONS

9.1. Conclusions

- The proposed project is in line with Kenya's constitution and policy objectives regarding clean water access and sanitation. Kenya ratified the sustainable development goals in 2015, committing to ensure the availability and sustainable management of water and sanitation for all by the year 2030. Specifically, target 6.1 of SDG 6 is to achieve universal and equitable access to safe and affordable drinking water for all by the year 2030. SDG 6 is in tandem with Kenya's Vision 2030.
- The project will improve water supply to residents of Ruiru and Juja towns where demand for clean water is increasing.
- The project will negatively affect landowners in the dam site who will have to cede land for its construction.
- The negative impacts, however, are identifiable and can be mitigated through design and administrative measures. However, the overall positive impacts of the project far outweigh the negative projects through the mitigation measures outlined for the project.

9.2. Recommendations

a. Continuous engagement of the area residents to reach a consensus on how they could benefit from the project and allow it to be implemented.
b. Implementation of the proposed environmental management plan to enhance the positive impacts and mitigate negative impacts.
c. Prepare a risk and hazard management plan for the operational phase of the project.

ANNEXES

Annex A. Baseline water quality

No.	Parameter	Unit	Measured values	GB3838-2002		KS EAS12:2018	Evaluation	CJ3020-93	Evaluation
				Class III	Evaluation	Local drinking water standard		Grade 2	
1	Turbidity	NTU	2.2			5	Satisfied		
2	PH		7.1	6~9	Satisfied	6.5 to 8.5	Satisfied	6.5 to 8.5	Satisfied
3	Color	degree	10			15	Satisfied	other salient disordered color is not accepted	
6	Total dissolved solids (TDS)	mg/L	44			1000	Satisfied	1000	Satisfied
7	Total hardness (count in $CaCO_3$)	mg/L	20			300	Satisfied	450	Satisfied
8	Iron	mg/L	0.02	0.5	Satisfied	0.3	Satisfied	0.5	Satisfied
9	Manganese	mg/L	/	0.1	Satisfied	0.1	Satisfied	0.1	Satisfied
10	Copper	mg/L	/	1	Satisfied	1	Satisfied	1	Satisfied
11	Zinc	mg/L	/	1	Satisfied	1	Satisfied	1	Satisfied
14	Sulphate	mg/L	0.1	250	Satisfied	400	Satisfied	250	Satisfied
15	Chloride	mg/L	1	25	Satisfied	250	Satisfied	250	Satisfied
16	Fluoride	mg/L	0.2	1	Satisfied	1.5	Satisfied	1	Satisfied
25	Nitrate (count in N)	mg/L	1.6	20	Satisfied	45	Satisfied	20	Satisfied
26	Nitrite (count in N)	mg/L	<0.01	0.015		0.9	Satisfied		
No.	Parameter	Unit	Measured values	GB3838-2002		KS EAS12:2018	Evaluation	CJ3020-93	Evaluation

No.	Parameter	Unit	Measured values	GB3838-2002		KS EAS12:2018	Evaluation	CJ3020-93	Evaluation
				Class III	**Evaluation**	**Local drinking water standard**		**Grade 2**	
				Class III	Evaluation	Local drinking water standard		Grade 2	
30	Total number of bacteria	CFU/mL	132						
31	Fecal coliform count	pcs/L	13000	2000	Exceeding standards	/	Exceeding standards	10000 (pcs/L)	Satisfied

Annex B: Public consultation notice

REPUBLIC OF KENYA

ATHI WATER WORKS

Accelerating Access to Water and Sanitation

ATHI WATER WORKS DEVELOPMENT AGENCY

NOTICE

INVITATION TO PUBLIC PARTICIPATION FORUMS ON CONSTRUCTION OF NDARUGU II WATER SUPPLY PROJECT

Athi Water Works Development Agency (AWWDA) is one of the nine (9) Water Works Development Agencies established under the Water Act 2016 vide Legal Notice No. 28 of 26th April 2019 under the Ministry of Water, Sanitation and Irrigation. AWWDA is responsible for the planning, development, maintenance and management of water and sewerage infrastructure in the counties of Nairobi, Kiambu and Muranga Counties covering 5,800.4Km2 with a total population of 9,320,287 people.

Several water and sewerage projects have been implemented in Kiambu County but still some areas have not been adequately covered.

One of the proposed priority water sources for Gatundu, Ruiru and Juja areas is the development of the Ndarugu II Dam. The main development objective of the project is to increase bulk water supply by 50,000m3/day to serve residents of Ruiru and Juja areas and reduce the projected water demand.

The proposed Ndarugu II Dam is a water supply project on the confluence of Ndarugu and Githobokoni rivers.

Pursuant to the provisions of the Constitution of Kenya 2010, Article 196 (1) on public participation, AWWDA has scheduled public consultative forums to be held on **Friday 13th January 2023** as follows;

S/No.	Sub Locations	Venue	Time
1.	Gatei	Githigoni Coffee Factory	9.00am – 1.00pm
2.	Gathaite	Gathaite Chief's Camp	9.00am – 1.00pm
3.	Kanjuku	Kanjuku Primary School	9.00am – 1.00pm
4.	Muimuto	Muimuto Nursery School	9.00am – 1.00pm

A map of the affected area may be obtained from the AWWDA website at **www.awwda.go.ke**.

The public is also invited to submit written comments on or before **20th January 2023** to the following email address: **ndarugudam@awwda.go.ke**.

Hard copies may be sent to:

CHIEF EXECUTIVE OFFICER
Athi Water Works Development Agency,
Athi Water Plaza,
Muthaiga North Road,
P.O. Box 45283 00100,
Nairobi

Signed:
Chief Executive Officer,
Athi Water Works Development Agency

Accelerating Access to Water and Sanitation

Annex C: Public Consultation Minutes Gathaite Location

Meeting attendance:	**Facilitators:** i) Vincent Oduor – EMC – Lead consultant ii) John Gichaga – EMC - Taking Minutes iii) Douglas sakana - EMC iv) Dorcus wambui gichuki – Assistant Shief –Gathaite Sub-location v) Gladys Chebet- Athi Water vi) Eng Denning Kiai - Athi Water vii) Charity Iminza – Athi Water viii) Hellen Wangui- Assistant Chief Mbichi Sub-location **Attendants:** See signed attached list	
Date:	13th January 2023	
Time:	11.03am - 11:29am	
Venue	Gathaite	
Agenda Topic #1: Introduction		**Remarks:**
The meeting started at 11.03am with a word of prayer from Ms. Helen Wangui the area assistant chief. The meeting was then followed by a brief welcome from the area (Gathaite) assistant chief who then introduced her colleague the assistant chief from the neighboring Mbichi sub location Ms. Dorcas Wambui. The Chief then welcomed the residents and emphasized the need for having a public participation meeting for both government and non-government's projects as required in the constitution and under the EMCA chapter 387. The Proponent took over the forum and made the introductory remarks in regards to the feasibility study process; the Consultant stated that the proposed development falls under the High risk classification and highlighted the need for the public participation meeting. The proponent submitted the Terms of reference (TOR) to the NEMA which had been approved. The proposed Project implementation would affect the local community and thus it was paramount that the local residents shared their views. The Proponent urged the residents to give as much feedback and opinion as possible once the open forum starts so that the views are incorporated into the mitigation measures and project's implementation by the proponent and the relevant parties.		*The participants were informed that this meeting was planned as part of the feasibility study and the need for the public participation.*
Agenda Topic #2: Purpose for the meeting		
After the introductory remarks, The Consultant asked Eng Denning Kiai one of the consulting team engineers to give details of the feasibility study. He explained that the scope of the subject project was big hence calling		

for the need to conduct a feasibility study and involve the locals so as to create awareness and consultative meetings amongst the affected stakeholders. He then urged the participants to give their comments on the proposed project at liberty. The consultant then opened the floor so that the participants would air their feedback and opinions.	
Agenda Topic #3: Open Discussion	
During the open discussion, several issues were raised and discussed among the participants; majority of the members present were reluctant to give their views about the development saying that it is located next to other similar projects and they have not been compensated from the previous similar projects also the project shall bring no benefits to the area and local residents. Some of the opinions raised are addressed as follows; **CM 1[11].** The participant a local resident expressed his dissatisfaction for the proposed project and its initial intentions and plans **CM2.** The participant raised concern on the need not to have the proposed construction of the dam done in their locality.	*The area assistant chief commented that the meeting was on feasibility study process.*
Agenda Topic #4: Closing remarks	
The Assistant Chief thanked everyone for finding time to attend the meeting. There being no other business, it was agreed that there would be continued stakeholder engagement on the said project. The meeting ended with a word of prayer from Pastor Amos an area resident. **The meeting adjourned at 11: 30am**	*All participants unanimously rejected the proposed project.* *There would be continued stakeholder engagement to reach a consensus.*

[11] We have used the notation CM where CM refers to commenter/participant and n is the numerals 1,2, etc. to refer to the participants talking in succession e.g. CM 1 refers to commenter 1 or first commenter; CM2 refer to commenter 2 etc.

Annex D: Public Consultation Minutes Gatei sub-location

Meeting attendance:	**Facilitators:** ix) Vincent Oduor – EMC - Lead Consultant x) Michael Mituki – EMC - Taking Minutes xi) Nicholus Ojung'a xii) Phenny Awuor- EMC – xiii) Mohammed Koech – Athi Water Works Development Agency (AWWDA) xiv) Loice Kamau- Athi Water xv) Cecilia Wambui- Athi Water xvi) Peter Kabutu – Athi Water **Attendants:** See signed attached list
Date:	13th January 2023
Time:	9.30 am-11:30am
Venue	Gatei Sub-location

Agenda Topic #1: Introduction	**Remarks:**
The meeting started at 10.00 am with a word of prayer from a local resident then followed by a round of introduction from the present meeting facilitators. There was a brief welcome from the area Chief covering Gathaite location. The Chief then invited the Assistant County Commissioner (ACC) covering Mang'u Division who then welcomed the team to the meeting.	*The participants were informed that this meeting was planned as part of the EIA process and the need for the public participation.*
The ACC welcomed the residents and emphasized the need for having a public participation meeting for both government and non-government's projects as required in the constitution and under the EMCA 1999. The Athi Water representative (Manager Environmental Safeguard) introduced the project briefly and other dam projects constructed by the national government in the area and outside the project area. Peter, the Engineer for the project introduced the project saying that there are various aspects of such projects that the proponent looks into. He highlighted the factors that are considered in constructing a dam project as water is a basic requirement for survival. The Engineer informed the gathering that the project was still at its emerging stage hence various factors were still under consideration by various actors of the project, this would also identify the most potential site to have the project sited. The proposed Project implementation would affect the local	*The Proposed Ndarugo II Dam is meant to increase the bulk water supply by 50,000M^3/ day to serve residents of Ruiru and Juja area thus reducing the current and projected water demand.*

community and thus it was paramount that the local residents shared their views. The proponent urged the residents to give as much feedback and opinion as possible so that the views are incorporated into the mitigation measures and project's implementation by the proponent. He stated that the implementation of any project would have negative and positive impacts to the environment, and it was upon the proponent to curtail the negative impacts and to enhance the positive impacts as much as possible. Some of the negative impacts that were stated include loss of land and evictions, dust, communal separation, loss of aesthetic value among others.	
Agenda Topic #2: Purpose for the meeting	
Some of the information passed were the project details including:- • Project Design (scope) and construction, • Project location details • Project's impacts both positive and negative including traffic effects, dust, noise, vibration etc. supply of residential facilities and employment opportunities. The land acquisition details would be ironed out in subsequent meetings.	
Agenda Topic #3: Open Discussion	
During the open discussion, several issues were raised and discussed among the participants; all the members present were supportive to the development saying that it is located next to other similar projects scope and also away from the residential areas, the project also shall bring a wide range of benefits to the area and local residents. Some of the opinions raised are addressed as follows; **CM 1[12].** The participant a resident expressed his disquiet that the project information had not been adequately disseminated to the residents and as such they were opposed to the project.	
Action Items:	*Responsible*
1. Involve the residents in all phases of the project including in	Proponent

[12] We have used the notation CM where CM refers to commenter/participant and n is the numerals 1,2,3 etc. to refer to the participants talking in succession e.g. CM 1 refers to commenter 1 or first commenter; CM2 refer to commenter 2 etc.

identifying the project site, technology, compensation and project timelines. 2. Ensure there is adequate dissemination of information to the residents so as to ensure there is project acceptability.	Proponent, Local Administration.
Agenda Topic #4: Closing remarks	
The Chief thanked everyone for finding time to attend the meeting. It was agreed that there would be continued stakeholder engagement to incorporate all issues raised. **The meeting adjourned at 11: 20am**	

Annex E: Public Consultation Minutes Kanjiku sub-location

Meeting attendance:	**Facilitators:** i. Vincent Oduor – EMC – Lead consultant ii. Elizabeth Wanjiru- Environmental Management Consultancy (Taking Minutes) iii. Phenny Okech- Environmental Management Consultancy iv. Winnie Kangai- Athi Water Works Development Agency v. Irene Ngetich- Athi Water Works Development Agency vi. Kungu Nelius- Athi Water Works Development Agency vii. Jonathan Shango- Athi Water Works Development Agency viii. Mr. Samuel- Ward Administrator, Kiambu County ix. Mr. Peter- Chief- Kanjuku Location **Attendants:** See signed attached list
Date:	13th January 2023
Time:	10:30 am-10.55am
Venue	Kanjuku Primary School, Gatundu North Sub county

Agenda Topic #1: Introduction	**Remarks:**
The meeting started at 10:30 am with a word of prayer from one of the community members. The area Chief welcomed everyone to the meeting and was followed by a brief introduction by the facilitators. Mr. Jonathan Shango (engineer at Athi Water) explained to the residents about the project that the proposed Dam will serve as a water storage with a capacity of 50,000m3/day. The meeting's objective was therefore to conduct a feasibility study for the purposes of informing the area residents and to assess the viability of the project.	*The meeting invited the Kanjuku location community members.* *The participants were informed that this meeting was planned as part of the project's feasibility study.*
Agenda Topic # 2: Open Discussion	
One of the invited community members questioned the reason as to why the dam must be built in their Sub County being that there are already two other dams. He went ahead to disagree with the idea and was supported by all the residents and was followed by the community members walking out of the meeting.	
Agenda Topic # 3: Closing Remarks	

Annex F: Public Consultation Minutes Mwimuto sub-location

Meeting attendance:	**Facilitators:** i) Vincent Oduor – EMC - Lead Consultant ii) Lucy Wanjiru - EMC -Taking minutes iii) Michael Mituki – EMC - iv) Phenny Awuor- EMC – v) Douglas Sakana – EMC - vi) Elizabeth Wanjiru – EMC vii) Elizabeth Wanjala -AWWDA viii) Bernard Think -AWWDA ix) Matilda Ngeyi -AWWDA **Attendants:** See signed attached list
Date:	13th Jan 2023
Time:	10:42am-11:30am
Venue	Mwimuto

Agenda Topic #1: Introduction	**Remarks:**
The meeting started at 10:42am with a word of prayer from One of the participants Mary Wangare. The meeting was then followed by a brief welcome from the area assistant Chief who then introduced his team. The Project Engineer John Muhia welcomed the residents and emphasized the need for having a public participation meeting for both government and non-government's projects as required in the constitution and under the EMCA 1999. The Engineer made the introductory remarks in regard to the proposed development of Ndarugo II dam and highlighted the need for the public participation meeting. The proposed Project implementation would affect the local community and thus it was paramount that the residents shared their views. The Consultant urged the residents to give as much feedback and opinion as possible once the open forum starts so that the views are incorporated into the mitigation measures and project's implementation by the proponent. The Engineer informed the participants about how the dam will be	*The participants were informed that this meeting was planned as part of the EIA process and the need for the public participation.*

constructed and demonstrated with a map to make the participants understand on the areas it will touch and the areas that will be affected by the construction. He further explained the benefits that will come with the construction of the dam to the community at large. He stated that the implementation of any project would have negative and positive impacts to the environment, and it was upon the proponent to curtail the negative impacts and to enhance the positive impacts as much as possible. Some of the negative impacts that were stated include noise, traffic, safety, dust and vibration among others. Consequently, several positive impacts would be experienced throughout the implementation of the project including; employment, an increase in development, domestic and agricultural water usage among others. This thus precipitated the need to call for the meeting to hear from the different affected individuals and urged the residents/neighbors to share the views/opinions and suggestions about the proposed project. He also thanked the residents/neighbors present for their time and participation in the process. The lead consultant urged all the participants to give their opinions freely; so that the project becomes of benefit to all.	
Agenda Topic #2: Purpose for the meeting	
After the introductory remarks, The Proponent gave details of the proposed Ndarugu II dam Which is a water supply project On the confluence of Ndarugu and Githobokoni rivers, and the mitigation measures recommended in the construction of the dam. Some of the information passed were the project details including: - • Dam Design (scope) and construction, • Dam location details • Land to be affected • Dam impacts both positive and negative including traffic effects, dust, noise, vibration etc. supply of residential facilities and employment opportunities. He then urged the participants to give their comments on the proposed project at liberty.	*The proposed development project involves the construction Of a Ndarugu II dam establishment of 50,000 m3 a day to serve residents of Ruiru and Juja areas and reduce the projected water demands.* *When the project is given the go ahead, it will be able to store and supply water for the benefit of all.*

The Proponent then opened the floor so that the participants would air their feedback and opinions.	
Agenda Topic #3: Open Discussion	
During the open discussion, several issues were raised and discussed among the participants; all the members present were not supportive to the development of the Ndarugu dam saying they are not willing to have the construction done there. Some of the opinions raised are addressed as follows; **CM 1[13].** The participant expressed that their is a similar project of a dam close by thus they don't want another one. **CM2.** The participant complained that with the construction of another Dam their will be climate change thus bringing cold to the area. **CM3.** The elder raised concern on relocation of business people around the project site. **CM5**. The participant who is also an elder at Muimuto raised a concern on the communities will be divided hence they will lose their social lives. **CM6**. The participant was concerned on water bodies and the safety of the community. **CM7.** A Village elder made a request on the proponent of considering a different location to build the Dam as they don't want it there.	
Action Items:	***Responsible***
1. Incorporate safety measures in the design, construction, and operation of the project. 2. Traffic management.	Proponent Proponent & other

[13] We have used the notation CM where CM refers to commenter/participant and n is the numerals 1,2,3 etc. to refer to the participants talking in succession e.g. CM 1 refers to commenter 1 or first commenter; CM2 refer to commenter 2 etc.

3. Emphasize more on the need for the Dam construction.	stakeholders (OCS and police)
Agenda Topic #4: Closing remarks	
The assistant chief tried to persuade the participants to allow the proponent to continue with the discussion, but due to their hostility they refused and one of the participant ended the forum with a word of prayer. **The meeting adjourned at 11: 30am**	*All participants were not in support for the proposed project.* *There would be continued stakeholder engagement to reach a consensus and avoid future conflicts with the project neighbors.*

PHOTOGRAPHIC PLATES

Images of the various public meetings

REFERENCES

AMCOW, T. A. M. C. on W. (2010). Water Supply and Sanitation in Kenya: Turning finance into Services for 2015 and Beyond.

Gicheruh, M. (2015). Hydrogeological and geophysical investigations Kibundani & Mtongwe area Likoni District, Mombasa County. Unpublished report.

GoK, G. of K. (1999). National population and housing census. Kenya National Bureau of Statistics (KENBS).

GOK, G. of K. (1999). The National Policy on Water Resources Management and Development, Sessional Paper No. 1 of 1999 [Hereinafter, Water Policy].

GOK, G. of K. (2007). Kenya Vision 2030 -The popular Version. A Globally Competitive and Prosperous Kenya: Https://www. Opendata. Go. ke/download/jih3-Amby/application/pdf.

GOK, G. of K. (2012). Kwale District and Mombasa Mainland South Regional Physical Development Plan. Ministry of Lands Department of Physical Planning.

GoK, G. of K. (2012). The National water Policy (NWP). Ministry of Environment and Natural Resources.

GoK, G. of K. (2013). Millenium development Goals Status Report. Ministry of Devolution and Planning.

GoK, T. government of K. (2010). National Climate Change Response strategy.

Hardenbrook, A. (2007). Equator Principles: The Private Financial Sector's Attempt at Environmental Responsibility, The. Vand. J. Transnat'l L., 40, 197.

Karanja, A. (2012). Income generating activities as an incentive for biodiversity conservation in Mombasa city. In Leveraging Urban Nature and Biodiversity for Local Development Course. Weitz Centre for Development Studies (Rehovot-Israel).

Khosla, P., van Wijk, C., Verhagen, J., Francis, J., & Arce, M. (2004). Gender and water. International Water and Sanitation Centre (IRC). Retrieved from http://protosh2o.act.be/VIRTUELE_BIB/Water_in_de_Wereld/GEN-Gender/W_GEN_E26_Gender_water_2.pdf

KNBS, K. N. B. of statistics. (2013). Exploring Kenya's Inequal;ities: Pulling apart or Pooling together? (Abridged Report). Nairobi: SID and KNBS. Retrieved from www.knbs.or.ke

Montgomery, M. A., & Elimelech, M. (2007). Water and sanitation in developing countries: including health in the equation. Environmental Science & Technology, 41(1), 17–24.

Mundial, B. (2007). Environmental, Health, and Safety (EHS) Guidelines. Washington, DC: Environment and Social Development Department, International Finance Corporation.

Munga, D., Mwangi, S., Ong'anda, H., Kitheka, J. U., Mwaguni, S. M., Mdoe, F., … Opello, G. (2006). Vulnerability and pollution of groundwater in Kisauni, Mombasa, Kenya. Groundwater Pollution in Africa. Taylor and Francis (Balkema), The Netherlands, 213–228.

Ray, I. (2007). Women, water, and development. Annu. Rev. Environ. Resour., 32, 421–449.

SIWI, S. I. W. I. (2005). Making Water a part of Economic Development: The Economic Benefits of Improved Water Management and Services (For the 13th meeting of the Commission on Sustainable Development CSD-13). Norway.

The Republic of Kenya. (n.d.). The Environmental Management and Co-ordination (Waste Management) Regulations, 2006. Retrieved from www.nema.go.ke

UN World water Assessment Program. (2005). Kenya National Water development Report. Prepared for the 2nd UN World Water Development Report (No. UN-WATER/WWAP/2006/12).

USAID. (2009). Kenya Water and sanitation Profile. Nairobi. Retrieved from www.usaid.org

Wallace, T., & Coles, A. (2005). Gender, water and development. Berg. Retrieved from http://library.wur.nl/WebQuery/clc/1785590

WHO, W. H. O. (2002). The World Health Report -Reducing Risks, Promoting Healthy Life. Geneva Switzerland.

ENDNOTES

1. Land here includes all developments therein
2. Commission on Revenue Allocation (2022). Kenya County fact sheets
3. County government of Kiambu (2019). Kiambu county integrated county development plan (CIDP)
4. Ibid
5. Commission on Revenue Allocation (2022). Kenya County fact sheets. Third edition
6. Ndirangu, N., Ng'ang'a, J., Chege, A., de Blois, R. J., & Mels, A. (2013). Local solutions in non-revenue water management through North–South water operator partnerships: The case of Nakuru. Water Policy, 15(S2), 137-164
7. www.worldbank.org/safeguards
8. Adopted from - Ogola, P. F. A. 2007. Environmental Impact Assessment General Procedures, presented at Short Course II on Surface Exploration for Geothermal Resources, organized by UNU-GTP and KenGen, at Lake Naivasha, Kenya, 2-17 November, 2007
9. *Adapted from - McFarland-Johnson, Inc. May 30, 2007*
10. https://energypedia.info/wiki/Kenya_Energy_Situation - Accessed 7th Jan 2023
11. Bowles, D. S., Giuliani, F. L., Hartford, D. N., Janssen, J., McGrath, S., Poupart, M., Stewart, D., & Zielinski, P. A. (2007). ICOLD bulletin on dam safety management. IPENZ Proceedings of Technical Groups, 33(2).
12. Land here includes all developments therein
13. We have used the notation CM where CM refers to commenter/participant and n is the numerals 1,2, etc. to refer to the participants talking in succession e.g. CM 1 refers to commenter 1 or first commenter; CM2 refer to commenter 2 etc.
14. We have used the notation CM where CM refers to commenter/participant and n is the numerals 1,2,3 etc. to refer to the participants talking in succession e.g. CM 1 refers to commenter 1 or first commenter; CM2 refer to commenter 2 etc.
15. We have used the notation CM where CM refers to commenter/participant and n is the numerals 1,2,3 etc. to refer to the participants talking in succession e.g. CM 1 refers to commenter 1 or first commenter; CM2 refer to commenter 2 etc.