Ministry of Water, Sanitation and Irrigation

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED INSTALLATION OF INSERTION ELECTROMAGNETIC FLOW METERS IN NAIROBI CITY.

Proponent: Nairobi City Water and Sewerage Company (NCWSCO)
18 February 2025

FINAL ESIA REPORT

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This EIA report was done in accordance with the requirements of the Environmental (Impact Assessment and Audit) Regulations, 2003, pursuant to the Environmental Management and Coordination Act (EMCA) 1999 and acceptable international standards.

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List of Abbreviations

EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
MoWSI	Ministry of Water Sanitation and Irrigation
NCWSC	Nairobi City Water and Sewerage Company
OP	Operational Policy
SDG	Sustainable Development Goals
WASREB	Water Service Regulatory Board
WB	World Bank
WHO	World Health Organization
WRA	Water Resources Authority
WRUA	Water Resources User Association
WSP	Water Service Provider
WSTF	Water Sector Trust Fund

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Executive summary

E1: Project background

The Ministry of Water, Sanitation and Irrigation (MoWS&I) is implementing Water and Sanitation Development Project (WSDP) with a credit from the International Development Association (IDA) that aims at improving water supply and sanitation services in selected regions in Kenya through the Water Service Providers (WSPs). The Project Development Objective (PDO) is to improve water supply and sanitation services in select Coastal and North Eastern regions in Kenya and improve the financial performance of Water Service Providers (WSPs) affected by the COVID-19 pandemic.

Following conclusion on allocation of grants to WSPs under the CLSG-1 program, WaterFund through the MoWS&I prepared documentation for the second phase of the CLSG program now referred to as CLSG-II program. The focus of CLSG-II is to support financial recovery of WSPs to pre-COVID levels or better. During this phase, only WSPs with potential to achieve financial recovery within a period of less than 12 months are eligible to receive the support.

A total of 31 WSPs with 77 interventions costing KES 2.198 billion have been pre-qualified to implement the CLSG II programme which is expected to start in February, 2024 for implementation period of 12 months. 18 WSPs will have significant interventions and are clustered into four groups based on their location within the county.

E2: Project location

The project involves the installation of Insertion Electromagnetic Flow Meters at various key locations within NCWSC's water supply network. These locations include:

1. Ngethu Treatment Works: Located in Kiambu County, approximately 60 km northeast of Nairobi.
2. Kabete Treatment Works: Situated in Kabete, a suburb west of Nairobi.
3. Sasumua Treatment Works: Located in Nyandarua County, about 80 km northwest of Nairobi.
4. Gigiri Reservoir: Located in the diplomatic district of Gigiri, Nairobi.
5. Kiambu Reservoir: Situated in Kiambu Town, about 15 km north of Nairobi.
6. Uhuru Highway: Along a major arterial road in central Nairobi.
7. Kikuyu Springs: Near Kikuyu Town, about 20 km west of Nairobi.
8. Loresho Reservoir: In the Loresho neighborhood, western Nairobi.
9. Showground: Within the Nairobi Showground along Langata Road.
10. Police Dog Section: Along Langata Road, near the Kenya Police Dog Section.

E3: ESIA Justification

Projects listed under the Amended Second Schedule of EMCA, Legal Notice No. 31 of 2019 must be subjected to Environmental Impact Assessment (EIA). The project is listed under *Low Risk Category*. The aim of the ESIA is to reduce negative environmental outcomes of the listed projects by identifying and implementing appropriate mitigation measures. This Environmental and Social Impact Assessment study was commissioned to ensure that significant impacts on the environment are taken into consideration at the construction and operation stages.

This ESIA report has identified both positive and negative impacts of the proposed project to the environment and community, and mitigation measures are elaborated in the chapter 7 of this report to address the potential negative impacts, during the construction, operation and decommissioning phases of the project, for overall environmental and social sustainability.

E4: Project Description

The project involves the installation of Insertion Electromagnetic Flow Meters at various points in NCWSC's water supply network. These meters will be installed on both raw and treated water pipelines of different sizes, ranging from DN200 to DN1400. The project aims to enhance the accuracy of water flow monitoring, improve water distribution system management, and ensure a more reliable water supply.

Key project activities include:

1. Site assessment and preparation
2. Procurement and logistics
3. Installation of flow meters
4. Calibration and testing
5. Integration with monitoring systems
6. Quality assurance and reporting
7. Commissioning and handover

E5: Project cost

The total project cost for the installation of the bulk meters and associated accessories is **Kenya shillings Fifty-Four Million (Ksh.54,000,000.00).** The EIA processing fee payable to NEMA is 0.1% of the project cost which translates to **KSh. 54,000**.

E6: Legislative, Policy and Institutional Framework

The ESIA has been conducted in accordance with Section 58 of Environmental Legislation, Environment Management and Coordination Act (EMCA) 1999 and its subsidiary legislation, including the Environmental Impact Assessment and Auditing Regulations (EIA/EA) of 2003 and Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019. The ESIA has also been done following the WB OP and World Bank Group Environmental Health and Safety Standards.

Pertinent regulations, standards and regulatory bodies governing environmental quality, health and safety, protection of fauna and flora species, environment, economic activities, siting and land use control as relevant to the site and its immediate environs was evaluated and reported. A legal register listing all legislation, legal instruments relevant to the site has been prepared, indicating applicability to the site. In addition, permits and licenses that are required to be obtained during construction and operation has been provided. The ESIA was undertaken within the reference framework of the following standards and regulations: applicable National Environmental Management, Occupational Health and Safety, Public Health and Labour laws and regulations.

E6: Stakeholder Engagement

Stakeholder consultations were conducted through semi-structured questionnaires, targeting individuals directly affected by or knowledgeable about the project impacts. A total of 100 people (72 male, 28 female) were interviewed over a 5-day period from July 22-26, 2024. A sample size of 10 respondents per project site was selected because issues raised attained saturation point. Based on preliminary research and pilot studies, it was determined that after interviewing 10 individuals per site, there was a clear pattern of similar responses, indicating that the main concerns and issues had been adequately captured. By stopping at 10 respondents, the study avoided redundancy while ensuring that the key points of interest had been fully explored. This approach also balanced the need for thorough stakeholder engagement with time and resource constraints, making it both efficient and effective in gathering representative data.

Key concerns raised during consultations included:

1. Temporary water shortages during installation
2. Improved meter reading and accountability
3. Noise pollution during construction
4. Safety hazards from open trenches
5. Improved hygiene and reduced waterborne diseases

E7: Project Impacts

The anticipated impacts will be during the installation of flow meters due excavations to expose the pipeline and installation works.

The table below highlights some of the key anticipated negative impacts.

Table 1: Anticipated impacts

Impacts	Descriptions of impacts	Mitigation measures
Vegetation Disturbance	- Localized trampling or clearing of vegetation, especially in densely vegetated areas.	- Utilize existing access paths to minimize new clearing. - Limit vegetation clearing to only what is necessary.

Impacts	Descriptions of impacts	Mitigation measures
	- Potential loss of individual plants, particularly small shrubs, grasses, and ground cover. - Possible disruption of plant communities in forested areas.	- Handle soil and vegetation carefully to avoid unnecessary disturbance.
Waste Disposal	- Generation of solid and liquid waste during installation and demobilization. - Potential for improper handling of domestic solid waste, construction debris, and sanitation wastewater.	- Provide waste collection bins for waste segregation. - Collect all solid waste at a central location for proper disposal. - Implement a Waste Management Plan following EMCA regulations. - Reduce material residual wastes through accurate estimation. - Reuse materials and packaging to reduce waste. - Use NEMA licensed waste handlers for disposal.
Noise & Air Pollution	- Temporary disturbance to local wildlife and communities from machinery noise. - Dust and emissions affecting air quality in the immediate vicinity.	- Select equipment designed to operate at lower noise levels. - Restrict noisy activities to daytime hours. - Inform local communities about potential noise impacts in advance. - Implement dust control measures such as water spraying.
Soil Compaction	- Compaction of soil around access routes and installation sites due to heavy personnel movement. - Potential hindrance to root growth and reduced water infiltration.	- Designate specific routes for machinery to minimize soil disturbance. - Use soil aerators or subsoilers to alleviate compacted layers. - Replant native vegetation and monitor disturbed areas for recovery.
Potential for Invasive Species	- Risk of introducing non-native or invasive plant species through equipment and personnel movement. - Possible disruption of ecological balance in sensitive ecosystems.	- Clean equipment thoroughly before moving between sites. - Conduct periodic monitoring to identify invasive species early. - Implement rapid removal or control strategies for invasive species. - Prioritize replanting with indigenous species.

Impacts	Descriptions of impacts	Mitigation measures
occupational health and safety risks	Work at the proposed site may involve hazards such as accidental falls into open trenches, slippery walkways, and heavy equipment which have the potential of causing accidents and injuries.	– The Contractor shall conform to all the stipulations of the Occupational Health and Safety Act, 2007. The Act requires the designation of a Health and Safety representative when more than 20 employees are deployed. – The contractor shall provide ample warning signs, guard rails, warning tape, etc., around open excavations, stacks of material, debris, etc. and shall be held liable for all claims as a result of neglect of such precautions and provisions. – Use of requisite Personal Protective Equipment (PPE) always during construction works – Shoring of excavations especially manholes and other management measures (buttering, benching etc) of trenches
community health and safety risks	Work at the proposed sites may cause hazards such as accidental falls into open trenches to the surrounding community. Also, construction equipment which have the potential of causing accidents.	– The contractor shall provide barricade the work sites and provide warning signs around open excavations. – Sensitize the community on the safety measures and unauthorize access implemented. – Shoring of excavations especially manholes and other management measures (buttering, benching etc) of trenches
Temporary Habitat Disruption	- Disruption of habitats for small wildlife species and plant communities. - Possible temporary displacement of ground-dwelling animals and insects.	- Conduct installation work during less vulnerable seasons for local wildlife. - Mark and protect sensitive habitats. - Restore disturbed habitats promptly after installation.
Disruption of services water supply.	During insertion of meters, the water supply may be affected temporarily.	The contractor will insert the flow meters on a live system, where the water pipeline will not be cut off, hence, supply will not be interrupted.
Sexual exploitation and abuse of community members by project workers	This impact refers to sexual exploitation and abuse committed by Project staff against communities, and represents a risk at all stages of the Project, especially when employees and community members are not clear	- Develop and implement and SEA action plan with an accountability and Response Framework as part of the C-ESMP. The SEA action plan will follow guidance on the World Bank's Good Practice Note for Addressing Gender-based Violence in

Impacts	Descriptions of impacts	Mitigation measures
	about prohibitions against SEA in the Project. The project will experience the influx of people who will be seeking employment during construction phase, therefore, SEA will be a critical aspect to be monitored.	Investment Project Financing involving Major Civil Works (Sept 2018).
Gender-based violence	GBV constitutes acts of gross misconduct and are therefore grounds for sanctions, penalties and/or termination of employment. This impact refers to gender-based violence at the community level that women and girls may experience as a result of Project implementation.	- Develop and implement provisions that ensure that gender-based violence at the community level is not triggered by the Project, including: ✓ effective and on-going community engagement and consultation, particularly with women and girls; ✓ review of specific project components that are known to heighten GBV risk at the community level, e.g. employment schemes for women; delivery of supplies; etc. ✓ Specific plan for mitigating these known risks, e.g. sensitization around gender-equitable approaches to employment; supply services; etc - Ensure adequate referral mechanisms are in place if a case of GBV at the community level is reported related to project implementation.
Violation of children rights by contractor and child labour on site	Violence against Children (VAW) is defined as physical, sexual, emotional and/or psychological harm, neglect or negligent treatment of minor children (i.e. under the age of 18), including exposure to such harm, that results in actual or potential harm to the child's health, survival, development or dignity in the context of a relationship of responsibility, trust or power. This includes using children for profit, labour, sexual gratification, or some other personal or financial advantage.	- Develop and implement a Children Protection Strategy that will ensures minors are protected against negative impacts associated by the Project. - All staff of the contractor must sign, committing themselves towards protecting children, which clearly defines what is and is not acceptable behaviour - Children under the age of 18 years shall not be hired on site as provided by Child Rights Act (Amendment Bill) 2014.
Spread of HIV/AIDS, STIs and other communicable diseases	The project will bring together groups of people, such as workers, community members, or visitors, which can lead to increased social interactions and mobility, contributing to the spread of HIV/AIDS and STIs. Economic development may also encourage behaviours associated with higher risk, such as multiple sexual partnerships. Migrant workers could introduce new infections or increase the transmission rates of existing	- Carry out periodic HIV/AIDS awareness training for workers and the beneficiary community. - Distribution of condoms to workers and beneficiary communities, especially the Common Interest Groups. - Carryout voluntary HIV/AIDS testing for workers and community members. - If tested positive, further guidance will be offered and directed to the nearest public hospital to receive free antiretroviral (ARVs) drugs and other services.

Impacts	Descriptions of impacts	Mitigation measures
	diseases, while women and young girls may be more vulnerable due to gender inequalities and transactional relationships.	- The project team should use the services of contracted GBV/SEAH service providers to undertake community outreach activities. - Hire local workers where possible to minimize the extent of any influx. - All workers shall sign CoC/ contract that has provisions on GBV/SEAH.
Workers/ Labour Influx Impacts	The project will attract an influx of workers and laborers to the area, which could lead to increased pressure on local resources such as housing, water, and food supply, potentially resulting in higher costs for community members. This influx may also strain local infrastructure, including transportation and healthcare services, as the population temporarily grows.	- Ensure that locally available labour force is given priority during recruitment. Especially for casual and unskilled positions. - Providing accommodation for workers in camps if the workforce is large

E8: ESMP summary and implementation arrangements

The ESMP provided in chapter 8 provides the mitigations measures of the anticipated environment and social impacts, monitoring indicators, responsible party and the cost of mitigation measures. Key impacts and risks anticipated include: waste generation, clearance of vegetation, loss of biodiversity, air pollution, occupational health and safety risks, GBV, etc. The cost for the implementation of the ESMP shall be included in the overall design, construction supervision cost of the project. Most of the environmental cost which involves engineering design is embedded in the engineering costs. However, Ksh. 40,000 will be spent in the implementation of the mitigation measures and environmental management administration. These costs shall also cover environmental monitoring.

The ESMP shall be provided along with bidding documents. Compliance with the ESMP shall be clearly provided for in the contract documents. The Contractor shall prepare a C-ESMP to operationalize the ESIA findings and recommendations. Method statements will also be prepared and will be task-specific after undertaking specific risk assessments. In addition, the contractor will have a qualified fulltime EHS person to be based on site who will be responsible for the implementation of the ESMP. The contractor will be required to submit monthly progress reports on ESMP implementation during construction phase. Also, the contractor should submit incident reports, and any other as per the WB standards.

The Nairobi Water and Sewerage Company will be the implementing Agency of the project. The company has capacity to supervise the implementation of the E&S activities. It has full time social and environmental safeguards staff to assist in the project. At the national level, WSTF will form a project implementation unit comprising of the E&S experts to oversee the project activities.

E9. Conclusions

The environmental, and social Impact Assessment (ESIA) of the proposed project has been conducted in accordance with national legislative requirement, the World Bank Policies, IFC's Performance Standards and World Bank's Environmental Health and Safety (EHS) Guidelines. The ESIA study has been carried out based on the site visit, baseline environmental and social condition survey stakeholder consultation, analysis of the possible project intervention. The experts identified and evaluated potential environmental impacts associated with all aspects of the proposed project.

The key potential environmental impacts due to the project construction as established by the ESIA study are loss of vegetation, air and noise pollution, loss of habitat, solid waste generation and disposal, increase in traffic and occupational health and safety. The economic opportunities in terms of local employment and provision of services during construction and operation phases are assessed as positive impacts. During the operation of the proposed project, the key issues related to the environment has been identified from the ESIA study are ecological, and occupational health and safety.

1 Introduction

1.1. Background

The Ministry of Water, Sanitation and Irrigation (MoWS&I) is implementing Water and Sanitation Development Project (WSDP) with a credit from the International Development Association (IDA) that aims at improving water supply and sanitation services in selected regions in Kenya through the Water Service Providers (WSPs). The Project Development Objective (PDO) is to improve water supply and sanitation services in select Coastal and North Eastern regions in Kenya and improve the financial performance of Water Service Providers (WSPs) affected by the COVID-19 pandemic.

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A total of 31 WSPs with 77 interventions costing KES 2.198 billion have been pre-qualified to implement the CLSG II programme which is expected to start in February, 2024 for implementation period of 12 months. 18 WSPs will have significant interventions and are clustered into four groups based on their location within the county.

1.2. Project activities

The project activities include the following:

i. Installation of Insertion Electromagnetic Flow Meters: Raw water meters - Ngethu T. Works (DN1200, DN1400)
ii. Installation of Insertion Electromagnetic Flow Meters: Raw water meters - Kabete T.Works (DN225, DN300, DN400) and Sasumua T. Works (DN400, DN600)
iii. Installation of Insertion Electromagnetic Flow Meters: Treated Water meters - Ngethu T. Works (DN700, DN1000, DN1200) Gigiri Reservoir (DN700, 2no.DN1000, DN900), Kiambu Reservoir DN1000, and Uhuru Highway DN1000.
iv. Installation of Insertion Electromagnetic Flow Meters: Treated Water meters - Sasumua T. Works (DN400, DN600), Kabete T. Works (DN400, DN450), Kikuyu Springs (DN200, DN250), Loresho Reservoir DN400, Kabete Reservoir DN600, Langata line at Showground DN450, Langata Line at Police Dog Section DN400

1.3. The Project Area

The **Ngethu Treatment Works** is located in the lush, green highlands of Kiambu County, approximately 60 kilometers north of Nairobi. Situated along the Chania River, which flows from the Aberdare Ranges, this facility is a critical source of potable water for the Nairobi metropolitan area. The project at Ngethu involves the installation of insertion electromagnetic flow meters on both raw and treated water pipelines. For raw water, the flow meters will be installed on DN1200 and DN1400 pipelines, which are the main conduits bringing water from the river into the treatment plant. These pipelines run through rugged terrain, making precise flow measurement crucial for

optimizing water treatment processes. For treated water, flow meters will be installed on DN700, DN1000, and DN1200 pipelines. These pipelines are responsible for delivering treated water to several key reservoirs and supply zones, including parts of Nairobi's northern and eastern suburbs. The meters will help ensure accurate monitoring and efficient distribution of this vital resource.





Figure 1: Location of Ngethu T. Works Raw water meters (DN1200, DN1400) & Treated Water meters (DN700, DN1000, DN1200)

The **Kabete Treatment Works** is nestled in the rolling hills of the Kabete area, located to the west of Nairobi, about 15 kilometers from the city center. This facility is integral to the water supply for the western and central parts of Nairobi. The project here involves installing insertion electromagnetic flow meters on both raw and treated water pipelines. Raw water enters the Kabete Treatment Plant through DN225, DN300, and DN400 pipelines, which draw from nearby rivers and streams. These pipelines traverse varied landscapes, including agricultural land and residential areas, making accurate inflow measurement essential for effective water treatment. On the treated water side, the project includes the installation of flow meters on DN400 and DN450 pipelines (coordinates: -1.2602845, 36.7561723). These pipelines distribute treated water to the densely populated suburbs of Westlands, Parklands, and surrounding areas. The meters will play a crucial role in monitoring water output, ensuring consistent quality and efficient delivery to consumers.








Figure 2: Location of Kabete Treatment Works Raw Water meters (DN400, DN450) & (DN225, DN300, DN400)

The **Kabete Reservoir**, located adjacent to the Kabete Treatment Works, is another critical storage and distribution point. The DN600 pipeline serving this reservoir will be equipped with a flow meter to monitor water flow to the surrounding areas.




Figure 3: Location of Kabete Reservoir Treated Water meter DN600

The **Sasumua Treatment Works** is located in the scenic Aberdare Ranges, near the town of Njabini, approximately 90 kilometers northwest of Nairobi. This facility draws its water from the Sasumua Reservoir, which is fed by streams originating in the Aberdare Forest. The project at Sasumua involves the installation of insertion electromagnetic flow meters on raw and treated water pipelines. Raw water is brought to the treatment plant through DN400 and DN600 pipelines, which meander through mountainous terrain and dense forest. The installation of flow meters on these pipelines will enhance the accuracy of raw water intake measurements, ensuring that the treatment process is both efficient and effective. For treated water, flow meters will be installed on DN400 and DN600 pipelines. These pipelines are responsible for distributing treated water to the southern and southwestern parts of Nairobi, including areas such as Karen and Langata. The meters will ensure that

the output from Sasumua is consistently monitored, improving the reliability of water supply to these regions.



Figure 4: a) Location of Sasumua T. Works (DN400, DN600)



Figure 5: b) Location of Sasumua T. Works (DN400, DN600)

The **Gigiri Reservoir** is situated in the diplomatic hub of Gigiri, near the United Nations offices and several embassies, approximately 10 kilometers north of Nairobi's city center. This reservoir plays a pivotal role in supplying water to Nairobi's northern suburbs and key institutions. The project involves installing flow meters on DN700, two DN1000, and DN900 pipelines (coordinates: -1.2308743, 36.8127159) that connect the reservoir to the wider distribution network. These pipelines

run through residential and commercial areas, making accurate flow measurement essential for managing water distribution in this high-demand zone.



Figure 6: a) Location of Gigiri Reservoir Treated Water meters (DN700, 2no.DN1000, DN900)



Figure 7: b) Location of Gigiri Reservoir Treated Water meters (DN700, 2no.DN1000, DN900)

The **Kiambu Reservoir** is located in Kiambu Town, about 15 kilometers northeast of Nairobi. It serves as a major supply point for the rapidly growing Kiambu County. The DN1000 pipeline (coordinates: -1.1878230, 36.8379605) that supplies this reservoir will be equipped with a flow meter to facilitate precise monitoring and efficient distribution of water to surrounding areas, including residential estates and agricultural lands.



Figure 8: Location of Kiambu Reservoir Treated Water meters DN1000

The **Uhuru Highway** pipeline is a major supply line that runs along one of Nairobi's busiest highways, linking the city center with the southern suburbs. The DN1000 pipeline along this route will also have an insertion electromagnetic flow meter installed to improve the management and distribution of water to densely populated areas like Upper Hill and South B.



Figure 9: Location of Uhuru Highway Treated Water meters (DN1000)

The installation of flow meters on treated water pipelines also serves several key locations in Nairobi, including **Kikuyu Springs**, **Loresho Reservoir**, **Kabete Reservoir**, and the **Langata Line**.

Kikuyu Springs is a natural water source located near the town of Kikuyu, approximately 20 kilometers west of Nairobi. This area is characterized by its verdant landscape and is an important source of water for the western suburbs of Nairobi. Flow meters will be installed on DN200 and DN250 pipelines (coordinates: -1.2579669, 36.6773864) to ensure accurate measurement of water flow from this spring, improving its contribution to Nairobi's overall water supply.



Figure 10: Kikuyu Springs



Figure 11: Location of Kikuyu Springs Treated Water meters (DN200, DN250)

The **Loresho Reservoir** is situated in the leafy suburb of Loresho, about 12 kilometers northwest of Nairobi's central business district. This reservoir supplies water to Loresho, Kitisuru, and other affluent neighborhoods. A flow meter will be installed on the DN400 pipeline serving this reservoir to ensure precise monitoring and efficient distribution of water.



Figure 12: Location of Loresho Reservoir DN400

The **Langata Line** serves the southern part of Nairobi, including the populous Langata and Karen areas. The project includes the installation of flow meters on DN450 at the Showground (coordinates: -1.3085146, 36.7699260) and DN400 at the Police Dog Section (coordinates: -1.3186567, 36.7745622), key points along the pipeline that are essential for maintaining an efficient water supply to these rapidly growing suburbs.



Figure 13: Location of Langata Line at Police Dog Section Treated Water meter DN400



Figure 14: Location of Langata line at Showground Treated Water meter DN450

See below the map of Nairobi County.

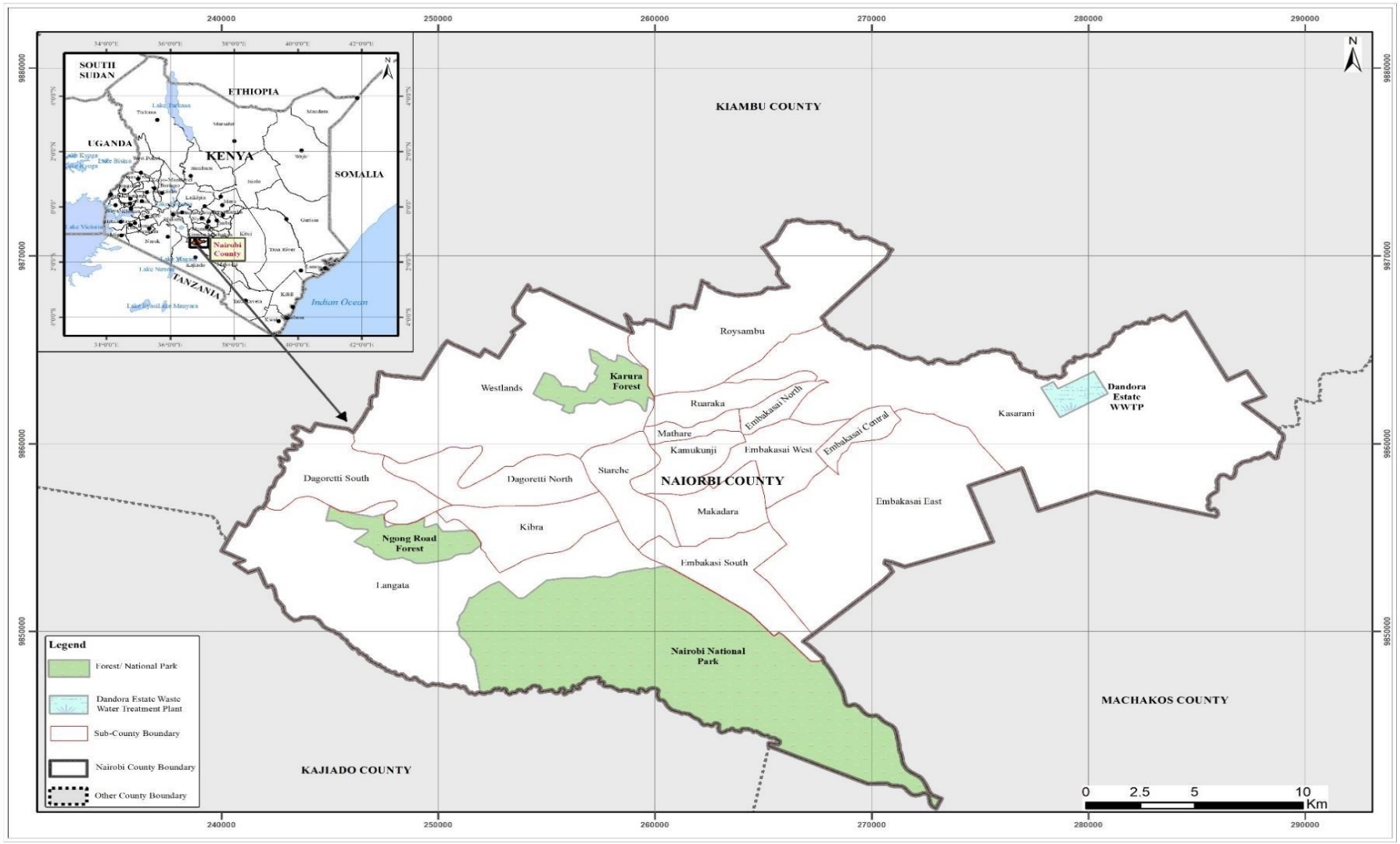


Figure 15: Map of Nairobi City (Source: Artelia/ MIBP GIS Data base 2022)

1.4. Justification for the proposed project

The installation of electromagnetic flow meters, especially in raw and treated water systems, is critical for enhancing the accuracy of water flow monitoring. Currently, water supply systems face challenges such as unaccounted-for water losses due to inaccurate or outdated measurement systems. The proposed meters will allow real-time and precise data collection on water flow, reducing discrepancies and inefficiencies in water distribution. This will result in better demand management, resource allocation, and proactive leak detection, ultimately reducing water loss.

As part of the Credit Line Support Grants Phase II (CLSG-II) program, NCWSC has been selected to participate due to its potential for financial recovery within 12 months. The flow meters will play a vital role in improving billing accuracy and water revenue collection. The ability to measure exact water usage at critical points such as Ngethu, Kabete, and Sasumua will contribute to more efficient revenue management, enabling NCWSC to return to pre-pandemic financial stability or exceed previous performance.

By enabling real-time monitoring and control, these flow meters will provide critical data on the operational performance of NCWSC's water infrastructure. This will facilitate better decision-making regarding maintenance, upgrades, and expansion projects. Additionally, it will streamline operational workflows, ensuring that water is directed to high-demand areas, reducing operational downtimes, and improving service delivery to Nairobi's residents.

The project aligns with Kenya's broader water sector reforms and the national goals of ensuring equitable access to clean water as part of Vision 2030. By installing these meters in key strategic locations across Nairobi, NCWSC is contributing to the efficient management of a scarce resource in a rapidly urbanizing environment. The project will also ensure compliance with regulations on water resource management and measurement, supporting national goals of environmental sustainability.

The flow meters will enhance the ability of NCWSC to monitor the quality and quantity of treated water delivered to consumers. This is particularly critical for regions such as Gigiri, Kiambu, and Loresho, which face periodic water shortages. By accurately tracking water flow in real time, NCWSC will be able to adjust supply to meet demand, particularly during peak periods. This will lead to more reliable water service, improving customer satisfaction and public health outcomes by ensuring continuous access to clean water.

Nairobi's population continues to grow, putting increasing pressure on its water supply infrastructure. Installing electromagnetic flow meters will provide valuable data to inform future expansion projects, such as pipeline upgrades and water treatment facility expansions. This data will help ensure that the city's water supply system remains sustainable in the long term, preventing over-exploitation of existing resources while planning for future demand.

1.5. Objectives of the Assignment

The specific objective of this assignment was to undertake Environmental and Social Impact Assessment (ESIA) for cluster 2 interventions. The ESIA will identify key environmental and social issues related to the interventions, and design appropriate mitigation measures for the potential risks and impacts identified. ESMP and monitoring plan will be provided in the report. The ESIA provides information to enable approval of the proposed intervention by the National Environment Management Authority (NEMA), and guidance on environmental and social management during project implementation.

1.6. Scope of Work

The Scope of Work for the ESIA comprised of the following tasks and activities

Task 1 Detailed Project Description:

The Consultant provided a detailed information on the following

- Geographic, ecological, general layout including maps at appropriate scale where necessary.
- Land required and its availability
- Intervention design and construction processes
- Natural resources (water and construction materials) required for the construction process
- Labour requirements in all phases of the interventions
- Waste generated
- Applicable permitting process
- Applicable design and operational standards
- Project timeline

Task 2: Description of the Baseline Environment:

The Consultant collected, analysed and presented qualitative and quantitative baseline information on the existing physical and natural environment, social and economic as well as demographic conditions within the project site and its area of influence. This allowed for the positive socio-economic, environmental and health effects of the proposed interventions to be realized to the maximum extent possible, while minimizing the negative impacts related to the project.

The baselines emphasized those aspects of the natural, cultural and socio – economic environment that affected by the interventions, including but not necessarily limited to the following:

- Physical environment
    - Air quality
    - Noise
    - Water Quality and hydrology
    - Soil
    - Geology and hydrogeology
- Bio –Physical Environment

    - Terrestrial Flora
    - Terrestrial Fauna
    - Aquatic flora and fauna where applicable
- Socio- economic and cultural environmental (including gender)- The socio-economic assessments was based on NEMA's and World Bank's OP and guidelines with special attention on demography; land-use; status of existing water resource management programmes (conservation and reuse); community structure; employment; gender; local communities; livelihoods, Sources and distribution of income, goods and services, recreation, cultural properties (e.g., archaeological and historically significant sites), Education, health, waste disposal, community participation, customs/norms, attitudes; traditional knowledge, perception and aspiration and social amenities and infrastructure. In addition, it includes Risks of gender-based discrimination, threats to human security through the escalation of personal, communal or inter-state conflict, crime or violence, discrimination toward individuals or groups, economic displacement (i.e. loss of assets or access to assets that leads to loss of income sources or means of livelihood). Consider the aspects that depends on environmental changes (public health, vulnerability to disasters, vulnerability to increasing climate variability and the expected effects of climate change, access to natural resources and associated conflicts), those that can produce environmental impacts, and, more broadly, the socio-economic conditions that might be affected by the project. This needs to show how the proposed project may increase or reduce the population's vulnerability to the effects of climate change.

Task 3: Stakeholder Engagement

The consultant reviewed the stakeholders identified both county, and non-county actors (direct and indirect affected persons) and continued with the engagement process in line with national & World Bank's OP requirements. In this regard the consultant carried out the following;

- Conduct stakeholder analysis that outlines the affected and interested parties. This was to enhance identification, analysis and categorization of project stakeholders, possible interests in the project and risks associated with any of these interests.
- Review, update and address issues identified & raised during the preliminary engagement process. This was to ensure project affected persons, relevant authorities and interested parties with concerns pertaining the project received feedback; suggest mitigation measures to such risks establish the level of knowledge and support for the project from the identified key stakeholders.
- Develop a communication strategy to engage with all levels of stakeholders, including planned consultations` activities, information materials and measures for encouraging participation of Vulnerable individuals, women, elderly, youth and PWDs.
- Keep records of all meetings organized to enable stakeholders to present their concerns and opinions regarding the proposed project, and these was signed off by the participants. Records must show the number of public consultations and list of attendees during those consultations.

- Ensure that stakeholder concerns are incorporated into the ESIA report recommendations and propose means for these to be incorporated into the project design/project activities as/where appropriate.

Task 4: Description of the Relevant National and International Legislative and Institutional Regulatory Framework:

The Consultant provided a description of the pertinent policies, regulations, standards and regulatory bodies governing water sector, environmental management, water, biodiversity, climate change, occupational Health and safety, public & community health & safety, labour, waste management, energy, gender and land.

The ESIA was undertaken within the reference framework of the following standards and regulations, the list not limiting:

- Applicable National policies, laws and regulations.
- Applicable county by-laws.
- The triggered World Bank Operational Policies
- World Bank Group/IFC EHS guidelines

Task 5: Analysis and Assessment of Potential impacts and recommendations for mitigation and potential development needs

The consultant carried out the following;

- Identify, assess and determine the significance of potential positive and adverse impacts of the project on the physical & natural environment, social, socio-economic and cultural environment of the project area. Particular attention was paid to the impacts due to pollution (air, noise & water quality), impacts on biodiversity (terrestrial & aquatic) and project affected persons.
- Carry out a climate risk vulnerability assessment to identify, assess and describe potential risks posed, effects on baselines and impacts to the project activities due to climate change (adaptation and resilience).
- Assess the magnitude and significance of the residual environmental and social impacts after the mitigation hierarchy has been applied.
- Make recommendations on the enhancement of positive impacts from the project/project activities.
- Provide analysis of alternatives (in case of adverse effects) and provide for mitigation measures.

Task 6: Cumulative Impact Assessment

The consultant assessed the cumulative impacts of the project on Valued Environmental & Social components (VESCs). The report outline ways in which the cumulative impact assessment and management could subsequently be progressed further over a period of 10-20 years.

Impact assessment addresses cumulative impacts, including but not limited to:

- Impacts created by the activities of other adjacent, upstream and downstream developments, projects and landholders.
- Cumulative Impacts Synergies and conflicts with other projects in the area will be evaluated:
- Competition for water resources.
- Competition for use of existing services and infrastructure.
- Access to natural resources and business opportunities

Task 7: Waste Management (Solid and liquid/ effluents/wastewater)

The consultant was required to.

- Describe all the expected waste streams from the proposed project activities during the construction, operational, rehabilitation and decommissioning phases of the project.
- Describe the estimated quantity, and physical and chemical characteristics of each significant waste, any attributes that may affect its dispersal in the environment, and its associated risk of causing environmental harm.
- Define and describe objectives and practical measures for protecting or enhancing environmental values from impacts from wastes.
- Assess and describe the proposed management measures against the preferred waste management hierarchy, namely: avoid and reduce waste generation; cleaner production; reduce; recycle; reuse; reprocess and reclaim; waste to energy; treatment; disposal. This includes the generation and storage of waste.
- Provide water quality limits that are appropriate to maintain background water quality and protect other water uses.

Task 8: Assessment of alternatives:

The Consultant assessed alternatives to the proposed project, which included the "No Project" alternative, project design, location and layout. The Pros and cons of each alternative was considered in terms of environmental and social impacts.

In case the analysis of alternatives reveals an alternative with less impact, the consultant must either recommend a redesign to the project attribute to favour one with less impact or explain why the proposed attribute was selected instead of one with less impact.

Task 9: Development of Environmental & Social management & monitoring plan:

The Consultant prepared an Environmental, climate and social management plan that recommends a set of mitigation, monitoring and institutional measures to eliminate, minimize or reduce to acceptable levels of adverse environmental and impacts and/or maximize socio-economic benefits. Simple restoration measures/ plan was developed for any change of land use necessitated by the

project. The Consultant provided cost outlays for the proposed measures as well as their institutional and financial support.

The monitoring plan is required to give a specific description, and technical details, of monitoring measures, including the parameters to be measured, methods to be used, sampling locations, frequency of measurements, and definition of thresholds that will signal the need for corrective actions as well as deliver monitoring and reporting procedures. The Consultant provided a time frame and implementation mechanism, staffing requirements and cost outlays.

1.7. Methodology

In order to meet the study objectives, the first step was for the consultant to undertake desk study and preliminary site visit. Based on the site visit various considerations relevant to project that could influence the Environmental and Social Impact Assessment were identified. The stepwise activities as well as methodologies followed for this study is described below:

1.7.1. Desk Study

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) as well as the policy, legal and institutional documents.

The team reviewed relevant literature including but not limited to the following reports:

- Design Report; to understand the project background, the preliminary designs and the implementation plan
- Secondary data through literature reviews to collect baseline information in the project area
- Relevant Legal, Policy and Regulatory documents with special emphasis to requirements under the EMCA, 1999, and the Environmental Impact Assessment and Audit Regulations, 2003
- World Bank's Environmental Health and Safety (EHS) Guidelines.

1.7.2. Understanding the project

The first step in environmental assessment of the proposed project was to understand the proposed site based on maps and, also analysing the direct and indirect environmental impacts; which are key in determining the scope and depth of the study.

1.7.3. Site Survey and Baseline Data Collection

Physical project site inspections and observations constituted the main baseline survey activities. The team visited the meter installation sites inspecting the site characteristics to assess the existing baseline condition with respect to physical, biological and socio-economic environment.

1.7.4. Physical environment

The baseline data collection methodology applied for physical environment involved a combination of primary and secondary data collection methods ranging from direct observations

& visual analysis to interaction with stakeholders during field survey on various parameters such as land use & topography, natural drainage, flood flows, climate, air, and noise quality etc.

1.7.5. Physical Cultural Resources

Archaeological and Cultural Heritage impact assessment has been undertaken to identify and ensure the protection of archaeological and cultural heritage assets associated with the project sites to ensure that effective management and mitigation controls are in place. The assessment included a desktop review of any available documents and records associated with archaeological and cultural heritage resources within the project sites as well as field survey of project site.

1.7.6. Biodiversity Assessment

Both qualitative (desk-stop literature review) and quantitative (field sampling) methods were employed to assess biodiversity of the study area.

The general biodiversity information gathered includes the following.

- Detailed lists of flora and fauna species (mammals, avifauna, reptiles and amphibians, fish and invertebrates) occurring in the project area.
- Fauna and flora Species of Conservation Concern (SCC) were identified based on the IUCN Red List of species i.e. Critically Endangered, Endangered, Vulnerable or Near Threatened.
- Other biodiversity value characterization criteria such as nationally threatened, nationally protected, restricted-range and endemic species, congregatory, migratory species as well as invasive species were also applied.
- Characterization of vegetation structure and habitat types i.e. modified, natural, critical

1.7.7. Data Evaluation and Analysis

Environmental assessment was carried out to identify potential impacts of the project on the environment, biodiversity and the community. The assessment was carried out in three main steps, as follows:

- Prediction of potential impacts
- Execution of specialized ecological studies on biodiversity and evaluation and assessment of the impacts in terms of their significance
- Identification/ proposing mitigation measures for minimizing the effects of the significant impacts.

After exclusion of the negligible impacts, the remaining aspects were assessed based on the following criteria:

- Magnitude of the impact;
- Duration: period of time that impact lasts;
- Mitigation measures; its availability whether integrated in the project design or implemented as management measures; and
- Residual impacts.

Where negative environmental impacts are expected, majority of them will be experienced during the construction phase. To help manage the potential negative impacts, mitigation measures are suggested and the residual impact evaluated.

1.7.8. Public Consultations.

Public consultations were undertaken during the environment and social impact assessment study to document the social impacts to the project area and general community perceptions on the project. In general, the following steps were followed in carrying out the entire consultation and public participation process: -

- Identification of institutions and individuals and compiling a list of the interested and affected parties
- Administration of questionnaires to different target groups and local community members within the proposed project site.

These interviews were conducted to augment and confirm data and information obtained using the other tools and methodologies. .

2. Project Description

2.1. Location of the project

Ngethu Treatment Works is situated near the banks of the Chania River in Kiambu County, approximately 60 kilometers northeast of Nairobi. The site is accessed via the Thika Superhighway, with the Ngethu Road connecting it directly to the plant.

Kabete Treatment Works is located in Kabete, a suburb to the west of Nairobi. The plant is positioned off Waiyaki Way, one of Nairobi's major highways, and is nestled within a residential area known for its lush greenery and proximity to both urban and peri-urban settlements.

Sasumua Treatment Works is located in Nyandarua County, approximately 80 kilometers northwest of Nairobi. It is the 2nd largest water treatment plant for NCWSC. It is adjacent to Sasumua Dam, which is nestled in the Aberdare mountain range, making this facility a vital water source for Nairobi. The site is accessible via the Naivasha-Nyahururu road.

The Gigiri Reservoir is located in the diplomatic district of Gigiri, Nairobi. This area is home to several international organizations, including the United Nations Environment Programme (UNEP) headquarters. The reservoir is situated off Limuru Road, close to the Karura Forest Reserve, and is a central point for water distribution in the northern parts of Nairobi.

Kiambu Reservoir is located in Kiambu Town, the administrative capital of Kiambu County. It is roughly 15 kilometers north of Nairobi and is accessible via the Kiambu Road. The reservoir serves both Kiambu County and parts of Nairobi's northern suburbs.

The installation site along Uhuru Highway is located in the central part of Nairobi, a major arterial road that runs through the Central Business District (CBD).

Kikuyu Springs is located near Kikuyu Town, about 20 kilometers west of Nairobi. The springs are nestled in the rolling hills of Kiambu County and serve as an important water source for the surrounding areas, including Nairobi's western suburbs. Access is via the Southern Bypass or Waiyaki Way.

Loresho Reservoir is located in the Loresho neighborhood, a high-end residential suburb in western Nairobi. The reservoir is situated off Loresho Ridge Road, near the Nairobi Ring Road, and serves as a key distribution point for water to surrounding areas.

Showground installation site is located within the Nairobi Showground, a well-known venue for exhibitions and agricultural fairs. The showground is positioned along Langata Road, southwest of Nairobi's Central Business District. The area is easily accessible from Langata Road and serves nearby residential areas, including Karen and Langata. This strategic location inside the showground supports water distribution to the surrounding growing suburbs.

Police Dog Section installation site is located further along Langata Road, near the Kenya Police Dog Section, a facility dedicated to training police dogs. This area is in the vicinity of the Langata neighborhood and serves as a water distribution point for the surrounding residential areas.

2.2. Project Components

The main component of this water project is the installation of Insertion Electromagnetic Flow Meters, aimed at enhancing the accuracy and efficiency of water flow monitoring across key points in Nairobi's water supply network. The project will address both raw and treated water systems, with specific installations at various treatment works, reservoirs, and pipeline sections. Each installation will involve distinct environmental and social considerations, as outlined under section 7.

2.3. Project Activities

The project activities will consist of a range of operations that are aimed at ensuring that the proposed project will be completed in time and will be operational as required. The installation of Insertion Electromagnetic Flow Meters will involve the following key activities:

1. **Site Assessment and Preparation**: The initial phase will involve a thorough assessment of the identified locations, including Ngethu, Kabete, Sasumua, Gigiri, Kiambu, Uhuru Highway, Kikuyu Springs, Loresho, and Langata. This includes site surveys to determine the exact placement of the raw water and treatment water meters. Site clearance, if necessary, and the preparation of access routes for equipment and personnel will be undertaken to ensure that installation can proceed without obstruction.
2. **Procurement and Logistics**: The next step will involve the procurement of the Insertion Electromagnetic Flow Meters and other necessary materials. This will be followed by the planning and execution of logistics to ensure the timely delivery of the equipment to the respective sites. Coordination with suppliers and transporters will be crucial to avoid any delays that could impact the project timeline.
3. **Installation of Flow Meters**: The core activity will involve the installation of the Insertion Electromagnetic Flow Meters at the designated raw water and treatment water entry points. This will include the insertion of the meters into the existing pipelines and ensuring that they are securely mounted and aligned for accurate flow measurement. Qualified technicians and engineers will carry out this task following industry standards to ensure precision and reliability.
4. **Calibration and Testing**: Once installed, the flow meters will be calibrated to ensure that they provide accurate readings. This process will involve setting the meters to the required specifications and conducting a series of tests to validate their performance. Any necessary adjustments will be made to ensure that the meters operate optimally under varying flow conditions.
5. **Integration with Monitoring Systems**: The installed flow meters will be integrated with the existing water monitoring and management systems. This will involve connecting the meters to a central data collection and analysis platform, enabling real-time monitoring of raw water and treatment water flow rates. Training sessions will be conducted for the relevant personnel to familiarize them with the new system.

6. **Quality Assurance and Reporting**: Throughout the project, quality assurance measures will be in place to ensure that all activities meet the required standards. Regular inspections will be conducted, and detailed reports will be prepared to document the progress of the installation, calibration, and integration processes. Any issues identified will be addressed promptly to maintain the project schedule.
7. **Commissioning and Handover**: The final phase of the project will involve the commissioning of the installed flow meters. This will include a final round of testing to confirm the system's functionality and reliability. Once verified, the system will be handed over to the Nairobi Water & Sewerage Company for operational use, accompanied by comprehensive documentation and operational training for staff.

2.4. Labour requirements

A number of personnel will be required at the project site to carry out various activities and functions associated with implementation of the proposed project. They include among others professional staff; operators, drillers, drivers and labourers. The number of personnel to be involved in the Works will however be determined at the commencement of project. The Table below gives a summary of personnel requirements for the proposed project. It is recommended that priority is given to the residents near the project sites when recruiting the personnel.

Table 2: Labour requirements for project operations

No	Trade	Responsibility
1	Inspectors of works	Being in charge of the site operations and work instructions
2	Health and Safety Officer	Supervision of implementation of health and safety requirements during project implementation
3	Environmentalist	Supervision of implementation of environmental requirements during project implementation
4	Sociologist	Dealing with community liaison and grievances arising in the course of project implementation
5	Welders	In charge of welding works within project sites
6	Laborers	In charge of unskilled labour within project sites
7	Drivers	In charge of driving vehicles and equipment used in project sites
8	Plumbers	In charge of plumbing works within construction sites
11	Security Officer	In charge of site security

2.5. Land required and its availability

All the project sites are situated on land already owned and managed by NCWSC, ensuring that there are no issues related to land acquisition. The land at these locations has been dedicated for water infrastructure operations, including the existing pipelines and reservoir facilities. The installation of the electromagnetic flow meters will primarily be conducted within the established wayleaves and service corridors, minimizing any disruption to surrounding areas. No additional land acquisition is required for the project, as the infrastructure installations are confined to the designated NCWSC properties.

Given that the works will be conducted on existing utility land, there are no anticipated conflicts with private landowners or public use areas. The proposed installation locations have been carefully selected to ensure that they do not interfere with other infrastructure or environmental resources. Thus, the availability of land is confirmed, and all the necessary access permissions and usage rights are already in place under NCWSC's ownership.

2.6. Waste generated

Table 3: Anticipated Waste Generated

Type of Waste	Description
Construction and Installation Waste	- **Packaging Materials:** Boxes, pallets, and plastic wrappings used for transporting flow meters and equipment. - **Metal Offcuts:** Scraps from cutting and fitting metal components. - **Plastic and Rubber Waste:** Waste from protective coverings, seals, and gaskets. - **Concrete and Masonry Debris:** Debris from drilling and chiseling during installation. This will be done on the manholes.
Excavation Waste	- **Soil and Earth:** Excavated soil and earth from trenching and digging, especially for large meters. - **Rock Fragments:** Fragments from breaking or cutting through rocky areas.
Operational Waste	- **Used Tools and Equipment:** Worn-out or damaged tools and equipment. - **Empty Containers and Drums:** From storage and use of lubricants, adhesives, and other materials.
Hazardous Waste	- **Chemical Waste:** Residual chemicals from cleaning or maintenance processes, such as solvents or degreasers.
General Waste	- **Paper and Cardboard:** Discarded documentation, instructions, and other paperwork. - **Food and Beverage Waste:** Packaging and other food-related waste generated by personnel.

2.7. Applicable permitting process

A legal register listing all legislation, legal instruments relevant to the site has been prepared, indicating applicability to the site. In addition, permits and licenses that are required to be obtained by the project during construction and operation has been provided.

Table 4: Permits and licenses that are required

No.	Licenses/Permits	Legislation
1.	ESIA License for project	EMCA 1999
2.	Workplace Registration License from DOSHS	OSHA 2007
3.	NEMA License to transport waste	EMCA 1999

2.8. Project cost

The total project cost for the installation of the bulk meters and associated accessories is **Kenya shillings Fifty-Four Million (Ksh.54,000,000.00).** The EIA processing fee payable to NEMA is 0.1% of the project cost which translates to **KSh. 54,000**.

Table E1: Summary of the BoQ

Item No.	Bill	Unit	Quantity	Unit Price	Amount
A0	Allow for all costs associated with compliance with environmental, health, and safety requirements as specified **Environmental and Social (ES) requirements** of this bid document and the Environmental and Social Management Plan (ESMP) as required by government agencies and prevailing legislation. The cost under this item to include quarterly environmental audit in the ESMP by a registered Lead Expert.	Item	LS	516,000	516,000
A1	Supply, Delivery, Configuration, Testing and Commissioning of BATTERY Power-operated EM Insertion Pipe Flowmeter and Transmitters and Requisite Peripherals. This shall include Supply, delivery, deployment, configuration and commissioning of a remote meter monitoring system including a Meter Data Management System and for communication between Meters and NCWSC Control Office.				
	The quoted cost shall include associated data system costs such as; Registration, Activation and subscription with local data service providers for the meters and server for a period of 3 years. (local network), Software cost plus perpetual Software Licenses applicable for the				

Item No.	Bill	Unit	Quanti ty	Unit Price	Amount
	meter data collection, management and analytics system, Annual Cloud Hoisting Charge and Office Server				
	i7-10510U, 16GB RAM, Base LP DDR3, 512 GB SSD M.2 2280 NVMe, Integrated, 14.0''FHD IPS MultiTouch, e -privacy, win 10 Pro64, Intel AX201 2x2AX+BT, Y -FPR, TPM 2.0, IR HD Cam, RJ45 Extn Connector, 4 Cell 51Whr, 65W USB-C UK, KYB BL UK English,3 -year carry-in.				
	The supplied meters shall be for NCWSC Production, Reservoir Sites & Selected Distribution Mains sizes as below:				
A-1.1	**Ngethu Water Treatment Works**				
A-1.11	DN 700 outlet line	**No.**	1	1,600,000	1,600,000
A-1.12	DN 1000 outlet line	**No.**	1	2,000,000	2,000,000
A-1.13	DN 1200 outlet line	**No.**	1	2,500,000	2,500,000
A-1.14	DN 1200 raw water main	**No.**	1	2,500,000	2,500,000
A-1.15	DN 1400 raw water main	**No**	1	3,000,000	3,000,000
A-1.2	**Sasumua Water Treatment Works**				-
A-1.21	DN 600 outlet line	**No.**	1	1,400,000	1,400,000
A-1.22	DN 400 outlet line	**No.**	1	1,200,000	1,200,000
A-1.23	DN 600 raw water main	**No.**	1	1,500,000	1,500,000
A-1.24	DN 400 raw water main	**No.**	1	1,200,000	1,200,000
A-1.3	Kikuyu Water Springs				-
A-1.31	DN 300 outlet lines	**No.**	1	1,000,000	1,000,000
A-1.32	DN 200 outlets	**No.**	1	800,000	800,000
A-1.4	**Ruiru Dam Raw water inlet at Kabete**				-
A-1.41	DN 400 raw water inlet line at Kabete	**No.**	1	1,200,000	1,200,000
A-1.42	DN 300 raw water inlet line at Kabete	**No.**	1	1,000,000	1,000,000
A-1.43	DN 225 raw water inlet line at Kabete	**No.**	1	800,000	800,000
A-1.5	**Gigiri Reservoir**				-
A-1.51	DN 700 Phase I inlet line	**No.**	1	1,500,000	1,500,000
A-1.52	DN 1000 Phase II Inlet line	**No.**	1	2,000,000	2,000,000
A-1.53	DN 1000 Phase III Inlet line	**No.**	1	2,000,000	2,000,000
A-1.54	DN 900 Phase III-B inlet line	**No.**	1	2,000,000	2,000,000
A-1.6	**Kabete Water Treatment Works**				-
	Kabete Inlet Lines				-
A-1.61	DN 600 Sasumua Inlet line	**No.**	1	1,500,000	1,500,000
	Kabete Outlet Lines				-
A-1.62	DN 450 production line	**No.**	1	1,200,000	1,200,000
					-
A-1.63	DN 450 production line	**No.**	1	1,200,000	1,200,000
A-1.7	Kiambu Reservoir				-
A-1.71	DN 1000 outlet line	**No.**	1	2,000,000	2,000,000
A-1.8	Loresho Reservoir				-
A-1.81	DN400 Sasumua Inlet line	**No.**	1	1,200,000	1,200,000
A-1.9	**SELECTED MAIN LINES**				-
A-1.91	DN 450 Show ground-Kibera inlet	**No.**	1	1,200,000	1,200,000
A-1.92	DN 400 Langata inlet/Kibera outlet	**No.**	1	1,200,000	1,200,000

Item No.	Bill	Unit	Quanti ty	Unit Price	Amount
A-1.93	DN 1000 Corridor 1	No.	1	2,000,000	2,000,000
	SUB -TOTAL (A)				**41,216,000**
B	Installation of insertion flow meter at various points. This will involve but not limited to exposing of pipes, boring the pipes to affix the meter, insert hexagonal nipple and valves required, then mounting the transmitter and communication module in a suitable point. Quote should include all materials, equipment and labour for the works. Bituminous lined steel pipe of various lengths will act as the Sensor Protection Chamber. It will be put in place after boring the pipe and before installation of the meter.				
B-1.0	**Excavation**				
B-1.1	Excavation in soft soil depth not exceeding 1m	M^3	300	500	150,000
B-1.2	Excavation in soft rock depth not exceeding >1m < 2m	M^3	300	800	240,000
B-1.3	Excavation in Rock depth > 2m	M^3	200	1,500	300,000
B-1.4	Backfilling and making good of surfaces	M^3	800	1,000	800,000
B-2.0	Meter/ Sensor Protection Chambers				-
B-2.1	Lockable chequered plate cover 14G 800mmDia	No.	26	40,000	1,040,000
B-2.2	Bituminous lined steel pipe 800mDia	M	150	43,400	6,510,000
B-3.0	Installation of Insertion flow meter				-
B-3.1	Provide Talbot Under Pressure Tapping Machine – 2" capacity	No.	1	20,000	20,000
B-3.2	Provide Talbot compatible hexagonal nipples	No.	52	2,000	104,000
B-3.3	Under pressure Boring and installation of Insertion flow meter	Sum	26	15,000	390,000
B-4.2	**Provide Insurance for the works**	Days	150	1,000	150,000
B-4.2	**Provide necessary permits for the works**	Sum	1	100,000	100,000
	SUB -TOTAL (B)				**9,804,000**
C-1.0	Maintenance Support				
C-1.1	Provide after commissioning support of the installed complete meter system including Meter Data Management System (MDM) and remote monitoring system for Meter Site point and NCWSC control Offices. All Data and Controls will belong to the Client and to be hosted by NCWSC with full rights. The first 6 Months should be hand holding period and should not be costed.	months	24	15,000	360,000
	SUB -TOTAL (C)				**360,000**
D-1.0	Training for Metering System operation and maintenance.				
D-1.1	Technical site training (End users) On-the-Site Training on the installation, operation, trouble shooting and maintenance	Per Person	20	5,000	100,000

Item No.	Bill	Unit	Quanti ty	Unit Price	Amount
	of the installed complete meter system hardware and use of MDM software.				
D-1.2	System training for Administrators on (MDM) System and NBIoT/GPRS-GSM wireless communication system. (Note: The cost should include venue of training and all training materials concerned)	Per Person	10	2,000	20,000
D-1.3	Pre-shipment factory visit: Factory visit by the procuring entity to the actual manufacturing plant of the meters to be supplied. This will be to ascertain capacity and compliance to the contract specifications as per the submitted bidder's information. The visit will be after signing of the contract and before production of the first batch of meters. The factory visit will be at the cost of the procuring entity.	Per Person	5	500,000	2,500,000
	SUB -TOTAL (D)				**2,620,000**
	SUB -TOTAL(A+B+C+D)				**54,000,000**

3. Legislative, Policy and Institutional Framework

This chapter presents a review of the current policy, legal and regulatory framework applicable to environmental management of the proposed Installation of Insertion Electromagnetic Flow Meters, both at local and international levels.

3.1. Policy framework

The following key policies are relevant to the project:

Table 5: key policies relevant to the project

Policy	Description
Environmental Policy, 2012	The revised draft of the National Environmental Policy, dated April 2012, sets out important provisions relating to the management of ecosystems and the sustainable use of natural resources, and recognizes that natural systems are under intense pressure from human activities particularly for critical ecosystems including forests, grasslands and arid and semi-arid lands. The objectives of the Policy include developing an integrated approach to environmental management, strengthening the legal and institutional framework for effective coordination, promoting environmental management tools, supporting the implementation of the Forest Conservation and Management Act, 2016, and developing national standards and appropriate forest-based development mechanisms in emerging carbon markets.
The National Water Policy	The Policy is built on the achievements of the sector reform commenced with the Water Act and based on the sector principles lined out in the National Water Policy 1999. On water resources management, the policy seeks the management of water resources along natural catchment/basin boundaries following the Integrated Water Resource Management approach. It aims to ensure a comprehensive framework for promoting optimal, sustainable, and equitable development and use of water resource for livelihoods of Kenyans. Proponent, its contractors and associated Vendors will protect water catchment areas and ensure sustainable use of water. The ground water abstraction will have approvals and requisite licenses for conservative use.
Kenya's Vision 2030	Vision 2030 aspires to transform Kenya into a newly industrialized middle-income country by 2030. The blueprint recognizes that Kenya is a water scarce country and further that the economic and social development envisaged in the vision 2030 will require more high-quality water supply. Regarding environment, the Vision states that Kenya aims to be a nation living in a clean, secure and sustainable environment by 2030. The goals for 2012 are: (i) to increase forest cover from less than 3% at present to 4%; and (ii) to lessen by half all environment related diseases. Specific strategies involve: promoting environmental conservation for better support to the economic pillar flagship projects and for the purposes of achieving the Millennium Development Goals (MDGs); improving pollution and waste management through the design and application of economic incentives.
Land Policy	The National Land Policy in Chapter 3 under section 3.4, Environmental Management Principles, provides for the policy actions for addressing the environmental problems such as the degradation of natural resources, soil erosion, and pollution of air, water and land. The policy advocates for environmental assessment and audit as a land management tool to ensure environmental impact assessments and audits are carried

Policy	Description
	out on all land developments that may degrade the environment and take appropriate actions to correct the situation. Public participation has also been indicated as key in the monitoring and protection of the environment. Section 3.4.3.3 advocates for the Implementation of the polluter pays principle which ensures that polluters meet the cost of cleaning up the pollution they cause, and encourage use of cleaner production technologies. In section 131 (d) the government undertakes to provide mechanisms for resolving grievances arising from human/wildlife conflicts for sustainable management of land based natural resources.
National Policy on Gender and Development	The National Policy on Gender and Development provides a framework for the state to reduce gender imbalances and inequality. The policy provides guidance to different sectors in line with Government's effort to spur economic growth, reduce poverty and unemployment by taking into consideration the needs and aspirations of Kenyans - women, men, girls and boys across economic, social and cultural lines.
Kenya National Climate Change Action Plan	Kenya launched its National Climate Change Action Plan in March 2013. The plan addresses the options for a low-carbon climate resilient development pathway as Kenya adapts to climate impacts and mitigates growing emissions. Also, the enabling aspects of finance, policy and legislation, knowledge management, capacity development, technology requirements and monitoring and reporting.
Environment and Sustainable Development Policy, Sessional Paper No. 6 of 1999	This Policy aims to harmonize environmental and developmental goals for sustainability. • The policy defines approaches that will be pursued by the Government in mainstreaming environment into development. • The policy harmonized environmental and developmental objectives with the broad goal of achieving sustainable development. The policy paper has provided guidelines and strategies for government action regarding environment and development. This policy is relevant to the proposed project in view of the potential impacts on the environment and involvement of the public in project planning. The proponent will harmonize environmental and developmental objectives with the broad goal of achieving sustainable development through ensuring all potential impacts of proposed development will be avoided or mitigated in an acceptable and sustainable manner.
Kenya National Youth Policy 2016	This Policy aims at ensuring that the youth play their role alongside adults in the development of the Country. The National Youth Policy visualizes a society where youth have an equal opportunity as other citizens to realize their fullest potential. Proposed project will provide direct employment to the youth as required by the Policy. Youths should be encouraged to apply and be given equal employment opportunity in the project. It is expected the proposed project will identify the needs and concerns of youth and include their views.

Policy	Description
HIV/AIDS Policy, 2009	In summary, the policy provides a mechanism for: • Setting Minimum Internal Requirements (MIR) for managing HIV and AIDS; • Establishing and promoting programs to ensure non-discrimination and non-stigmatization of the infected; • Contributing to national efforts to minimize the spread and mitigate against the impact of HIV/AIDS; • Ensuring adequate allocation of resources to HIV/AIDS interventions; and • Guiding human resource managers and employees on their rights and obligations regarding HIV/ AIDS. Proponent & its associated contractors and suppliers will sensitise workers on HIV/AIDS prevention, supply condoms, and respect employees' rights regarding HIV/AIDS and non-discrimination/stigmatization of affected persons.
National Occupational Health and Safety Policy of 2020	This policy is intended to protect safety and health of workers in work places. The proposed project will provide employment opportunities to many workers in various categories during construction and operation. The contractor will be expected to comply with the requirements of this policy when engaging workers in various construction activities. The environmental management provides mitigation measures that can be undertaken to ensure compliance with the requirements of this policy.

3.2. Legislative Framework

3.2.1. The Constitution of Kenya

Article 42 of the Bill of Rights of the Kenyan Constitution provides that every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures. Part 2 of Chapter 5 of the Constitution is dedicated to Environment and Natural Resources. Article 69 in Part 2 provides that the State shall among others. Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits.

- Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
- Protect and enhance intellectual property in, and indigenous knowledge of biodiversity and the genetic resources of the communities;
- Encourage public participation in the management, protection and conservation of the environment;
- Protect genetic resources and biological diversity;
- Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;

- Eliminate processes and activities that are likely to endanger the environment; and
- Utilize the environment and natural resources for the benefit of the people of Kenya

Article 10 outlines the national values and principles of governance which include democracy and participation of the people, human dignity, equity, inclusiveness, social justice and human rights including non-discrimination and protection of the marginalized.

Article 33 guarantees the freedom of expression including freedom to seek, receive or impart information or ideas. Every person should feel constitutionally empowered to share information and ideas during public participation process. Article 35 provides for every citizen's right of access to information held by the state and information held by another person, and which is required for the exercise or protection of any right or fundamental freedom, this includes information required for effective public participation to take place. Article 69(d) encourages public participation in the management, protection and conservation of the environment. Under guiding values and principles of the Land Act, every public officer must ensure democracy, inclusiveness and participation of the people in matters related to land. People should participate in determining critical land matters for instance determining the economic viability of minimum and maximum acreage in respect of private land for various land zones in the country. Article 174(c) provides that one of the objects of devolution of government is to give powers of self-governance to the people and enhance the participation of the people in the exercise of the powers of the state and in making decisions affecting them.

Relevance

The proposed project complies with the Constitution by proposing a framework in its ESIA on Social, Health, Safety and Environmental protection.

3.2.2. The County Government Act 2012

This legislation is based on chapter 11 of the constitution. It provides for the powers, functions and responsibilities of county government. Section 87 of the Act provides for citizens' participation based on timely access to information, data, documents and other information relevant or related to policy formulation and implementation.

Relevance

The Contractor will be expected to carry out implementation of the project in consultation with the County Government of Nairobi.

3.2.3. The Environmental Management and Co-ordination Act, 1999

The main objective of EMCA and the related Regulations is to provide for the establishment of an appropriate legal and institutional framework including procedures for the management of the environment in Kenya. The Act further aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. In addition, The Act seeks to harmonize all the 77-sector specific legislation touching on the environment in a manner designed to ensure protection of the environment. This is in line with national objectives and sustainable development goals enunciated in Agenda 21 of the Earth Summit. As such, in terms of environmental management, EMCA provides

a comprehensive and an appropriately harmonized legal and institutional framework for the handling of all environmental issues in Kenya and supersedes all sectoral laws.

The EMCA 1999 provides that every person in Kenya is entitled to a clean and healthy environment in accordance with the constitution. The Act also acknowledges that public participation is important in the development of sustainable policies, plans and processes for the management of the environment. Anyone alleging the denial, infringement, violation or threat to their right to a clean environment and healthy environment is empowered to seek legal redress in the Land and Environment Court. The court may make certain orders to stop the offence and would be guided by the principle of public participation among other sustainable development principles.

Relevance

Under EMCA, NEMA has gazetted legal tools that govern conduct of EIAs and general environmental protection. The proposed project has been screened against these tools with results outlined below.

Some key Sections of the Act relevant to the proposed project are:

Section 3 – Entitlement to Clean and Healthy Environment.	The project shall maintain a clean and healthy environment and the proponent and its contractors has a duty to safeguard and enhance environmental management in accordance with sub-sections 1, 2, 3, 4, and 5.
Section 50 – Biological Diversity	The project shall ensure that at the operation phases, conservation of biological diversity shall be observed as prescribed in (a) to (g) of this section.
Section 51 & 52 – Biological resources	The project shall enforce all measures to ensure conservation of biological resources both *in situ* and *ex situ* to ensure species threatened with extinction are protected.
Section 78 – Air quality	The proponent shall enforce air quality standards and be maintained as per NEMA's Standard and Enforcement Review Committee requirements.
Section 87 – Handling and Disposal of Wastes	The proponent shall adhere to the disposal of wastes requirement in such a manner as not to cause pollution to the environment or ill health.
Section 102 – Excess Noise	Noise during construction of the project especially from the construction vehicles and machinery is prohibited and shall be maintained to the desirable levels as is also pointed out in Cap 394.

The subsidiary legislations under EMCA is discussed in detailed as follows:

i. **Environmental Management and Co-ordination (Water Quality) Regulations 2006:**

The Water Quality Regulations provide for the protection of lakes, rivers, streams, springs, wells, and other water sources. The regulations also stipulate that all industries should refrain from any actions, which may directly or indirectly cause water pollution. This regulation gives quality standards for water supply for domestic. The table below shows the water quality parameters.

Table 6: Quality Standards for Domestic Water (NEMA)

No	Parameter	Guide Value (max allowable)
1	pH	6.5 – 8.5
2	Suspended solids	30 (mg/L)
3	Nitrate-NO_3	10 (mg/L)
4	Ammonia –NH_3	0.5 (mg/L)
5	Nitrite –NO_2	3 (mg/L)
6	Total Dissolved Solids	1200 (mg/L)
7	Scientific name *(E.coli)*	Nil/100 ml
8	Fluoride	1.5 (mg/L)
9	Phenols	Nil (mg/L)
10	Arsenic	0.01 (mg/L)
11	Cadmium	0.01 (mg/L)
12	Lead	0.05 (mg/L)
13	Selenium	0.01 (mg/L)
14	Copper	0.05 (mg/L)
15	Zinc	1.5 (mg/L)
16	Alkyl benzyl sulphonates	0.5 (mg/L)
17	Permanganate value (PV)	1.0 (mg/L)

Source: Water Quality Regulations - 2006 (NEMA)

ii. Environmental Management and Co-ordination (Waste Management) Regulations 2006:

The Waste Management Regulations sets out standards for handling, transportation and disposal of various types of wastes. The regulations stipulate the need for facilities to undertake, in order of preference, waste minimisation or cleaner production, waste segregation, recycling or composting. These regulations provide guidelines on how to store, transport and dispose any wastes generated during the construction. Some of these wastes may fall under the hazardous wastes category and thus require disposal arrangements.

Relevance

The Contractor will follow the Waste Management Plan to carry out segregation, storage, transportation and disposal of waste at all the operational areas (Office, and Construction site).

Table 7: Waste Management Regulations

	PART II – GENERAL PROVISIONS
Responsibility of Waste Generator	(1) No person shall dispose of any waste on a public highway, street, road, recreational area or in any public place except in a designated waste receptacle. (2) Any person whose activities generate waste shall collect, segregate and dispose or cause to be disposed of such waste in the manner provided for under these Regulations. (3) Without prejudice to the foregoing, any person whose activities generates waste has an obligation to ensure that such waste is transferred to a person who is licensed to transport and dispose off such waste in a designated waste disposal facility.
Segregation of Waste by Generator	5. (1) Any person whose activities generate waste, shall segregate such waste by separating hazardous waste from non-hazardous waste and shall dispose of such wastes in such facility as is provided for by the relevant Local Authority.
Cleaner Production Principles	(1) Any person who owns or controls a facility or premises which generates waste shall minimize the waste generated by adopting the following cleaner production principles: (ii) improvement of production process through: conserving raw materials and energy (iii) eliminating the use of toxic raw materials within such time as may be prescribed by the Authority (iv) reducing toxic emissions and wastes monitoring the product cycle from beginning to end by: (v) identifying and eliminating potential negative impacts of the product. (vi) enabling the recovery and re-use of the product where possible. reclamation and recycling. (c) incorporating environmental concerns in the design, process and disposal of a product.
Waste Transportation Licence	7.(1) No person shall be granted a licence under the Act to transport waste unless such person operates a transportation vehicle approved by the Authority upon recommendation from the relevant lead agency. Any vehicle used for transportation of waste or any other means of conveyance shall be labelled in such a manner as may be directed by the Authority. The Authority in consultation with the relevant lead agency may designate particular geographical areas as areas for operation for licensed waste transporters. The application for a licence to transport waste shall be in Form I of the First Schedule to these Regulations and shall be accompanied by the prescribed fee set out in the Second Schedule.

	PART II – GENERAL PROVISIONS
	A licence issued under the Act for the transportation of waste shall be in Form II of the First Schedule to these Regulations and shall be valid for one year from the date of issue.
Mode of transporting waste.	A person granted a licence to transport waste shall ensure that: 1) the collection and transportation of such waste is conducted in such a manner that will not cause scattering, escaping and/or flowing out of the waste; 2) the vehicles and equipment for the transportation of waste are in such a state that shall not cause the scattering of, escaping of, or flowing out of the waste or emitting of noxious smells from the waste; 3) the vehicles for transportation and other means of conveyance of waste shall follow the scheduled routes approved by the Authority from the point of collection to the disposal site or plant; and 4) he or his agent(s) possess at all times during transportation of the waste, a duly filled tracking document as set out in Form III of the First Schedule to these Regulations and shall produce the same on demand to any law enforcement officer.
Transportation of waste by licensed transporter	9.Any person licensed to transport waste shall collect waste from the designated area of operations or storage areas and shall deliver such waste to the designated storage site, disposal site or plant.
Transitional Provision for transporting waste	10. Any person, who before the commencement of these Regulations was carrying on the business of transporting waste, shall apply to the Authority for a licence for the transportation of waste within ninety days after the commencement of these Regulations in the prescribed Form I as set out of the First Schedule to these Regulations.
Licence for disposal facility	11. (1) Any person granted a licence under the Act and any other licence that may be required by the relevant Local Authority to operate a waste disposal site or plant, shall comply with all conditions imposed by the Authority to ensure that such waste disposal site or plant operates in an environmentally sound manner. (2) An application for a licence to operate a waste disposal site or plant shall be in Form IV of the First Schedule to these Regulations and shall be accompanied by the prescribed fee set out in the Second Schedule. A licence issued under the Act for the operation of a waste disposal site or plant shall be as in Form V as set out in the First Schedule to these Regulations.
Transitional Provision for disposal facilities	12. Any person who before the commencement of these Regulations was carrying on the business of operating a waste disposal site or plant shall apply to the Authority for a licence as prescribed in these Regulations within ninety days after the commencement of these Regulations.
Waste treatment by operators of disposal sites. Cap 265	13. Any operator of a disposal site or plant shall apply the relevant provisions on waste treatment under the Local Government Act and Regulations thereunder to ensure that such waste does not present any imminent and substantial danger to public health, the environment and natural resources.

	PART II – GENERAL PROVISIONS
Validity of license and renewals	14. A licence to operate a waste disposal site or plant shall be valid for a period of one year from the date of issue and may be renewed for a further similar period on such terms and conditions as the Authority may deem necessary or impose for purposes of insuring public health and sound environmental management.
Requirement for Environmental Audit	15. Every licensed owner or operator of a waste disposal site or plant shall carry out an annual environmental audit pursuant to the provisions of the Act.
Re-use and recycling plants	16. Notwithstanding any provisions to the contrary herein, these Regulations shall apply to plants and sites established for re-use or re-cycling of wastes.

iii. Environmental Management and Coordination (Conservation of Biodiversity, Access to Genetic Resources and Benefit Sharing) Regulations 2006:

The Conservation of Biodiversity Act Sections 5-9 provides for the protection of endangered species, creation of an inventory, and monitoring of their status, protection of environmentally significant areas, provision of access permits, material transfer agreements and benefit sharing. These regulations guide the construction of the project with a view to avoiding areas of environmental significance and protection of endangered species.

Relevance

Though the project is located in a disturbed areas, the ecosystems need to be protected as per the requirements of this regulation

iv. Environmental Management and Co-ordination (Noise and Excessive Vibrations) Regulations 2009:

The regulations define noise as any undesirable sound that is intrinsically objectionable or that may cause adverse effects on human health or the environment. The regulations prohibit any person from making or causing to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. The Contractor will be expected to meet the noise level requirements as provided in the following schedules of the regulations and also carry out noise level monitoring:

Schedule 1 – Noise levels at residential and commercial sites

Schedule 2 – Noise levels at Construction sites

Relevance

The Contractor to observe noise level requirement according to the regulations.

Table 8: Maximum Permissible Noise Levels – Residential and Commercial (NEMA)

Zone		Sound Level Limits dB(A) (Leq,14 h)		Noise Rating Level (NR) (Leq,14 h)	
		Day	Night	Day	Night
A.	Silent Zone	40	35	30	25

B	Places of worship	40	35	30	25
C.	Residential: Indoor Outdoor	45 50	35 35	35 40	25 25
D.	Mixed residential (with some Commercial and places of entertainment)	55	35	50	25
E.	Commercial	60	35	55	25

Source: Noise and Excessive Vibration Pollution Control) Regulations, 2009

Table 9: Maximum Permissible Noise Levels for Construction Sites (NEMA)

Facility		Maximum Noise Level Permitted (Leq) in dB(A)	
		Day	Night
(i)	Health facilities, educational institutions, homes for disabled etc.	60	35
(ii)	Residential	60	35
(iii)	Areas other than those prescribed in (i) and (ii)	75	65

Source: Noise and Excessive Vibration Pollution Control) Regulations, 2009

v. Environmental Management and Co-ordination (Fossil Fuel Emission Control) Regulations 2006:

The Fossil Fuel Emission Control Regulations provide for acceptable emission standards in Kenya. Section 4 of the regulations state that any internal combustion engine for motor vehicles and generators must comply with the emission standards provided for in the First Schedule of those regulations. Hence, anyone who operates such engines whether on the road, street, public highway or any premises, which emits smoke in excess of the emissions standard in the First Schedule contravenes the regulations and is liable to prosecution. Section 8 provides that any person intending to use any fuel catalysts other than those permitted by the authority to disclose it and seek prior approval. Establishments (including construction sites) that use generators as alternative sources of energy must take account of the regulation on the emission standards.

Relevance

This regulation is applicable to the proposed project since there will be use of machinery and equipment that depend on fossil fuel as their source of energy. The requirements of the regulation must be implemented to eliminate or reduce air quality degradation.

Sections of the regulation citing the standards of recommended emission levels will be given to the contractor and or pinned at strategic points in the contractor's field offices.

vi. Environmental Management and Coordination (Air Quality) Regulations, 2014:

These regulations provide for the safeguarding of the ambient air quality and give guidelines to prevent and control air pollution. The first and seventh schedules of the regulations provide a list

with associated emission limits of prohibited, controlled, and un-controlled air pollutants. The regulations also give ambient air quality tolerance limits. The regulation is relevant to the construction works (including transportation).

Relevance

The Contractor will be required to observe the limits for Air Quality as provided in Schedule 1 – Ambient Air Quality Tolerance Limits. The Proponent shall ensure that the Contractor observes the policy and regulatory requirements and implement the mitigation measures proposed in this report.

Table 10: Schedule 1 – Ambient Air Quality Tolerance Limits

No	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
1.	Sulphur oxides (SOX);	Annual Average*	80 g/m3	60 g/m3	15 g/m3
		24 hours**	125 g/m3	80 g/m3	30 g/m3
		Annual Average		0.019 ppm/50 g/m3	
		Month Average			
		24 Hours		0.048ppm/125 g/m^3	
		One Hour			
		Instant Peak		500 g/m3	
		Instant Peak (10 min)		0.191 ppm	
2.	Oxides of Nitrogen (NOX);	Annual Average*	80 g/m3	60 g/m3	15 g/m3
		24 hours**	150 g/m3	80 g/m3	30 g/m3
		8 hours			
		Annual Average		0.2 ppm	
		Month Average		0.3 ppm	
		24 Hours		0.4 ppm	
		One Hour		0.8 ppm	
		Instant Peak		1.4 ppm	
3.	Nitrogen Dioxide	Annual Average	150 g/m3	0.05 ppm	
		Month Average		0.08 ppm	
		24 Hours	100 g/m3	0.1 ppm	
		One Hour		0.2 ppm	
		Instant Peak		0.5 ppm	
4.	Suspended Particulate matter (SPM)	Annual Average*	360 g/m3	140 g/m3	70 g/m3
		24 hours**	500 g/m3	200 g/m3	100 g/m3
		mg/Kg			
		Annual Average****		100 g/m3	
		24 hours***		180 g/m3	
5.	Respirable Particulate Matter (<10 m (RPM)	Annual Average*	70 g/m3	50 g/m3	50 g/m3
		24 hours**	150 g/Nm3	100 g/Nm3	75 g/Nm3

No	Pollutant	Time weighted Average	Industrial area	Residential, Rural & Other area	Controlled areas***
6.	PM2.5	Annual Average	35 g/m3		
		24 hours	75 g/m3		
7.	Lead (Pb)	Annual Average*	1.0 g/Nm3	0.75 g/Nm3	0.50 g/m3
		24 hours**	1.5 g/m3	1.00 g/m3	0.75 g/m3
		Month Average		2.5	
8.	Carbon monoxide (CO) carbon dioxid (CO2)	8 hours**	5.0 mg/m3	2.0 mg/m3	1.0 mg/m3
		1 hour	10.0 mg/m3	4.0 mg/m3	2.0 mg/m3
		mg/Kg			
		24 hours**			
9.	Hydrogen Sulphide	24 hours**	150 g/m3		
10.	Non-methane hydrocarbons	instant Peak	700ppb		
11.	Total VOC	24 hours**	600 g/m3		
12.	Ozone	1-Hour	200 g/m3	0.12 ppm	
		8 hour (instant Peak)	120 g/m3	1.25 ppm	

vii. Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulation, 2009.

These regulations provide for the protection of all wetlands on both private and public land. The regulations provide for sustainable exploitation of wetlands and are aimed at maintaining both the wetlands and hydrological, ecological, social and economic functions and services.

Relevance

The proposed project has no potential of impacting wetlands on the project area but it is important to undertake appropriate mitigation measures to minimize or avoid degradation of wetlands especially Kikuyu springs.

3.2.4. The Environmental Impact Assessment and Audit Regulations 2003 (Legal Notice No. 101)

Regulation 24 – EIA Licence: - Environmental Impact License shall be issued after the authority approves the study report under regulations 23 and shall be issued in form.

Regulation 28 – false or incorrect information: -Substantial change or modification and when project poses an environmental threat or revelation that information or data given by the license were false, incorrect or intended to mislead.

Regulation 24 – Annual Environmental Audit: - Annual environmental auditing after presentation of an EIA study report shall be undertaken by the licensee to ensure the implementation of

environmental management plan is audited on regular basis, an audit report submitted to NEMA annually and ensuring that the criteria to audit is based on environmental management plan developed during the EIA process or after the initial audit.

Regulation 40 - Monitoring changes after project implementation

Monitoring by NEMA and Lead Agencies shall be done to establish any possible changes in the environment and their possible impacts, immediate and long-term effects of its operations, identify and determine parameters and measurable indicators and conduct changes that occurred after implementation.

Relevance

The proposed project must comply with the requirements of the regulations that also include conducting regular monitoring and annual audits. The project requires an EIA license from NEMA before commencement of any activity.

3.2.5. The Water Act 2016

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

The Water Act (General) Rules make provision for discharges in a number of respects, as follows:

- Effluent shall not be returned to any body of water unless it has been purified. Further, it must not contain poisonous or injurious matter or excess silt, gravel or boulders.
- The regulating authority may determine the potential prejudicial effects of the pollutant discharges and order the removal already made.
- It is an offence to allow effluent discharges, either domestic or industrial, if this would harm fish, and a fish warden may order its removal. Plans for rendering such effluent innocuous shall be submitted to and approved by the enforcing authority.
- Additionally the applicant for a water permit is required to outline the methods to be used for treating effluent before discharge (Form WAB 13, question 18). The permit would only be issued subject to satisfactory provision being made for the treatment of effluent. The Water Act, apart from the Rules, makes only limited provision for controlling water pollution. The provision is limited to the pollution of drinking water.
- Under section 145, the water undertaker may make regulations to control polluting activities, which may threaten its source of water. It may itself construct the necessary works for intercepting, treating or disposing of foul water (s.149). Section 158 makes it an offence to pollute such waters. Similarly, under section 169, it is an offence to throw or convey polluting matter into a body of water.

Relevance

The proponent shall be expected to comply with the Water Act 2016 by ensuring that the installation and operation of the flow meters support accurate monitoring of water abstraction volumes, aid in the detection of potential pollution events, provide data for regulatory reporting and decision-making processes, and ultimately contribute to the sustainable management and protection of water resources as mandated by the Act, particularly in relation to permitted water use, quality management, and overall system efficiency.

3.2.6. The Forests Act, 2016

The Forests Act, 2016 provides for the establishment, control and regulation of Forests. The Act created a new semi-autonomous body, the Kenya Forest Service (KFS) and supportive institutions for management and conservation of all types of forests. This Act mandates the KFS to conserve and manage all forests. It also sets out the roles and responsibilities of communities in managing forests. KFS is also responsible for formulating policies regarding the management, conservation and use of all types of forest areas in the country. The Act embraces the concept of participatory forest management and considers formation of forest community associations, which are recognized as partners in management. It enables members of forest communities to enter into partnership with KFS through registered Community Forest Associations. It also allows lease arrangements by interested groups to supplement government efforts in plantation forest.

Relevance

The project does not affect any Forest, the proponent should engage with the Kenya Forest Service for guidance on any activities that may impact forest areas, even indirectly in project sites near forested areas (e.g. Sasumua).

3.2.7. Land Act, 2012.

The Land Act was enacted by Parliament to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land-based resources, and for connected purposes. The Act applies to all land declared as (a) public land under Article 62 of the Constitution; (b) private land under Article 64 of the Constitution; and (c) community land under Article 63 of the Constitution and any other written law relating to community land.

The Land Act guarantees security of tenure for land under (a) freehold; (b) leasehold; (c) such forms of partial interest as may be defined under the Act and other law, including but not limited to easements; and (d) customary land rights, where consistent with the Constitution and guarantees equal recognition and enforcement of land rights arising under all tenure systems and non-discrimination in ownership of, and access to land under all tenure systems. Under the Lands Act 2012, The Wayleaves Act, Cap 292 and The Land Acquisition Act, Cap. 295 have been revoked but Sections 8 and 9 allow for Compulsory Acquisition as an option in acquiring land for public utility.

Relevance

All the project sites are situated on land already owned and managed by NCWSC, ensuring that there are no issues related to land acquisition.

3.2.8. The Wildlife management and Conservation Act 2013

The Wildlife and Conservation Act deals with the conservation and management of wildlife in Kenya. The Act provides that wildlife should be conserved so as to yield optimum returns in terms of cultural, aesthetic, scientific and economic benefits. The Act requires that full account be taken of the inter-relationship between wildlife conservation and land use. The Act controls activities within the national parks, which may lead to the disturbance of wild animals. Unauthorized entry, residence, burning, damage to objects of scientific interest, introduction of plants and animals and damage to structure are prohibited under this law.

Relevance

The construction activities will make mitigation provisions for any wildlife which might be within the project area.

3.2.9. The Occupational Safety and Health Act, 2007

This Act of Parliament was enacted to provide for the health, safety and welfare of persons employed in workplaces and for matters incidental thereto and connected therewith. Part II of the Act provides the General duties that the occupier must comply with respect to health and safety in the workplace. Such duties include undertaking S&H risk assessments, S&H audits, notification of accidents, injuries and dangerous occurrences. Several sections under this part are applicable to the project.

This Act will provide some guidance on the mitigation measures for any negative impacts in particular those concerning the workers within the site. Section 17 of the Act further highlights the importance of an employer or in this case Contractor to ensure the health and safety of persons other than his/her employees. As such this Act also ensures the inclusion of community health and safety in this ESIA.

Relevant

The project construction, operation and decommissioning activities will have occupational, public health, safety and security issues that have to be mitigated and monitored and this ESIA proposes a number of mitigation measures as provided under Chapter 7 and 8.

3.2.10.Public Health Act (Cap 242) of Revised Edition 2012

This legislation requires that Local Authorities now County Government take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable for injurious or dangerous to human health. Part IX section 115 states that no person shall cause nuisance or condition liable to be injurious or dangerous to human health.

Part XI section 129 of the Rules states in part "It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes, and purifying such supply so polluted". Section 130 provides for making and imposing on local authorities and others the duty of enforcing rules in respect of

prohibiting use of water supply or erection of structures draining filth or noxious matter into water supply as mentioned in section 129.

Relevance

The installation of the proposed project has potential for pollution risks related to soil, water, air and noise during construction. The contractor will need to ensure that air and water pollution is controlled and does not affect workers and people within the project site area

3.2.11. HIV/AIDS Prevention and Control Act (Act No.14 of 2006)

The Act provides for measures of prevention, management and control of HIV and AIDS. It Promotes public health, counselling, support and care for those affected or living with HIV. Part 11, Section 7 requires HIV and AIDs education in the workplace. The government is expected to ensure provision of basic information and instruction on HIV and AIDs prevention and control to; Employees of all Government Ministries, Departments, Authorities, and Other Agencies; and, Employees of Private and Informal Sectors. The information on HIV/AIDs is expected to be treated with confidentiality at the workplace.

Relevance

This Act will ensure that the Contractor makes provision for Voluntary Counselling and Testing (VCT) for the workers. This will greatly contribute to management of HIV and AIDS and also bringing down stigmatization.

3.2.12.The National Gender and Equality Act, 2011

National Gender Equality Commission is a constitutional Commission established by an Act of Parliament in August 2011, as a successor commission to the Kenya National Human Rights and Equality Commission pursuant to Article 59 of the Constitution. NGEC derives its mandate from Articles 27, 43, and Chapter Fifteen of the Constitution; and section 8 of NGEC Act (Cap. 15) of 2011, with the objectives of promoting gender equality and freedom from discrimination. Gender mainstreaming in the project will ensure that the concerns of women and men form an integral dimension of the project design, implementation, operation and the monitoring and evaluation ensures that women and men benefit equally, and that inequality is not perpetuated.

Relevance

The contractor will ensure gender equality is addressed to the best level possible.

3.2.13.The Employment Act, 2007

The Employment Act, 2007 defines the fundamental rights of employees including the basic conditions of employment of workers. It also regulates employment of children under section 56 which makes it illegal to employ children under the age of 13 years. Children between ages 13 – 16 years can be employed in light work while those between 16 and 18 are considered employable.

Relevance

The contractor on site will have to employ casual labourers (those who are engaged on need basis and paid daily) probably from the communities where the project is located during construction.

The basic conditions of employees should be observed to avoid unnecessary conflicts during the construction works. The Contractor shall pay the entire amount of the wages earned by or payable to the workers. Payment of such wages shall be done at the end of a working day at or near the place of work. The Contractor shall also ensure that all statutory deductions are submitted without delay to appropriate government agencies e.g., Kenya Revenue Authority, NSSF, NHIF, among others.

3.2.14.The Sexual Offences Act, 2006

This Act protects people and employees from any unwanted sexual attention or advances by staff members. This act ensures the safety of women, children and men from any sexual offences which include: rape, defilement, indecent acts.

Relevance

This law will govern the code of conduct of the Contractor's staff and provide repercussions of any wrong doing. The code of conduct will ensure that sexual rights are protected.

3.2.15.Physical Planning Act (Cap. 286)

This Physical Planning Act, Cap. 286 provides for the preparation and implementation of physical development plans. Section 36 of the Act provides for environmental impact assessments and states that if in connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant shall be required to submit together with the application an environmental impact assessment report'.

Relevance

The Proponent and Contractors of the proposed project will need to comply with the requirements of this Act.

3.2.16.The Work Injury Benefits Act, 2007

Part V provides for compensation to employees for work related injuries and disease contracted in the course of their employment and for connected purposes. Key sections of the Act include the obligations of employers; right to compensation; reporting of accidents; compensation; occupational diseases; medical aid etc.

Relevance

The proponent/contractor shall comply with all requirements of the Act i.e. putting in place an insurance cover that shall protect employees, should their employees incur injuries or die in the course of work.

3.2.17.Climate change Act 2016

Under Section 3 of the Act, the objectives of the Act include to provide for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve low carbon climate development.

Relevance

The project design shall be climate- proof over its lifespan and undertaken as per provisions of the act specifically on planning and implementation stages.

3.2.18.National Museums & Heritage Act, 2006

An Act of Parliament to consolidate the law relating to national museums and heritage; to provide for the establishment, control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya; to repeal the Antiquities and Monuments Act (Cap. 215) and the National Museums Act.

Relevance

The proponent shall follow due procedures including notification of the National Museums in case of unearthing any antiquity to ensure they are protected and conserved to promote cultural resources in the context of economic development of the Country.

3.2.19.Sustainable Solid Waste Management Act 2022

The act establishes the legal and institutional framework for the sustainable management of waste, towards the realization of the constitutional provision on the right to a clean and healthy environment and for connected purposes. The objects of the act are: promote sustainable waste management; improve the health of all Kenyans by ensuring a clean and healthy environment; reduce air, land, fresh water and marine pollution; promote and ensure the effective delivery of waste; create an enabling environment for employment in the green economy in waste management, recycling and recovery; establish an environmentally sound infrastructure and system for sustainable waste management; promote circular economy practices for green growth; mainstream resource efficiency principles in sustainable consumption and production practices; and inculcate responsible public behaviour on waste and environment.

The act provides for general principles including: the polluter pays principle in which the cost of cleaning up any element of the environment that has been damaged by pollution, the cost of the beneficial uses of the environment that have been lost as a result of the pollution, and any other costs associated with or incidental to the pollution shall be paid by the polluter; and zero waste principle in which products and processes are designed and managed to reduce the volume and toxicity of waste and materials, and to conserve and recover all resources, and to prevent the burning or burying of resources, in order to treat waste as a resource that can be harnessed for wealth creation, employment and the reduction of pollution.

The Act provides for public and private entities to segregate waste and section 13 provides for extended user responsibility.

Relevance:

The client and contractors should adhere to this Act. The Act calls for sustainable waste management by ensuring zero waste generation and if unavoidable, intervention measure (reduce, recycle, repurpose etc.) should be in place. Also, the Act states the generator of the waste is responsible for its management and safe disposal.

2.3. World Banks Operational Policies (OP)

The World Bank's ten safeguard policies are designed to help ensure that programs proposed for financing are environmentally and socially sustainable, and thus improve decision-making. The Bank's Operational Policies (OP) are meant to ensure that operations of the Bank do not lead to adverse impacts or cause any harm. They include guidance on EA requirements. Of the Bank's Safeguard Policies, two are relevant for consideration under the project. These are:

- Environmental Assessment (OP 4.01);
- Involuntary Resettlement (OP/BP 4.12)

2.3.1. Environmental Assessment (OP 4.01)

The OP 4.01 requires among others that screening for potential impacts is carried out early, in order to determine the level of EA to assess and mitigate potential adverse impacts. The Bank's project screening criteria group projects into three categories:

- Category A – A proposed project is classified as Category A if it is likely to have adverse impacts that are insignificant (based on type, location, sensitivity, and scale of the project and the nature and magnitude of its environmental impacts).
- Category B –A proposed project is classified as category B if the potential impacts are typically site specific, reversible in nature, less adverse than category A projects, and for which mitigatory measures can be designed more readily.
- Category C – A proposed project is classified as a category C if there are minimal or no adverse impacts.

2.3.2. Involuntary Resettlement (OP/BP 4.12)

The Policy on Involuntary Resettlement is intended to assist displaced people arising from development projects, in order not to impoverish any affected people within the area of influence of projects. An action plan that at least restores the standard of living must be instituted, in cases where resettlement is inevitable or loss of assets and impacts on livelihood occurs.

2.3.3. Bank's Policy on Disclosure (BP 17.50)

The Bank's policy on disclosure requires that all the people residing in the given areas of a project have the right to be informed of the proposed development project. Prior to project appraisal therefore, the summary of the study of the development action along with other relevant information should be disclosed in the info-shop and in the project area as well as nationally. The ESIA will be submitted to the Bank's Info shop and disclosed on the project website. The ESIA is also being submitted to NEMA. The issues raised in the documents will continue to be discussed with different stakeholders during implementation.

2.4. Institutional Framework

2.4.1. National Environmental Management Authority (NEMA)

The National Environment Management Authority (NEMA) is established under Section 7 of the Environmental Management and Co-ordination Act Cap 387 NEMA is the institution with the legal authority to exercise general supervision and co-ordination over all matters relating to the environment and is the principal instrument of the Government charged with the implementation of all policies relating to the environment. NEMA is the body that coordinates and administers the Environmental Impact Assessment (EIA)/ Environmental Audit (EA) on behalf of the Cabinet secretary for Environment and Natural Resources. EIA/EA is applicable to both public and private sector development projects and programmes. A scheduled activity will not receive the necessary authorization from NEMA to proceed or continue operating, until all EIA/EA requirements have been fulfilled and accepted by NEMA.

2.4.2. National Environmental Complaints Committee

The National Environment Complaints Committee performs the following functions:

- To investigate;
    i. any allegations or complaints against any person or against the Authority in relation to the condition of the environment in Kenya;
    ii. on its own motion, any suspected case of environmental degradation, and to make a report of its findings together with its recommendations thereon to the CS;
- To prepare and submit to the CS, periodic reports of its activities which report shall form part of the annual report on the state of the environment under section 9(3);
- Undertake public interest litigation on behalf of the citizens in environmental matters; and

To perform such other functions and exercise such powers as may be assigned to it by the CS.

2.4.3. Environmental and Land Court

The Court was established under Section 4 of the Environment and Land Court Act No. 19 of 2011. It has the Jurisdiction to hear any other disputes relating to environment and land.

Legal Register

A legal register listing all legislation, legal instruments relevant to the site has been prepared, indicating applicability to the site. In addition, permits and licenses that are required to be obtained by the project during construction and operation has been provided.

No.	Licenses/Permits	Legislation
1	ESIA License for project	EMCA 1999
2	Workplace Registration License from DOSHS	OSHA 2007
3	NEMA License to transport waste	EMCA 1999

4. Baseline Information

This section presents the geographic characteristics, baseline environmental conditions including the socio-economic conditions within the area. For convenience, the description of the larger Nairobi City area is provided followed by presentation of details that are more specific to the project site.

Gathering of baseline data was necessary to meet the following objectives:

- To *understand* key biological, physical, ecological, social, cultural, economic, and political conditions in areas potentially affected by the proposed project;
- To *provide data* to predict, explain and substantiate possible impacts;
- To *understand* the expectations and concerns of a range of stakeholders on the proposed development;
- To *inform* the development of mitigation measures; and
- To *benchmark* future socio-economic changes/ impacts and assess the effectiveness of mitigation measures

It should however be noted that the comprehensiveness of the descriptions of the general geographic and environmental characteristics of the study area is variable being governed by availability of relevant data and information.

4.1. Physical environmental condition

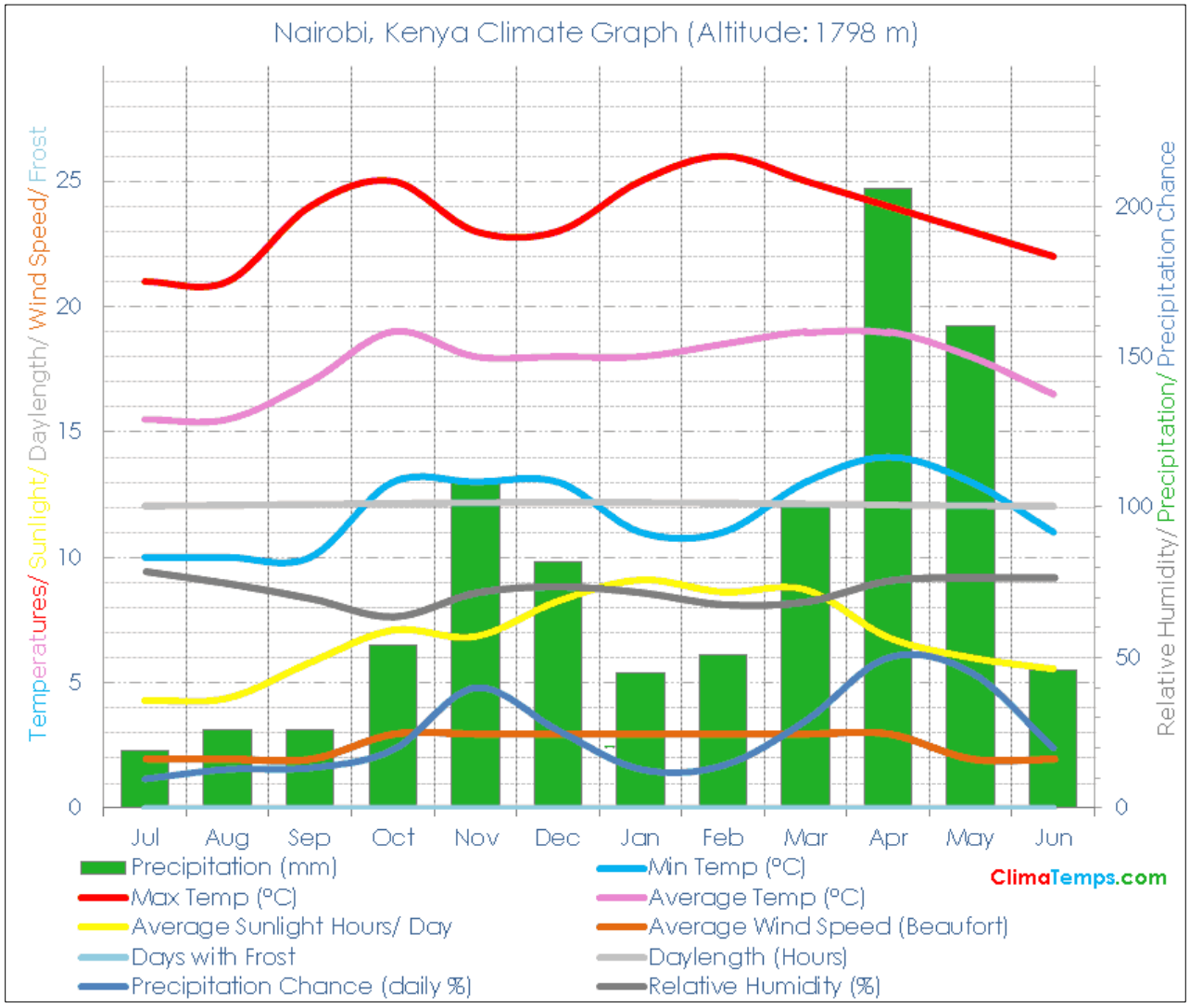
4.1.1. Climate

Nairobi is situated close to the equator hence the differences between the seasons are minimal and the timing of sunrise and sunset varies little throughout the year. Under the Köppen climate classification, Nairobi has a subtropical highland climate (Cwb). At 1,795 metres (5,889 ft) above sea level, evenings may be cool, especially in the June/July season, when the temperature can drop to 9 °C (48 °F). The sunniest and warmest part of the year is from December to March, when temperatures average in the mid-twenties Celsius during the day. The mean maximum temperature for this period is 24 °C (75 °F). Actual temperature ranges from a low of 10 degrees to a high of 29 degrees Centigrade.

Due to the ITCZ (Inter- Tropical Convergence Zone) that forms throughout the area around the equinoxes, where the prevalent winds of the Northeast and Southeast converge, Nairobi has a bimodal rainfall pattern with the long rains season falling between March to June while the short rains season falls between October and December. The mean annual rainfall is 900 mm ranging from 500mm to 1500mm. During the long rains, the storm water mostly disappears as run off due to the poorly drained cotton soil and the paved land resulting in flooding.

Prevailing wind direction in Nairobi is almost exclusively from the northeast, air quality impacts from the Project will therefore be expected to predominantly be experienced to the southwest of the Project site, for both short-term and annual average concentrations.

Figure 16: Climate of Nairobi County



Source: Climate.top

4.1.2. Topography

Nairobi area is characterized by undulating hilly topography with elevation in a range of 1,460 m to 1,920 m. Lowest elevation occurs at the Athi River at the eastern boundary of the city and highest at the western rim of the city. The terrain in the eastern side of the County is gently rolling but divided by steep valleys towards the City boundaries. To the north, there is the Karura forest which is characterized by steep sided valleys. The Karen - Langata area is characterized by plains surrounded by Nairobi National Park on the east and Ngong Forest on the south. Several streams with steep-sided valleys covered with vegetation are a dominant landscape feature of the County. The main rivers in the County are Nairobi River, Ngong River and Kabuthi River.

4.1.3. Soils

Nairobi is characterised by nitisols and andosols (Kenya Soil Survey, 1980). Nitisols occur mainly in the tropics and subtropics, as well as in areas with a Mediterranean type of climate and are associated with basic rocks (e.g. basalts). Andosols occur throughout the world where volcanic activity is common. Soils in the Machakos (where the proposed project starts) counties typically include the vertisols, gleysols and phaeozems. They are characterized by having pockets of sodicity and salinity, are typically of low fertility and vulnerability to erosion.

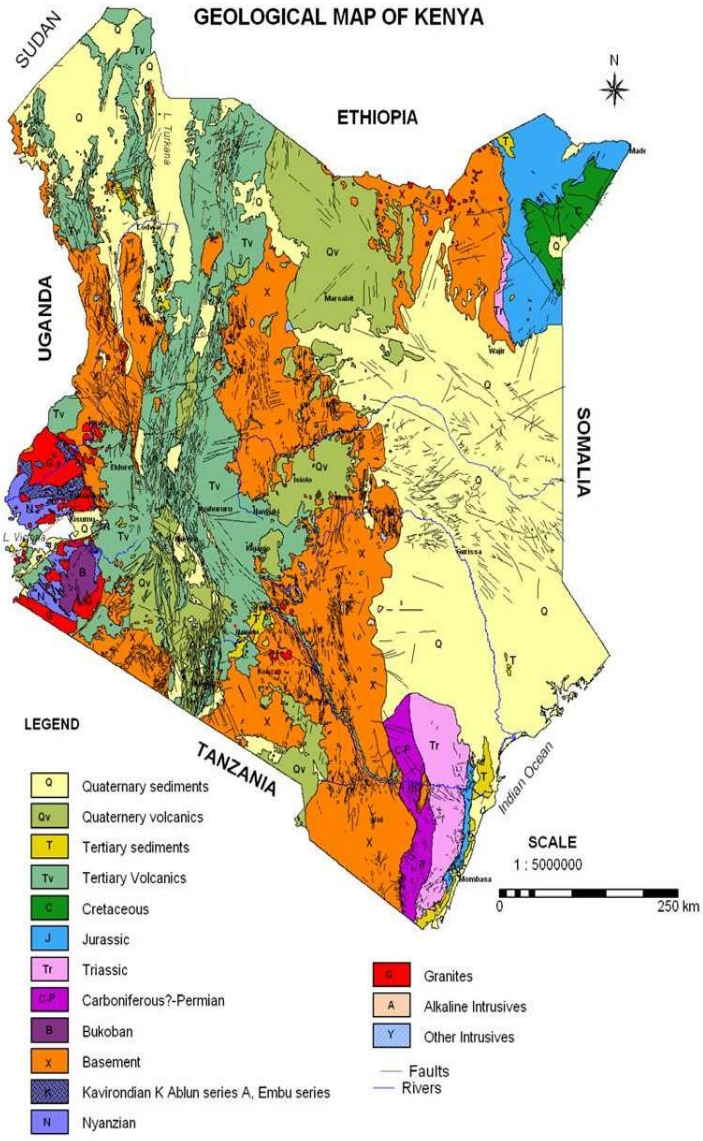


Figure 17: Geological Map of Kenya (Source: National Geodata Centre for Kenya, 2024)

4.1.4. Surface water and Hydrology

The project area is part of the upper Athi basin which drains into the Nairobi, Ngong, Athi rivers and several small streams. Prominent drainage feature is the Nairobi River and its tributaries which are permanent rivers that cross the proposed express way. Groundwater aquifers in the project

area occur mainly between the principal lava flows that have old land surfaces and in the fractured and weathered volcanic rocks. Near-surface aquifers occur in ferricrete deposits and weathered soil on former land surfaces and in addition to faults, fissures and joints may carry water in the proposed project area.

Table 11: Major surface water bodies

Name of River	Co-ordinates	Location
River Nairobi tributary	37 M 0258416 m E, 9855149 m S	Between Capital Centre and Nyayo stadium
River Nairobi	37 M 0257727 m E, 9856610 m S	Between Nyayo Stadium and Golf Club

The Nairobi Aquifer Suite (NAS) is a group of multi-layered aquifers in the volcanic flows rising from the southern Aberdares, the Kikuyu Escarpment and Ngong Hills and dipping gently eastward into the pre-Tertiary Athi Lake Basin, terminating at the Mozambican Basement System (See Figure 2-2). The groundwater basin extends from the zone of northsouth rift faulting west of the city (with an elevation of about 2400 m asl) towards the Athi river floodplain (with an elevation of 1500 m asl) east of the city centre. Volcanic activity has controlled the geomorphologic evolution – the rocks of the Nairobi basin mainly comprising a succession of volcanic lavas and ashes (tuffs), whose thickness reaches some 400 m underneath the city itself and which eastward gradually merge into to the Tertiary deposits of the Athi floodplain, (Gulf Power Ltd., 2010; Stephen F. and Albert T., 2005; WRMA, 2010).

The volcanic rocks show a wide range of porosity and permeability and have developed aquifer units separated by lower permeability strata. The aquifers consist of the Kerisha Valley Series and Upper Athi Series (transmissivity of 5-50 m2 /d and low storativity). The extension of this multi-layered aquifer system is fairly well known from the many boreholes that have been drilled to depths of 100-350 m. The Upper Athi Series is reported to be the main aquifer for boreholes in Nairobi, (Stephen F. and Albert T., 2005).

4.1.5. Geology

The Nairobi area covers part of the eastern flank of the Great Rift Valley and its geological history has been dominated by widespread volcanic activity of Caenozoic age. Lavas, welded tuffs and other pyroclastics cover nearly the entire area and overlie a foundation of poorly exposed, folded and metamorphosed Precambrian rocks of the Mozambique Belt. The characteristic magmatism changed from nephelinitic through phonolitic to trachytic and sometimes peralkaline salic, with basalt accompanying all stages but tending to change from alkali to transitional type (Clarke et al., 1990). A period of erosion prior to the deposition of volcanic rocks on top of basement rocks manifests as layers of gneissic ruble, clays, sands and detritus.

The project areas are characterized by complex and varied geological formations.

Ngethu Treatment Works is located within an area underlain by formations primarily from the Holocene and Pleistocene epochs. During the Holocene, the region was influenced by volcanic

activity from Longonot, a trachyte stratovolcano. The deposits in this area, including the Longonot Ash Member and Lower Trachyte, were formed during episodes of cone building and summit crater formation. The trachyte lavas and airfall tuffs, dating from approximately 5,600 to 3,300 years ago, play a significant role in the area's subsurface structure. Additionally, the Pleistocene epoch left behind the Kedong Valley Tuff, a series of trachytic ignimbrites and associated fall deposits. These were produced by caldera formation at Longonot and are identifiable by their weathered tops and calcite-replaced pyroclastic materials. The presence of these volcanic formations must be considered when installing the flow meters, as they could influence the drilling and stability of the infrastructure.

Kabete Treatment Works and the associated installation sites, such as **Sasumua Treatment Works** and the **Gigiri Reservoir**, are located within regions dominated by volcanic deposits from the Pleistocene and Pliocene epochs. The Kabete area is particularly noted for the Kabete Trachyte, a grey-green porphyritic trachyte that reaches substantial thicknesses in boreholes. This formation is stratigraphically similar to the Ruiru Dam Trachyte, suggesting a volcanic origin with significant historical eruptions contributing to the area's geology. The Sasumua region also exhibits similar geological characteristics, with trachytes from the Pleistocene period being prevalent. These trachytes are critical in defining the subsurface conditions, which could impact the installation process, especially in terms of drilling and anchoring the flow meters.

In the regions around **Kiambu and Uhuru Highway**, the subsurface geology is characterized by the Nairobi Trachyte and Kiambu Trachyte, which date back to the Pliocene epoch. The Nairobi Trachyte, a greenish-grey formation occasionally containing tabular feldspar phenocrysts, is one of the most prominent volcanic rocks in the area. With multiple thin flows reaching up to 90 meters in cumulative thickness, this trachyte underlies much of the area and provides a solid foundation for construction activities. The Kiambu Trachyte, on the other hand, is a light grey formation with numerous feldspar phenocrysts, some of which are vesicular with green chalcedony amygdules. This trachyte is particularly important in regions like Kiambu Reservoir, where its physical properties will directly influence the effectiveness of the meter installations.

The installations planned for the **Loresho Reservoir**, **Langata line at Showground**, and **Langata Line at Police Dog Section** involve areas underlain by complex trachytic formations, such as the Limuru Trachyte and Tigoni Trachyte from the Pleistocene period. The Limuru Trachyte, with its characteristic K-feldspar phenocrysts and bouldery outcrops, forms a substantial portion of the escarpment and must be carefully considered during installation to avoid any disruptions to the meter placement. The Tigoni Trachyte, known for its fine-grained texture, is another critical formation that will influence the project. The presence of these trachytes and their physical characteristics will dictate the approach to drilling and placement of the electromagnetic flow meters, ensuring that the installations are secure and stable over time.

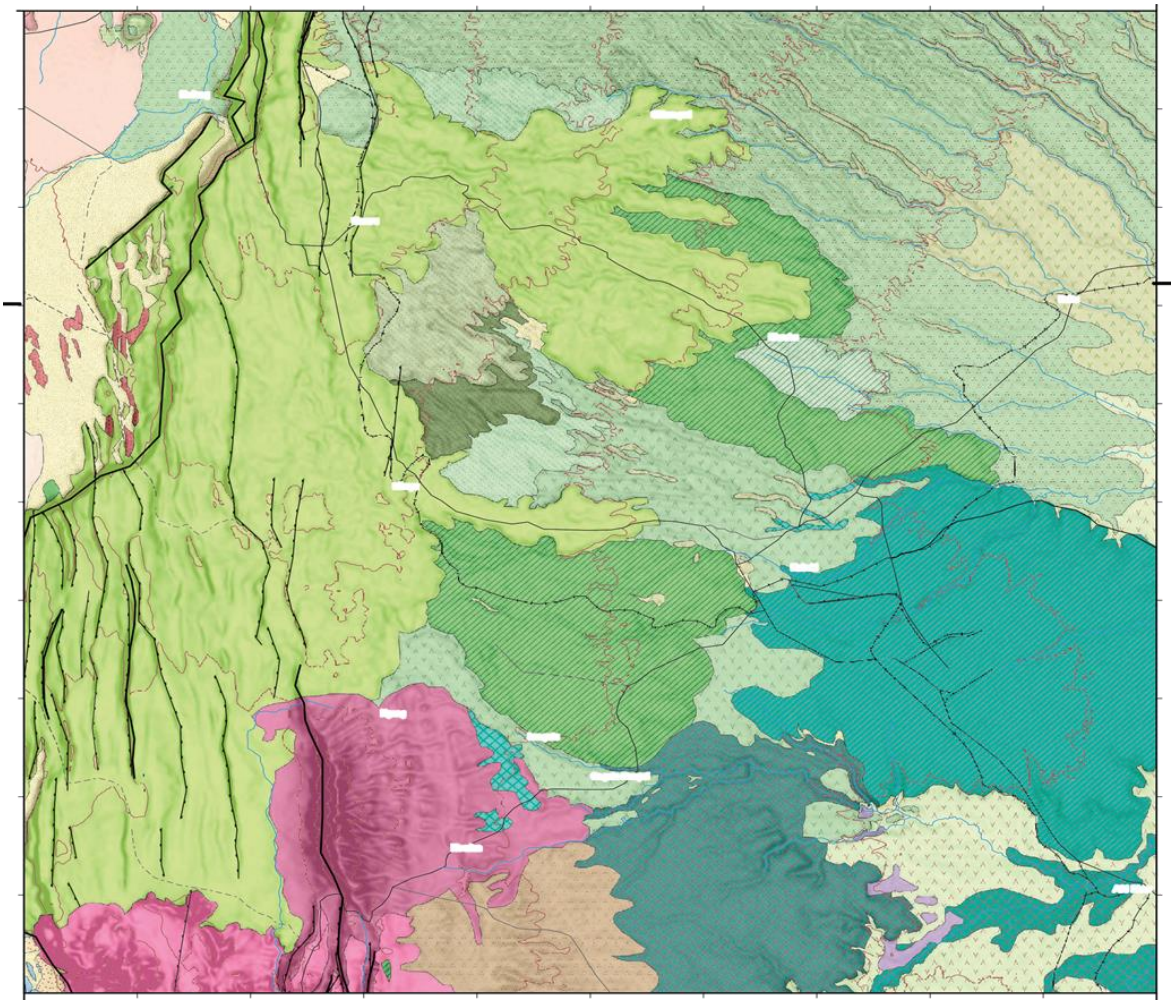


Figure 18: Geology of the Nairobi Region

4.1.6. Hydrogeology

The hydro-geology of Nairobi City and its environs is controlled by the nature and morphological set up of various volcanic lava flows and the configuration of the old land surface of the basement rock system. The river drainage system and indeed the groundwater table gradient closely follows the casterly direction of the lava flows. Aquifers occur within the Kirichwa valley tuffs and sediments, and the interface between Nairobi phonolite and Kapiti phonolite within the Athi series of tuffs and lake sediments.

In the southern part of the Nairobi arca, deep aquifers are encountered within the old land surface of the basement rocks. The old lava flows, namely trachytes and phonolite, are compact and impermeable and are as such aquicludes. The main streams and rivers draining the Kikuyu Highlands towards the Nairobi arca are perennial but are fed by springs that issue within the contacts of the Kirichwa valley tuffs and the trachytic lavas. The Nairobi River is fed by the Kikuyu springs at the headwaters while Mbagarhi springs in Ololua forest feed the Mbagathi river, which later become Athi River. Numerous springs issue between lava flows where the trachates and tuffs are relatively porous and permeable.

In the City Center, water draining eastwards from the permeable tuffs and sediments accumulates above the Nairobi phonolite to from a shallow perched water table. The Kirichwa valley tuffs lying to the cast of the Uhura Highway is so porous and pervious that the contact between them and the underlying impermeable Nairobi phonolite is a good aquifer. Thus, a number of buried channels containing groundwater occur beneath the Nairobi City centre. These channels represent the old river courses of the Nairobi River and its tributaries and are encountered during geotechnical drilling for building foundation works.

The subsurface geological conditions underlying the City Centre and the Industrial area as far as Ngong River reveal that the Nairobi phonolite is overlain by Kirichwa valley tuffs and sediments. It is also known from drill holes that between the outcrops of Kirichwa valley tuffs of the central city area and the trachyte escarpment to the west of the Highway a buried channel of about 25 meters deep exists and filled with black cotton soils, clays and debris that accumulated at the foot of the trachyte scarp. Valley Road extending to Kenyatta Avenue follows the direction of an old buried stream course whose water flows onto the Athi Plains.

The underlying geological layer along Ngong road and the Dagoretti forests is the Upper Athi Series, which is porous and permeable, allowing for percolation, making it favourable as a watershed for discharge into rivers and recharge of aquifers. The Upper Athi Series is the main aquifer in the region while the Lower Athi Series is more clayey and therefore forms an aquiclude.

The Ngong river basin has clay soils making it swampy with good grass cover and light forests. In some place, it has deposits of shallow stony soils associated with rocky outcrops along its course. During weathering, much of the lava and tuff change into a pale brown or reddish ferriginous soil and ferricrete (also referred to as murram). The material is frequently hard and of sufficient thickness to allow quarrying.

The Motoine river soils are shallow, yellow-brown to yellow-red, friable clay overlying laterite horizon. They have low humus content and are overlying friable clays passing downwards into massive laterite (ferricrete) representing soils with slightly impeded drainage. At the Kibera/Nairobi dam area, the top geological formation over which the dam rests, comprises the Middle and upper Kerichwa Valley Tuffs while the immediately down the dam the rivers flows over alluvial clays and swamp soils.

Karen zone is characterized by an adequate shallow supply from Kerichwa Valley Series which directly underlies the ground surface. Confined water provides the main supply and the contribution of free groundwater is negligible. Thereafter, from Nairobi West area, and downstream through Industrial area and Embakasi the top formation is mainly Nairobi Phonolite, forming the basis for extensive quarrying activity. The Kerichwa Valley Tuffs are ashy to black in colour. The texture is soft, pumice rich and very permeable, thus allowing for water percolation. This formation buried a pre-existing landscape covered by Nairobi Trachyte and Nairobi Phonolite. The series also comprises welded tuffs (also referred to as Nairobi building stone), which are massive and generally impervious. Water draining eastwards accumulates on the low lying ground in Nairobi South, forming a perched water table above the Nairobi Phonolite (Kilonzo, 2005). The Kerichwa Valley Tuffs behave like a sponge (Saggerson, 1991) and form a perfect aquifer protected

by the underlying impermeable Nairobi Phonolite. (see the geological map for Nairobi on Appendix XVI).

Three general types of aquifer lithology are recognized as follows:

(i) Sands and sediment deposits intercalated in tuff, in which case, (Saggerson, 1991) and (Gevaerts, 1964) concur that most aquifers are either fluviatile or lacustrine deposits intercalated in most formations.

(ii) (ii) Rock formations with an appreciably good porosity and permeability. These types of aquifers occur in formations such as weathered basalt, trachytes and tuffs.

(iii) (iii) Contact between two rock formations such as basalt and tuffs or sands and sediments intercalated in weathered tuff. These contacts are the old land surfaces reported by (Saggerson, 1991) and (Gevaerts, 1964).

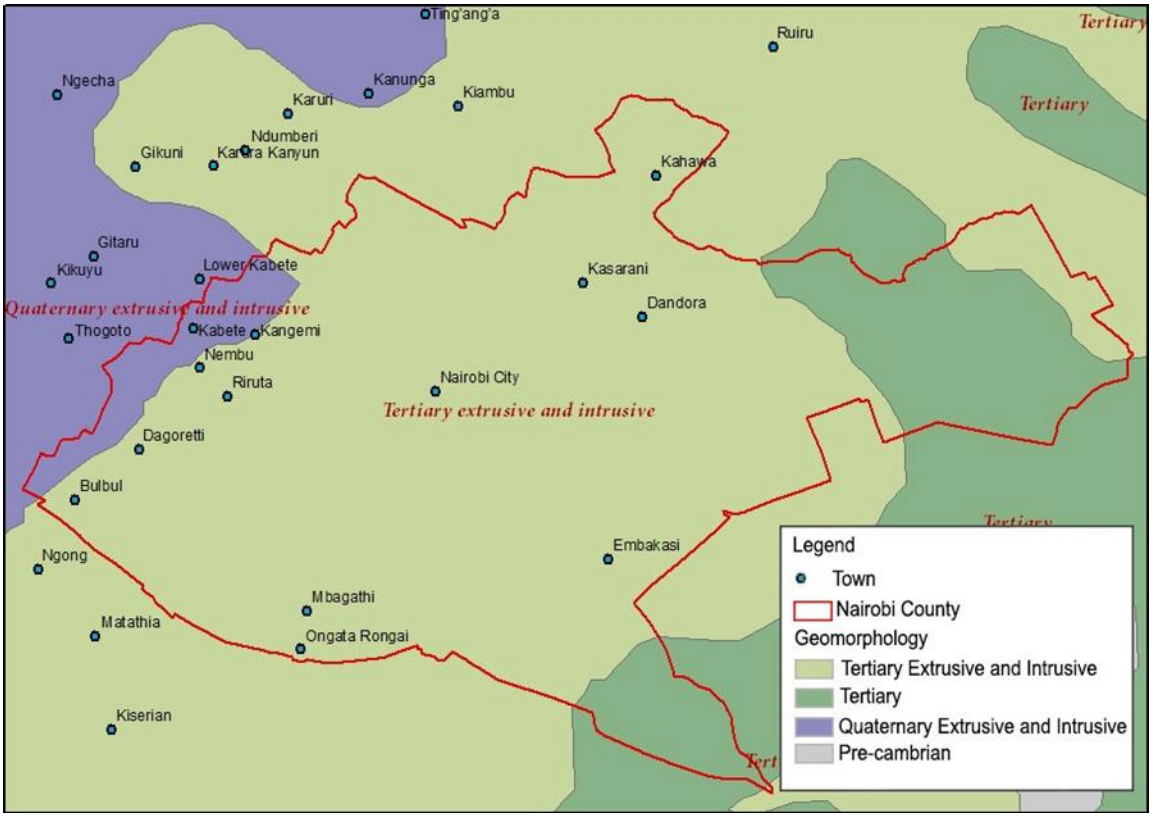


Figure 19: Geomorphology of Nairobi County

Source: WRI, 2009.

4.1.7. Land and Land Use

Nairobi County covers 696.1 square kilometers and has a population density of 7099 people/Km^2. Shortage of land is a major issue in the City County as the available land is overstretched. Security of tenure is a persistent problem throughout the county, with individuals lacking title deeds. Eastland's area is the most affected by this. The County has also lost to this challenge, with parcels

of land that belong to it, together with some public utilities, being illegally grabbed by or unprocedurally allocated to unscrupulous developers. As a result, implementation of projects is largely hampered by lack of appropriate land. There have been rapid changes in terms of land use patterns where preference is on development of residential areas and commercial centres.

Other land issues include lack adherence to spatial plans, many unresolved land conflicts, lack of an updated valuation roll, and widespread squatters menace mostly in informal areas. The joint land titling initiative by the national and county government to issue will help counter these problems.

4.1.8. Groundwater quality

The major groundwater quality concern in Kenya is the existence of fluoride that is triggered by the volcanic powder deposits that extent over wide parts, (Margat and van der Gun, (2012). Volcanic rocks extend the central region of Kenya from south to north, happening in the bottom of the Rift Valley and on the peneplains west and east of the valley. Disease causing bacteria like Escherichia coli, Vibrio cholerae, Salmonella tyhimurium, Pseudomonas species and Klebsiella species have been stated in groundwater sources (Momba, 2006). The major bacterial microbes to address in adulterated groundwater include Salmonella sp., Shigella sp., Escherichia coli (E.coli) and Vibrio cholera (Rajendran, 2006). The occurrence of fecal coliforms or E. coli has been broadly applied as an index for the occurrence of some of these water related disease causing microoorganisms (Ibe and Okplenye, 2005; Rajendran, 2006).

Groundwater quality in Nairobi generally meets safe drinking water standards, though some parameters exceed recommended limits, posing potential health risks. Nitrate levels are typically within safe limits, as recommended by the World Health Organization (WHO, 2017), but in certain areas, concentrations exceed these limits, which can lead to health issues such as methemoglobinemia or "blue baby syndrome" in infants (Ward et al., 2005).

The pH levels of groundwater in Nairobi largely fall within the safe range of 6.5 to 8.5, as per WHO guidelines. However, some sources exceed this range, indicating potential contamination. Water with a low pH can be corrosive and may contain harmful pollutants, while a high pH can lead to an unpleasant taste (Smedley, 2020). Similarly, turbidity levels are generally below the recommended limit of 5 NTU, but in some cases, elevated turbidity indicates the presence of pathogens, increasing the risk of waterborne diseases (WHO, 2017).

Iron concentrations in Nairobi's groundwater are mostly within the recommended limit of 0.3 mg/l. However, in some sources, the concentration exceeds this threshold, leading to aesthetic issues such as staining and, over time, potential health problems like stomach issues and nausea (Smedley, 2020). Magnesium levels are generally below the safe limit of 100 mg/l, and while elevated levels contribute to water hardness, they do not pose significant health risks (WHO, 2017).

Nitrite levels are usually within safe limits, though certain sources exceed the recommended 0.1 mg/l, posing potential health risks, particularly for infants and pregnant women (Ward et al., 2005). Ammonia concentrations are typically below the safe threshold of 0.2 mg/l, but in some

instances, elevated levels could lead to damage to organ systems and respiratory issues (WHO, 2017).

Other parameters like water colour are generally within acceptable limits below 15 Hazen units, indicating minimal contamination (WHO, 2017). Total Dissolved Solids (TDS) levels are also within safe limits, suggesting that the water is largely free from excessive inorganic and organic matter, making it suitable for drinking (Smedley, 2020). Similarly, total alkalinity is mostly below the 500 mg/l limit, indicating that the water is safe from excessive alkalinity (WHO, 2017).

Conductivity, which reflects the mineral content of the water, is generally within the recommended limit of 2500 μS/cm. High conductivity can indicate water hardness or alkalinity, but it does not directly impact health (Smedley, 2020). Calcium levels are typically below the recommended limit of 100 mg/l, with only a few sources exceeding this level. While high calcium levels are not harmful, they contribute to water hardness, which can impact the toxicity of other compounds (WHO, 2017).

Chloride levels in groundwater sources in Nairobi are mostly within safe limits, with only a few sources exceeding the recommended limit of 250 mg/l. Elevated chloride levels can give water a salty taste, though they generally do not pose significant health risks (WHO, 2017). Sulphate levels are also within safe drinking water standards, with higher concentrations observed only occasionally, potentially imparting a bitter or medicinal taste to the water (Smedley, 2020).

Total hardness in Nairobi's groundwater is generally within acceptable limits, indicating that the water is suitable for drinking without causing significant skin or health issues associated with hard water (WHO, 2017). However, fluoride levels present a significant concern, with many sources exceeding the recommended limit of 1.5 mg/l. High fluoride levels can lead to dental and skeletal fluorosis, highlighting the need for targeted mitigation measures to ensure safe drinking water quality in Nairobi (Nair et al., 2015).

4.2. Biological Environment

4.2.1. Terrestrial Flora

Sasumua T. Works

The Sasumua T. Works is a diverse and lush tropical forest ecosystem characteristic of highland areas near Nairobi. The terrestrial flora in this region is rich and varied, comprising multiple layers of vegetation that create a complex forest structure. The canopy is formed by a mix of evergreen and deciduous tree species, their branches stretching skyward to capture sunlight. Beneath this upper layer, a dense understory of shrubs and smaller trees creates a middle layer of vegetation, providing habitat for various wildlife species.

The forest floor is carpeted with a vibrant array of ferns, mosses, and low-growing plants, which play crucial roles in nutrient cycling and soil stabilization. Epiphytic plants, such as orchids and bromeliads, cling to tree trunks and branches, adding to the vertical diversity of the forest. Vines

and lianas intertwine with the trees, creating natural bridges throughout the canopy. A wide variety of herbaceous plants, both flowering and non-flowering, contribute to the biodiversity of the forest floor. In waterlogged areas and streams, aquatic plants thrive, further enhancing the ecosystem's complexity.

Given that the project is classified as low impact and primarily affects access and insertion areas, the direct impact on flora should be minimal. However, several potential effects warrant consideration. Some limited vegetation clearing may be necessary to create access routes and accommodate equipment placement, which could result in the loss of individual plants and minor habitat fragmentation. The installation process may cause soil disturbance, potentially affecting the root systems of nearby plants and temporarily disrupting the local soil ecosystem. There is also a risk of introducing non-native species through the movement of equipment and personnel, which could pose a threat to the native flora if invasive plants become established. The project activities may lead to temporary habitat disruption for small ground-dwelling flora and associated fauna, potentially affecting local biodiversity in the short term. Additionally, if the installation of flow meters affects local hydrology, even minimally, it could impact riparian and aquatic plants in the immediate vicinity of the project site.

To mitigate these potential impacts and preserve the integrity of this rich forest ecosystem, several measures should be implemented. Precise planning of access routes is crucial to avoid significant plant communities and minimize disturbance to the forest structure. Wherever possible, existing paths should be utilized to reduce the need for new clearing, thereby preserving the existing vegetation. Strict biosecurity measures must be put in place to prevent the introduction of invasive species, which could include cleaning equipment before it enters the site and educating workers about the importance of not introducing foreign plant material. During the installation process, careful handling of soil and vegetation is essential to minimize disruption to the local ecosystem. Any areas disturbed during the project should be promptly restored post-installation, using native plant species to maintain the area's ecological integrity.







Figure 20: Flora found at The Sasumua T. Works Project site

Kabete T. Works

The Kabete T. Works is situated in a more urbanized environment. The vegetation in the vicinity of the Kabete T. Works includes sparse grass and scattered shrubs, with some areas featuring more dense tree cover. This variation in vegetation suggests that the area has been partially cleared or managed, likely to accommodate the existing infrastructure. The sparse grass and scattered shrubs indicate an environment that can sustain basic plant life, while the denser tree cover in specific areas suggests localized pockets of natural growth.

The installation of Insertion Electromagnetic Flow Meters in this setting will require minimal clearance, primarily along the established access and the surrounding insertion areas. The existing wayleave paths are already designed to minimize disruption to the environment, meaning that the new installations can proceed without necessitating significant additional clearing or vegetation removal.

Given the current state of the vegetation and the nature of the installation work, the impact on terrestrial flora is expected to be low. The construction activities will have a limited footprint, with disturbances largely confined to narrow strips of land where the meters will be installed. This localized impact is unlikely to cause long-term or widespread damage to the natural environment, particularly as the areas with dense tree cover are likely to remain untouched. Moreover, the project can incorporate measures such as replanting or landscape restoration in areas where vegetation might be temporarily disturbed, further mitigating any potential environmental impact.



Figure 21: Flora found at Kabete T. Works Project site

Ngethu T. Works

The flora in this area is diverse and abundant, suggesting a rich ecosystem that has adapted to the local climate and soil conditions.

There are a variety flora types, including trees, shrubs, grasses, and some agricultural plants. The tree species range from tall, slender varieties of eucalyptus and some indigenous species. These trees play a crucial role in the local ecosystem, providing habitat for wildlife, stabilizing soil, and

contributing to the area's biodiversity. A dense understory of shrubs is also present forming a prominent feature of the landscape. This shrub layer adds complexity to the ecosystem, offering additional niches for various plant and animal species. Tall grasses are abundant throughout the scenes, which are a mix of cultivated Napier grass and wild grass species that contribute to the area's ground cover and potentially serve as a food source for local fauna. There is also a small maize field indicating some level of agricultural activity in the region. This mix of natural and cultivated flora demonstrates the interplay between human activity and the natural environment in this area.

Given the apparent diversity of flora in the area and the limited scope of the project, it's unlikely that the installation will have a significant long-term impact on the overall plant communities in the region. The resilience of natural ecosystems, combined with careful management of the installation process, should allow for the recovery of any disturbed areas. However, it remains crucial to approach the project with sensitivity to the local environment, following best practices for working in areas with diverse plant life to ensure the continued health and vitality of the region's terrestrial flora.



Figure 22: Flora found at Ngethu T. Works Project site

Gigiri Reservoir

The area has a diverse mix of cultivated and wild vegetation typical of urban and peri-urban areas in Nairobi. The flora comprises various elements, including trees, shrubs, grasses, garden plants, and pioneer species. Several native and exotic tree species are present, including acacia and eucalyptus, which provide essential ecosystem services such as shade, soil stabilization, and habitat for local wildlife. A diverse understory of woody shrubs is also present, some of which are ornamental. The ground cover consists of both maintained lawn areas and wild grasses, while cultivated sections have leafy vegetables and other garden plants. In disturbed soil areas, various small plants and weeds have taken root, demonstrating the area's natural regenerative capacity.

During installation, some plants may be temporarily affected by foot traffic or equipment placement. However, the project doesn't appear to require the removal of large trees, which would have a more substantial ecological impact. Given the tropical climate and the types of plants observed, many of which are fast-growing species, disturbed areas are likely to revegetate quickly if proper restoration measures are implemented.







Figure 23: Flora found at Gigiri Reservoir Project sites

Kiambu Reservoir

The project area is a diverse landscape characteristic of peri-urban areas in Nairobi, showcasing a mix of agricultural land and natural vegetation. The dominant flora present includes cultivated crops, primarily maize at various growth stages, alongside other vegetable crops. The area also features a variety of trees, including tall Eucalyptus species as well as various indigenous tree species forming small stands and individual specimens throughout the landscape. Interspersed among the crops and trees are mixed herbaceous plants and small shrubs, creating a rich undergrowth in uncultivated areas. Native grass species are also prevalent, particularly in uncultivated areas and along field margins.

Work near field margins or natural vegetation patches could have minor edge effects on plant communities. Localized soil disturbance could potentially affect root systems of nearby plants or create conditions for invasive species establishment.

The agricultural and mixed vegetation character of the site should remain largely unchanged following meter installation to help preserve the unique blend of agricultural and natural landscapes characteristics.



Figure 24: Flora found at Kiambu Reservoir Project site

Kikuyu Springs

The project area is situated within a lush, forested environment. The dominant vegetation includes mature ecosystem with presence of both evergreen and deciduous tree species, creating a robust canopy layer. Beneath the tree cover, the area is characterized by a diverse array of shrubs, herbaceous plants, ferns, and grasses, which contribute to the multilayered vegetation structure typical of a healthy, well-established forest habitat.

Given the ecologically significant nature of the project location, the planned installation of the water meters may have some impact on the surrounding flora. The primary concerns include the potential for localized vegetation clearing to accommodate the meter infrastructure, which could lead to the disturbance or damage of the root systems of larger trees, as well as the disruption of

the smaller plant communities. Additionally, the ground excavation and construction activities could result in soil compaction and disturbance, potentially affecting the growth and health of the existing plant life.



Figure 25: Flora found at Kikuyu Springs Project site

Loresho Reservoir

The dominant vegetation in the project area is various species of grass that cover the ground extensively. These grasses are typical of an open, maintained landscape. In addition to the grasses, there are a few shrubs scattered along the edges of the site. These shrubs are likely hardy, drought-resistant plants, which are well-suited to the local climate. There is also maize cultivated within the project area. These have been planted by local inhabitants for subsistence purposes. There is also presence of small trees and bushes in the background meaning that the area is part of a managed landscape surrounding nearby structures.

The installation of the meter is expected to have a low impact on the flora. The primary activities for this project involve accessing specific locations to install the meters, which will likely result in minimal ground disturbance. The flora immediately surrounding the meter installation sites may

experience some temporary disturbance due to the movement of personnel and equipment. This could lead to the trampling of grasses and low-lying vegetation. However, given the small scale of the disturbance, the impact is anticipated to be minimal and localized.

In terms of indirect impacts, the project is not expected to significantly affect the broader vegetation in the area. Since the installation process does not require extensive clearing or excavation, the existing flora, particularly the grasses and shrubs, will remain largely intact. The long-term impact on the vegetation is likely to be short-term and reversible. Once the installation is complete, the flora in the area should recover quickly, especially the resilient grasses and shrubs that dominate the landscape.



Figure 26: Flora found at Loresho Reservoir Project site

Langata line at Showground and Police Dog Section

The project area at showground is situated within a lush, forested environment, where the vegetation is primarily made up of a dense ground cover that includes a mix of grasses and small shrubs. This undergrowth is well-established, reflecting the area's healthy ecosystem. Additionally, the forest floor supports a variety of herbaceous plants such as ferns, which thrive in the shaded areas beneath the trees. Among the prominent tree species observed at the site are eucalyptus and gravillea trees, which contribute significantly to the area's ecological composition.

The project area at Police Dog Section is characteristic of a semi-urban environment. The vegetation primarily consists of a mix of common grasses, herbaceous plants, and some small to medium-sized trees typically found in the region. The surrounding environment includes a mixture of natural growth and human-modified areas, with the presence of cultivated banana plants indicative of localized agricultural activities or home gardening practices.

The project's impact is expected to be minimal, given its low-impact nature. The primary disturbance will be limited to the access required for the installation of the flow meters and the immediate surroundings of the meter insertion points. The vegetation directly around these sites may experience some localized disruption, including the removal or trampling of ground cover and low-lying shrubs to allow for the placement of equipment. However, these disturbances are anticipated to be temporary and restricted to specific areas, with the broader forested environment remaining largely untouched.



Figure 27: Flora found at Langata line at Showground Project site



Figure 28: Flora found at Police Dog Section Project site

4.2.2. Terrestrial Fauna

The County is predominantly a terrestrial habitat that supports a diverse web of biodiversity and ecosystems. It is home to about 100 species of mammals, 527 bird species and a variety of plant species. The terrestrial fauna across the various project areas exhibits varying characteristics due to the diversity in environments—from highly urbanized locations to lush forested ecosystems. The fauna within these areas largely reflects the degree of human activity and natural habitat preservation.

The Sasumua site, situated within a dense tropical forest, is home to a variety of wildlife, including small mammals, birds, reptiles, and a rich diversity of invertebrates. The forest canopy, understory, and forest floor provide habitats for numerous species, each adapted to the unique microhabitats within the forest structure. Birds such as hornbills, sunbirds, and various species of raptors may be observed in the canopy and mid-layer, while small mammals like bush babies and squirrels inhabit the trees and undergrowth. The dense vegetation also supports a variety of insects, amphibians, and reptiles, which contribute to the ecological balance of the forest.

The urban and peri-urban environments where the other project sites are located—such as Kabete, Ngethu, Gigiri, Kiambu, and Loresho—harbor less diverse fauna due to the significant human activity and altered landscapes. Commonly encountered fauna in these areas include small mammals like rodents, urban-dwelling birds such as pigeons, crows, and sparrows, as well as insects

that thrive in disturbed habitats, such as ants and beetles. Additionally, some reptiles, like lizards and geckos, may be found, particularly in areas where natural vegetation is still present. The areas around Kikuyu Springs and Langata Line, although more forested, still experience frequent human interaction, which limits the diversity and abundance of larger wildlife species.

4.3. Socio-Economic and Cultural Environment

4.3.1. Demographic information

Nairobi County, with a projected population of 4,750,056 as of 2023, demonstrates a balanced demographic structure, with males and females almost equally represented at 50% each. The population distribution shows that 31.3% are under the age of 15, indicating a significant youthful demographic. This creates a moderate dependency ratio, placing demands on social services such as education and healthcare. Nairobi's population density stands at 6,748 persons per square kilometer, driven by both natural growth and urbanization. Rapid urbanization, particularly in densely populated areas, has resulted in infrastructural challenges, such as inadequate water and sanitation services. The growing population necessitates careful planning to address the strain on resources and infrastructure. Additionally, the county's age distribution reveals a higher concentration of individuals in the working-age group (15-64 years), which highlights the importance of job creation and economic development initiatives to sustain the county's growth.

Using the commonly used compounded growth with diminishing growth rates of 3.6%, 3.2%, and 2.9% up to the years 2025, 2035, and 2045 respectively, the population is projected to be 179,717 persons in the project's ultimate design horizon (Year 2045).

4.3.2. Status of Existing Water Resource Management Programs

The County has no major water tower and relies on other neighbouring counties (Kiambu, Murangá, Nyandarua) within the Tana Basin which is around 50 Km from the City for its water supply. The bulk of the water supply is not reliable during drought periods, and endangered by siltation of the reservoirs due to deforestation in the catchment areas. The situation is further aggravated by the poor distribution system that which results to nearly 38% losses due to leakage, illegal connections, and inefficient and wasteful use of water by some consumers.

Nairobi City Water & Sewerage Company Limited is the water service provider for the City with piped water connection at about 80%. Existing boreholes and wells are operated by large private consumers or by individual residential owners in parts of the City that receive only intermittent supply. Water from the wells is shared with neighbours or water is sold for distribution by tankers and many private well owners are connected to the main water supply network (which provides cheaper water) but use groundwater as a back-up. Only 0.9% of the population takes 30- 59 minutes to the nearest water point.

Water supply and management in urban areas is complicated not only by increases in population, but also due to the nature of urbanization itself. The large number of multiple pollution sources such as sewers/latrines, cemeteries, domestic waste and landfills found in urban areas, complicate urban groundwater protection. These sources are compounded by variable dynamic distributions

in hydraulic head due to complex abstraction patterns and often a multitude of abandoned boreholes in urban areas (Cronin et al., 2003). In addition to these technical problems, there are socio-economic issues such as under-investment in the infrastructure needed for water provision (Sinclair, 2000). In formulating the Water Policy and Management Strategy, it was recognized that the major causes of morbidity are due to diseases or conditions arising from the low level of safe drinking water, lack of hygienic sanitation and poor environmental conditions (GoK, 2002b).

Groundwater may become contaminated due to improper disposal of liquid wastes, defective well construction and failure to seal abandoned wells. These provide openings for the downward movement of water into subsurface formations without the process of natural infiltration. Contamination may also take place through the movement of waste water through large openings such as animal burrows, fissures in rocks, coarse gravel formations or manmade excavations (Raghunath, 1987). A greater diversity of re-use management systems needs to be actively considered for developing country cities, especially in their peri-urban areas, as rapid urbanization, increasing volumes withdrawn from the underlying urban aquifers, and the high capital and maintenance costs associated with convectional piped systems mean that they are not viable options for the near future (Drangert and Cronin, 2004). Careful and informed choices are vital.

4.3.3. Community Structure

Nairobi is characterized by a multi-ethnic and multi-cultural community structure. Nairobi is a diverse city with a mix of ethnic communities. The largest groups include Kikuyu, Luhya, Luo, Kamba, and Kisii. These communities maintain their cultural traditions while also integrating into the broader urban fabric. Residential areas tend to have some ethnic concentrations, but the city overall is ethnically integrated.

The city is divided into 17 sub-counties, each representing distinct socio-economic profiles. For example, Westlands and Lang'ata are known for their middle to upper-class populations, while areas such as Embakasi and Kasarani have a mix of lower and middle-income residents. Informal settlements, which house about 60% of the city's population, present stark contrasts to the affluent neighborhoods. Kibera, the largest slum in Nairobi, is home to an estimated 250,000 people, living in highly congested conditions. Community organizations and local leadership, including Members of County Assemblies (MCAs), play crucial roles in addressing localized issues, from infrastructure to social welfare.

4.3.4. Employment

Wage Earners

Nairobi commands the largest share of formal sector wage employment in Kenya with a total of 453,000 people. The manufacturing industry accounts for the highest wage employment followed by trade, restaurants and hotels. The construction, transport and communications industry also play key role in generation of wage employment. Other important sectors include finance, real estate and business services. The main formal employment zones in Nairobi are the Central Business District (CBD), Industrial area, along Mombasa Road, along Thika Road and Dandora.

Self-Employed

A large segment of the labor force in Nairobi is self-employed largely in the informal sector with 1,548,100 being employed in this sector. This is about 3.5 times those in wage employment. The informal sector covers small scale activities that are semi-organized, unregulated and uses low and simple technologies while employing few people per establishment.

Labor force

According to the Kenya National Population and Housing Census 2009, Nairobi had a labor force of 2,148,605 comprising of 1,034,009 females and 1,114,596 males. Out of the 2,148,605 persons in the labor force, 1,832,751 were classified as employed while 315,844 were seeking for employment. The youthful proportion of the labor force consists of 561,457 males and 648,756 females.

Unemployment Levels

The level of unemployment in Nairobi stands at 14.70 per cent with the female unemployment rate standing at 18.99 per cent while that of males is 11.55 per cent. In Nairobi County, 34% of the residents with no formal education; 45% of those with a primary level of education and 49% for those with a secondary level of education or above are working for pay.

4.3.5. Gender

Gender disparities in Nairobi reflect broader national trends but are accentuated by urban factors. As of 2023, women make up approximately 51% of Nairobi's population. However, gender-based inequalities persist, particularly in the labor market. The formal employment sector sees women occupying about 39% of the jobs, often concentrated in lower-paying sectors such as education, healthcare, and retail. Despite these challenges, women are increasingly participating in leadership roles. For instance, the Nairobi County Assembly has 40% female representation, driven by affirmative action policies. However, issues like gender-based violence remain prevalent, with 45% of women reporting having experienced some form of violence, according to a 2022 study by the Kenya National Bureau of Statistics (KNBS).

4.3.6. Local Communities

Nairobi's local communities are shaped by a mix of indigenous and migrant populations. The Kikuyu community, at around 30% of the population, is the largest ethnic group, followed by the Luo and Luhya at 15% and 14%, respectively. The city also hosts significant Somali and Asian communities, who contribute to the cultural and economic vibrancy of the city. In recent years, Nairobi has seen an influx of migrants from other East African countries, further diversifying the local communities. Social cohesion within these communities is often maintained through ethnic associations, religious groups, and neighborhood committees that provide support systems and help mediate conflicts.

4.3.7. Livelihoods, Income Sources, and Distribution of Goods and Services

Nairobi's economy is driven by a mix of formal and informal sectors. The formal sector, which includes finance, technology, and retail, employs about 40% of the city's workforce. Nairobi is also

known as "Silicon Savannah" due to its rapidly growing tech industry, with over 200 tech startups as of 2023. However, the informal sector remains the backbone of the city's economy, employing nearly 60% of the population. This sector includes small-scale traders, artisans, and street vendors. The average income in Nairobi varies significantly, with residents in informal settlements earning less than KES 10,000 per month, while those in affluent areas may earn over KES 200,000. The distribution of goods and services is highly uneven, with informal settlements suffering from poor infrastructure and limited access to basic services like clean water and healthcare.

4.3.8. Recreation

Recreational opportunities in Nairobi cater to a wide demographic, reflecting the city's diversity. Urban parks such as Uhuru Park and Karura Forest provide green spaces for relaxation, jogging, and picnicking, attracting thousands of visitors every weekend. Nairobi National Park, which covers 117 square kilometers, is a unique feature as it is the only national park within a capital city, offering residents and tourists alike the chance to see wildlife such as lions, rhinos, and giraffes. Sports facilities are widespread, with football being the most popular sport. Stadiums like Kasarani and Nyayo host major sporting events, including the annual Kenya Premier League matches. The city's vibrant nightlife and entertainment industry, with venues such as Westgate Mall and the Alchemist Bar, also provide ample recreational activities.

4.3.9. Cultural Properties

Nairobi is rich in cultural heritage, with properties that reflect its diverse history. The Nairobi National Museum, established in 1930, is a key cultural property, showcasing Kenya's rich heritage in paleontology, ethnography, and history. The city also hosts the Bomas of Kenya, a cultural center that displays traditional homesteads and hosts cultural performances from various Kenyan communities. Nairobi's architecture is a blend of colonial-era buildings, such as the McMillan Library, and modern structures like the iconic Kenyatta International Convention Centre (KICC). Maasai Market, a weekly open-air market, is a significant cultural property, where artisans from different communities sell traditional crafts, fabrics, and jewelry, contributing to the preservation of cultural practices.

4.3.10. Education

Education in Nairobi is a priority, with a literacy rate of approximately 89% as of 2023. The city is home to Kenya's leading educational institutions, including the University of Nairobi, Kenyatta University, and Strathmore University, which collectively enroll over 70,000 students annually. However, there is a stark contrast in educational quality between public and private schools. Public schools are often overcrowded, with pupil-to-teacher ratios exceeding 50:1 in some cases. In contrast, private schools offer better facilities and lower student-to-teacher ratios, but they are accessible primarily to the affluent. Vocational and technical education is gaining importance, with institutions like the Nairobi Technical Training Institute (NTTI) offering courses that align with the city's growing demand for skilled labor in sectors such as construction, technology, and hospitality.

4.3.11. Health

According to the Ministry of Health (2013), Kenya currently has a total of 9,694 health facilities that are government, private, NGO and religious owned. The majority of Kenya's population within the broader AoI receive healthcare services from the public sector. Health care services are provided at the following levels by the government. Curative services only are provided at Level 4-6 facilities, while health promotion and prevention are also implemented through Level 1-3 facilities.

- Level 1: Community Health Services, which are community-based services.
- Level 2: Dispensaries for both public and private health services providers. These are usually run and managed by enrolled and registered nurses who are supervised by the nursing officer at the respective health center. They provide basic first aid and care as well as some preventative care.
- Level 3: Health Centres, provided by county governments. Health centers have a clinical officer in-charge and provide comprehensive primary care. They also focus on preventive care such as childhood vaccination programs, maternal health and HIV/AIDS prevention.
- Level 4: Sub County Referral Hospitals, which are managed by the respective County Governments and provide basic curative care often related to maternal and early childhood health and care for minor accidents and injuries.
- Level 5: County Referral Hospital, which are managed by the National Government and provide more complex curative care including surgeries, treatment for diseases such as cancer etc. They are also able to provide intensive care and life support. As the name suggests there is one such hospital per County.
- Level 6: National Referral Hospitals, which comprise of facilities that provide highly specialised services and include all tertiary referral facilities.

Health issues that affect the residents of Nairobi include Communicable diseases including HIV /AIDS and TB, Malaria, Road traffic injuries. Non-communicable diseases, skin diseases, diarrhoea, pneumonia, arthritis and joint pains, Urinary Tract Infections and respi ratory diseases. According to the Kenya Stepwise Survey for Non-Communicable Diseases risk factors 2015 report, non-communicable diseases account for 27% of the total deaths and over 50% of total hospital admissions in Kenya.

The major NCDs are cardiovascular conditions, cancers, diabetes, and chronic obstructive pulmonary diseases with their sequelae and their shared risk factors. Equally contributing to the huge burden of NCDs are violence and injuries, haemoglobinopathies, epilepsy, mental disorders, oral, eye and dental diseases Nairobi, being the largest population centre in Kenya, recorded the most outpatient visits for the largest range of diseases. For example, for children under five years old, Nairobi recorded the most hospital visits for 23 out of the 44 diseases recorded, including all respiratory diseases, road traffic injuries, burns, chicken pox and dental disorders.

Nairobi county has 681 health facilities, 115 (17%) publicly owned comprising of 4 County referral hospitals, 33 health centres, 55 dispensaries and 23 clinics. To reduce the occurrence and impact of top risk factors, the county government is providing community based preventive interventions

such as behaviour change interventions/facility-based screening, prevention and treatment generally offering Primary Health Care (PHC) services.

4.3.12. Waste Disposal

Uncollected solid waste is one of Nairobi's most visible environmental problems (2,475 tons of waste produced daily) as many parts of the city, especially the low and middle-income areas, do not even have waste collection systems in place. Nairobi's current waste disposal system is fraught with problems, from failure to prioritise solid waste management to inadequate infrastructure and the fact that multiple actors are involved whose activities aren't controlled. There is need to change ways of disposing solid waste from dumping and burning to recycling. About 61.5% of the population use flush toilets, while 32.1% use pit latrines and the remaining 4.8% of the population have no means of waste disposal. On garbage collection, 36.1% of the communities have their garbage collected by private firms and community groups within the neighbourhoods collect a similar percentage.

The overall collection system in Nairobi City for each organisation is envisaged in Table 12.

Table 12: Nairobi city waste collection categorization

Organization	Service Area	Collection Method	Equipment
CCN	CBD; Districts	Station type: common Door to door: very rare	Trucks with tipping function
Private company contracted with CCN	Districts	Station type	Trucks with/without tipping function
Private service provider	Middle and high income residential area	Door to door	Trucks without tipping function
CBOs and local youth group	Slum and low-income areas	Door to door	Handcart

There is an official landfill site in Dandora currently. However, there are many illegal dumping sites where the private contractors contracted by CCN and PSPs sometimes dispose their collected waste. The information on the current official landfill site and temporary dump sites are shown below:

Table 13: Nairobi landfill site and temporary dump sites

Name	Zone	Area [ha]	Present Condition
Dandora landfill site	Embakasi	46	Open dumping and no supervision of waste
Kayole temporary Dumpsite	Embakasi	4	Area is historically a quarry area. Currently, there is open dumping and there are some

The Dandora dumping site is currently the only official landfill site in Nairobi City. However, the operation of disposal in Dandora dumping site is open dumping, which means that there is no soil covering. This is located 7.5 km away from the northeast side of the city centre. The operation of the landfill site began in 1981 and the total area is approximately 46 ha. The total amount of disposed waste is estimated to be 3,550,000 t/day, according to DOE. There are many waste pickers who carry out waste picking activities during unloading operations of the collection vehicles and spreading activities by the landfill equipment. The access road is muddy and in bad condition, especially during the rainy season. Therefore, the unloading area is different based on the climate condition, and collection vehicles are pulled by bulldozers when they get stuck in the muddy areas of the access road during the rainy season.

4.3.13. Community Participation, Customs, and Norms

Community participation in Nairobi is heavily influenced by customs and norms that are rooted in both traditional practices and modern urban life. In informal settlements, community participation is often organized through grassroots movements, local NGOs, and community-based organizations (CBOs) that address issues such as access to clean water, sanitation, and education. In more affluent areas, participation tends to focus on neighborhood associations and social clubs, addressing local governance, security, and environmental conservation.

Customs and norms in Nairobi vary significantly across different ethnic groups. For example, Kikuyu customs emphasize the importance of family and community support, which is reflected in the active participation in social and economic initiatives within their neighborhoods. On the other hand, the Somali community in Eastleigh is known for its strong business networks and communal support systems, which have turned the area into a bustling commercial hub. Norms around gender roles, religious practices, and social behavior continue to shape community participation, although these are gradually evolving with increasing urbanization and exposure to global influences.

4.3.14. Traditional Knowledge, Perception, and Aspiration

Traditional knowledge in Nairobi is a rich tapestry woven from the various ethnic groups that reside in the city. This knowledge, passed down through generations, encompasses a wide range of practices, from medicinal uses of local plants to architectural designs suited to the local climate. For instance, the Maasai community, although more prominent in rural areas, influences the use of traditional herbal medicine within the city. Similarly, the Kikuyu community's agricultural knowledge has shaped urban farming practices in Nairobi, where rooftop gardens and small urban farms are becoming increasingly common.

Perceptions and aspirations in Nairobi are shaped by both traditional values and modern urban life. While older generations may hold onto cultural practices and communal living, younger Nairobians are more likely to aspire to modern lifestyles, characterized by education, professional success, and material wealth. This generational shift is evident in the city's educational institutions, where students increasingly pursue degrees in technology, business, and engineering, reflecting the aspirations of a rapidly modernizing society. Despite this shift, there is a growing movement among the youth to reconnect with their cultural heritage, as seen in the rise of cultural festivals and the popularity of traditional music and fashion.

4.3.15. Social Amenities and Infrastructure

Infrastructure is the underlying foundation for a county's development. The current road network in the County is inadequate in terms of coverage to meet current. The total road network covers 3,602 Km out of which 1,735 Km are tarmac while 1867 Km are earth roads. The current poor state of the road network is a great impediment to socio-economic growth leading to high production costs and low productivity. There is need for construction, expansion and maintenance of existing roads.

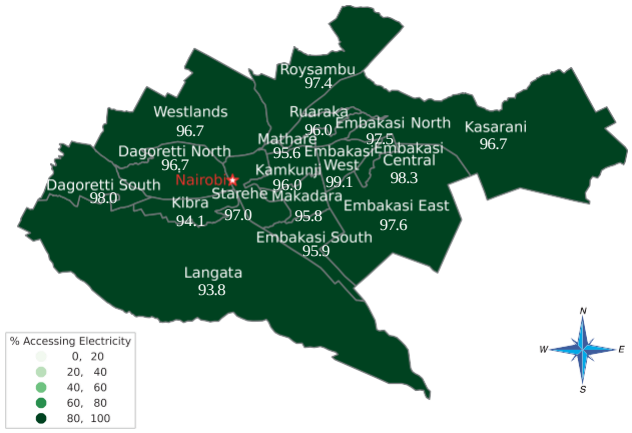
Although infrastructure delivery varies widely across Nairobi, low-income residents often rely on informal providers that may offer insecure, poorly maintained or low-quality services at a premium. In 2019, Nairobi's sewerage coverage was 51% and water coverage reached 77% of households, but offered only six hours of supply daily. Despite promising efforts to enhance water, sanitation and hygiene in Nairobi's informal settlements (for example, automated water dispensing units), many low-income residents continue to use shared, poorly maintained provision, including public water-taps, pay-per-use public toilets, and pit latrines. Lengthy queues at public taps and toilets can impose gender-inequitable time burdens, as well as heightened risks of sexual violence, especially at night in Nairobi's insecure informal settlements. Studies in informal settlements have also uncovered a "poverty penalty" and a rent premium, with residents paying more for lower-quality shelter and infrastructure than their counterparts.

Table 14: Summary table of socio-economic status of Nairobi County

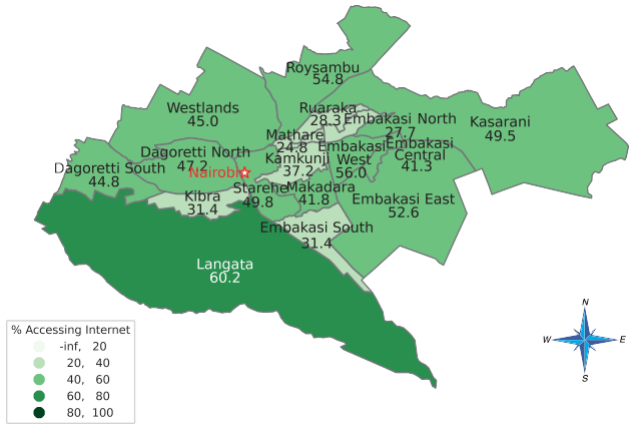
General Information				
County Headquarter	**Nairobi**			
Regional bloc				
Demographic data	**2009**	**Rank**	**2019**	**Rank**
Population	3,138,369	1	4,397,073	1
Rural	0	46	0	46
Urban	3,138,369	1	4,397,073	1
Population distribution (2019 Census)	**Cohorts**	**Female**	**Male**	**Total**
	0-5	305,599	309,302	614,901
	6-14	366,313	355,035	721,348
	15-35	1,097,131	989,864	2,086,995
	36-60	393,782	491,395	885,177
	61+	41,482	46,782	88,264
	2009	**Rank**	**2019**	**Rank**
Households	987,969	1	1,506,888	1
Rural	0	46	0	46
Urban	987,969	1	1,506,888	1
Households size	3.2	47	2.9	47
Surface area (Sq. km)	695		695	
Population Density (people per sq. km)	4,516	1	6,247	1
Sub counties	11			
Constituencies	17			
Wards	85			
Dominant economic activity	Finance and Insurance Services			
Poverty Levels	**2005/06**	**Rank**	**2015/16**	**Rank**
Poverty headcount	22.5	46	16.7	47
Poverty gap	6.9	42	3.4	46

Poverty severity			1.1	44
Food poverty	**2015/16**		**Rank**	
Poverty headcount	16.1		45	
Poverty gap	3.9		44	
Poverty Severity	1.5		44	
Child Poverty	**2015/16**		**Rank**	
0-5 Years	15.2		46	
6-13 Years	26.4		42	
14-17 Years	31.1		40	
0-17 Years	22.0		46	
Gini Coefficient	34		30	
Age Dependency Ratio	48.3		47	
Old Age Dependency Ratio	1.6		47	
Child Dependency Ratio	46.6		47	

Households with access to electricity 2019 (%)

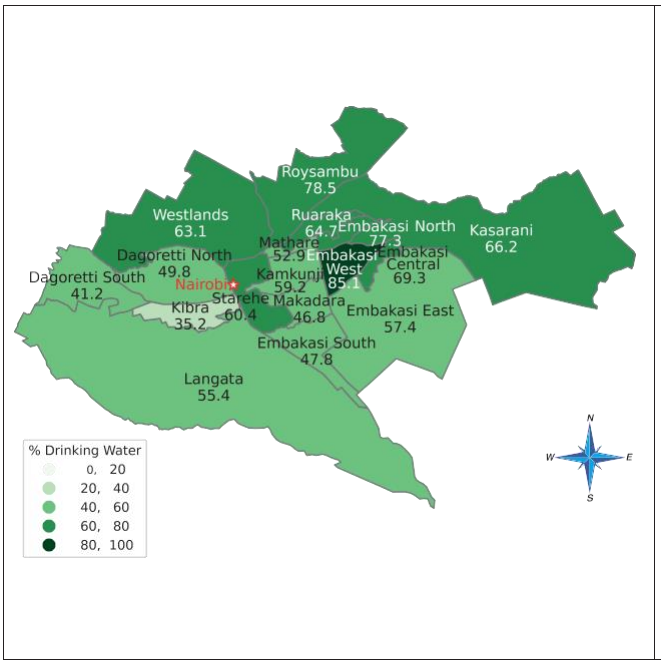


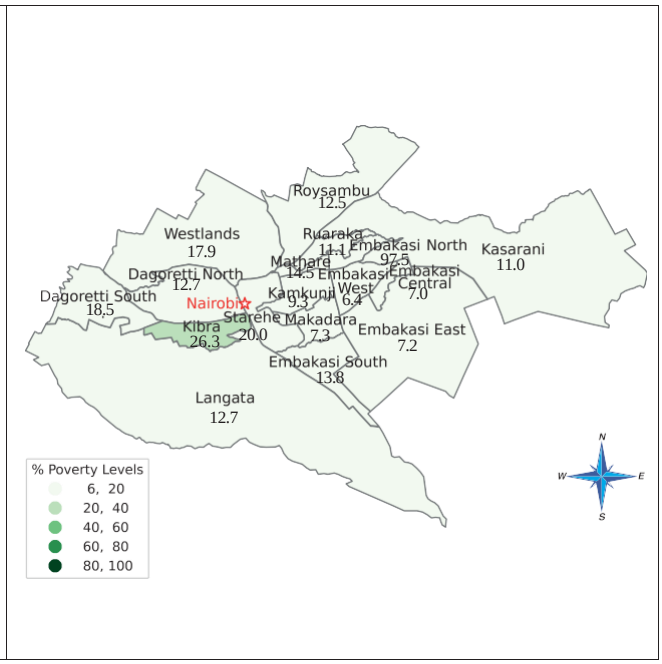
Population Accessing Internet 2019 (%)



Households Accessing Safe Drinking Water 2019 (%)

Poverty Levels 2019 (%)





4.4. Archeological, Historical, and cultural significance

Archeological and historical sites are protected resources. They are important and increasingly rare tools for learning about the past. They may also have religious significance. The current project locations are situated within existing water treatment works and reservoir compounds, which have been previously disturbed and developed. Consequently, the project is not anticipated to impact any archeological sites or require any archeological interventions, interfere with or damage any historically significant structures, or affect any cultural practices or disrupt cultural sites.

Chance Find Procedure

In the event that an archeological resource is discovered during the construction process a Chance Find Procedure will be implemented. A Chance Find Procedure, as described in Performance Standard 8 of IFC, is a process that prevents archeological sites from being disturbed until an assessment by a competent specialist is made and actions consistent with the requirements of PS8 are implemented. It is a project-specific procedure that outlines what will happen if previously unknown physical resources are encountered during project construction or operation. The procedure includes record keeping and expert verification procedures, chain of custody instructions for movable finds, and clear criteria for potential temporary work stoppages that could be required for rapid disposition of issues related to the finds. In accordance with this procedure, work will cease on a site where archaeological material is found. The site Environmental Officer will inspect and secure the site, and will then contact Museums of Kenya for advice and arrange for a survey or salvage work as appropriate.

4.5. HIV/AIDS

HIV prevalence in Kenya is estimated based on the Demographic and Health Survey (2003 and 2008/9), AIDS Indicator Surveys (KAIS 2012) and Antenatal Clinic (ANC) sentinel surveillance. A trend analysis starting from 1990 shows that prevalence in the general population reached a peak of 10.5% in 1995-96, after which it declined by about 40% to reach approximately 6.7% in 2003. Since then, the prevalence has remained relatively stable. The decline of the prevalence from 1995 to 2003 is partly attributed to high AIDS related mortality while the stabilization of the epidemic in the last 10 years is largely due to the rapid scale up of anti-retroviral therapy (ART) and reduction in the number of new infections that occurred during this period. (Source: Kenya AIDS Response Progress Report 2019).

Nairobi City County is one of the leading counties contributing to the HIV burden in Kenya, with close to 160,000 people living with the virus, including 11,104 children (Kenya HIV Estimates Report, 2014). As a capital city, Nairobi hosts highly mobile populations with in-and-out population flows due to internal migration and refugees (external migration notwithstanding). The County also features factors that put people at increased risk of contracting HIV, particularly among key populations and young girls, including rapid urbanization, high levels of poverty in ever-growing informal settlements, and lingering stigma and discrimination.

Although the last decade has seen a consistent decrease in HIV prevalence rates – from a high of 14% at the peak of the epidemic to the current rate of 8% – the number of new infections in the city remains high, at about 3,200 a year, with 39% HIV-TB co-infection and nearly 4,000 AIDS-related deaths (Kenya HIV Estimates Report, 2014). In addition, Nairobi hosts a large proportion of key populations (KPs), including sex workers men having sex with men (MSMs) and drug users, with the highest HIV prevalence rates ranging from 18 to 23%.

The main modes of HIV transmission in Nairobi are through heterosexual sex within unions, between regular partners and through casual sex, among men who have sex with men (MSM)/prison populations and between sex workers and their clients. These four groups account for over 90% of new infections. People who inject drugs (PWID) also contribute a high number of new infections nationally, amounting to 4%of all new infections.

The HIV prevalence among women in Nairobi City County is higher (8.4%) than that of men (5.3%). Despite the importance of HIV testing as a way to increase prevention and treatment, about 30 per cent of people in Nairobi City County had never tested for HIV by 2009 (KDHS, 2008/9). Approximately 55 per cent of individuals in Nairobi County had their first experience of sexual intercourse before the age of 18, an indication of early sexual debut, which increases vulnerability to HIV infection, especially in women. (KDHS 2014). Additionally, low adult condom use of less than 50% (KDHS 2014) contributes to the risk of infection among the population more generally.

Table 15: Nairobi County HIV Profile

	Overall	Adults (15+)	Adolescents (10-19)	Young Adults (15-24)	Pediatrics (0-14)
People Living With HIV	171,510	163,287	10,758	23,671	8,223
New HIV Infections Annually	4981 (5th Ranked)	4,719	1,035 (21%) (3 Per Day)	2,282 (46%) (7 Per Day)	262
HIV Related Deaths	2437	2,177	175	267	260
Need For ART	157,335	148,999	9521	21,304	8,336
Need For EMTCT	7008				

Source: HIV County Estimates 2015

The disease has weakened the economically productive population. The most affected age group is between 15 and 49 who constitute the majority of the workforce. The scourge has contributed significantly to high incidences of poverty. The greatest impact has been on the widows who are left with the heavy burden of caring for their households. This explains the increasing number of female-headed households in the region.

The number of Aids orphans has also been on the increase, resulting in a rise in the number of families headed by orphans. Most of the orphans are forced to drop out of school due to lack of school fees. Others become street children as a coping mechanism. A large amount of family resources is used for medication and other forms of care to the infected. Poverty is among the major pre disposing factors to HIV/AIDS, influx of people from outside the project area during construction and operation phases may further worsen the prevalence rates in the county. Also, important to note is the reversal of prevalence rates during the operation phase due to improved economic situation in the counties.

5. Public Consultation, Participation and Stakeholder Engagement

5.1. Introduction

This chapter describes the process and activities related to public consultation and stakeholder engagement that were undertaken to ensure that the relevant stakeholders and the public / community are informed about the project and are involved in the identification of key issues and impacts of the proposed project. Stakeholders are defined as persons or groups who are directly or indirectly affected by a project as well as those who may have interests in a project and / or the ability to influence its outcome, either positively or negatively.

The objectives of stakeholder engagement were;

- Share project information.
- Obtain feedback from the stakeholders.
- Bring the stakeholders up to date on the progress of the project as well as next steps to be undertaken.
- Garner support for the project hence acquiring the social license /acceptability.
- Reduce possibility of conflict through early identification of contentious issues.
- Understand culturally sensitive information about the stakeholders.

5.2. Consultation method and approach used in ESIA

Stakeholder mapping and analysis was undertaken in order to determine the particular stakeholders in the project area of influence (individuals, groups, communities, institutions/ organizations, agencies etc.) that will be affected directly or indirectly, either positively or negatively by the proposed project; or those who can contribute to, or hinder its success, and those with interests, have mandate over various issues related to the project. Overall, the critical guiding participation principles used are outlined below.

Table 16: Principles of Participation and how they were ensured in the ESIA process

Principle	How observed
Adaptive, communicative, meaningful and pro-active consultation	• Project information was shared in Swahili and English languages. In some cases where necessary translation was provided by a local person / someone appointed by the community or the chief. Some questions were however asked in Kiswahili, local language or English. • Information provided was extensive, detailed and providing as much information as possible but mainly revolving around dissemination of fundamental project background, objectives, scope, description of the proposed alignment, administrative footprint, potential positive and negative lenders, safety. • Effort was put towards simplification of technical processes and concepts.

Principle	How observed
Accessibility	• The locations for consultation were convenient to the stakeholders – in their offices or places where they live in the community. • Meeting venues were accessible to all those who wanted to attend; meetings were held within settlements, mainly in venues used for community meetings e.g. chiefs baraza, social halls, churches, schools, vocational centres, open air, tents, under trees. • There were no restrictions for attendance.
Inclusivity	• All the stakeholders – men, women, youth, leaders, vulnerable peoples, households etc. were notified of the meetings and involved in the meetings. • Notices for meetings were posted well in advance, announcements were made in community gatherings. • Community mobilizers were used to reach more people.
Right to questions and responses	• In line with Article 33 of the Constitution, which states that public participation should respect the freedom of expression of the participants, the stakeholders were allowed to ask questions, share their views, make recommendations, seek clarifications, make comments about all aspects of the project. • All the questions, requests for clarifications, or additional information were responded to. • Time was dedicated to a question-response session in all the engagements.

5.3. Consultation with WSP (NCWSC)

The consultation meeting with the NCWSC Technical Team primarily focused on discussing the project scope and methodology from a technical design perspective. The project aims to install insertion electromagnetic flow meters to improve efficiency and reduce non-revenue water losses. A significant aspect highlighted was the lack of meters in certain stations, which affects data accuracy. The installation of master meters will provide consistent, reliable data on water flow, both raw and treated, enhancing operational efficiency and water management.

In terms of project implementation, the NCWSC team confirmed that the company's internal grievance redress mechanism would be utilized. This includes appointing an Environmental, Health, and Safety (EHS) officer, installing suggestion boxes, and having designated staff with contact information at each site. Additionally, a youth representative will be included in the grievance committee, ensuring inclusivity in addressing community concerns. The mechanisms will ensure efficient communication between the public and project stakeholders.

The NCWSC team requested that the final report be submitted for review by social, environmental, and technical experts to ensure that all aspects of the project have been properly assessed. This review will confirm that the project design aligns with NCWSC standards, ensuring the social and

environmental impact is minimized while maximizing technical efficiency. An attendance list of the meeting is annexed to document stakeholder involvement.

Summary of the discussion with NWSC

Item of discussion	Remarks
Draft ESIA report for the project	NWSC team provided feedback/comments of ESIA report on the following sections: *Approach and methodology:* justify the sampling of the respondents and summarize the respondents as per the project sites. *Impacts:* categorize the impacts into high, medium and low *Stakeholders engagement:* The analysis of the questionnaires should show the numbers as well as the percentages. ESMP: re-work on the ESMP cost to reflects actual cost. The provided cost was very high.
Grievance redress mechanism	NWSC has an existing GRM and the it will be incorporated with the project to cover all the construction sites

5.4. Public consultation

Stakeholder consultations were conducted using semi-structured questionnaires, designed to identify key issues and concerns related to the Environmental and Social Impact Assessment (ESIA). Questionnaires were chosen as the primary data-gathering tool for this project due to the localized nature of the activities, which are concentrated at specific treatment works, reservoirs, and water pipelines.

The use of questionnaires allowed for targeted engagement with key stakeholders, including those most likely to experience or observe the effects of the project. Given the technical nature of the installations, it is unlikely that people outside of the immediate vicinity of the treatment works and reservoirs would be significantly impacted. Therefore, questionnaires were an appropriate method to collect detailed, site-specific feedback from stakeholders who have direct knowledge or experience related to the project areas.

These questionnaires provided essential data for analyzing the project's impacts and informing strategies to promote best practices for mitigating negative effects. The primary objective of these interviews was to capture a broad range of perspectives, allowing for the identification of potential impacts and the development of mitigation strategies. Additionally, these consultations served to identify any other concerns that could lead to conflicts during project implementation.

The participants were selected through purposive sampling, a method chosen to ensure that the most relevant and knowledgeable stakeholders were consulted. This technique focused on

individuals directly affected by or closely involved with the project, thereby ensuring the relevance and quality of the responses. Key stakeholders included local residents, small-scale business owners, and NCWSC staff whose proximity to the project areas made their feedback particularly valuable. These stakeholders were expected to offer critical insights into the project's social, environmental, and economic effects.

The consultation was conducted across neighborhoods surrounding the project sites, including Central Police Station, Kiambu Reservoir, Uhuru Highway, Kabete Treatment Works, Kikuyu Springs, Loresho Reservoir, Langata Line at Showground, Langata Line at Police Dog Section, Gigiri Reservoir, Gigiri Fire Station, Ngethu Treatment Works, and Sasumua Treatment Works. By engaging stakeholders from these locations, the consultation aimed to capture a comprehensive understanding of the concerns of those directly impacted by project activities.

A sample size of 10 respondents per project site was selected because issues raised attained saturation point. Based on preliminary research and pilot studies, it was determined that after interviewing 10 individuals per site, there was a clear pattern of similar responses, indicating that the main concerns and issues had been adequately captured. By stopping at 10 respondents, the study avoided redundancy while ensuring that the key points of interest had been fully explored. This approach also balanced the need for thorough stakeholder engagement with time and resource constraints, making it both efficient and effective in gathering representative data.

The consultation exercise took place from 22nd to 26th July 2024, during which a total of 100 individuals living or working in the project area were interviewed. The results of these consultations are detailed in the following section, with samples of the administered questionnaires annexed in this report.

Table 17: Summary of public consultation Demographics

No.	Public consultation	Participants		
		Male	Female	Total
1.	Central Police Station	6	4	10
2.	Kiambu Reservoir	9	0	10
3.	Uhuru Highway	4	7	10
4.	Kabete T. Works	7	3	10
5.	Kikuyu Springs	8	2	10
6.	Loresho Reservoir	9	1	10
7.	Langata line at Showground	4	6	10
8.	Langata Line at Police Dog Section	7	3	10
9.	Gigiri Reservoir	10	0	10
10.	Gigiri Fire Station	8	2	10
	Total	**72**	**28**	**100**

5.4.1. Concerns/Issues/Questions raised during the Stakeholder Engagement

In all the engagements – both high level and community level, a number of issues were raised. The issues ranged between questions, comments and recommendations. The issues were synthesized / summarized below.

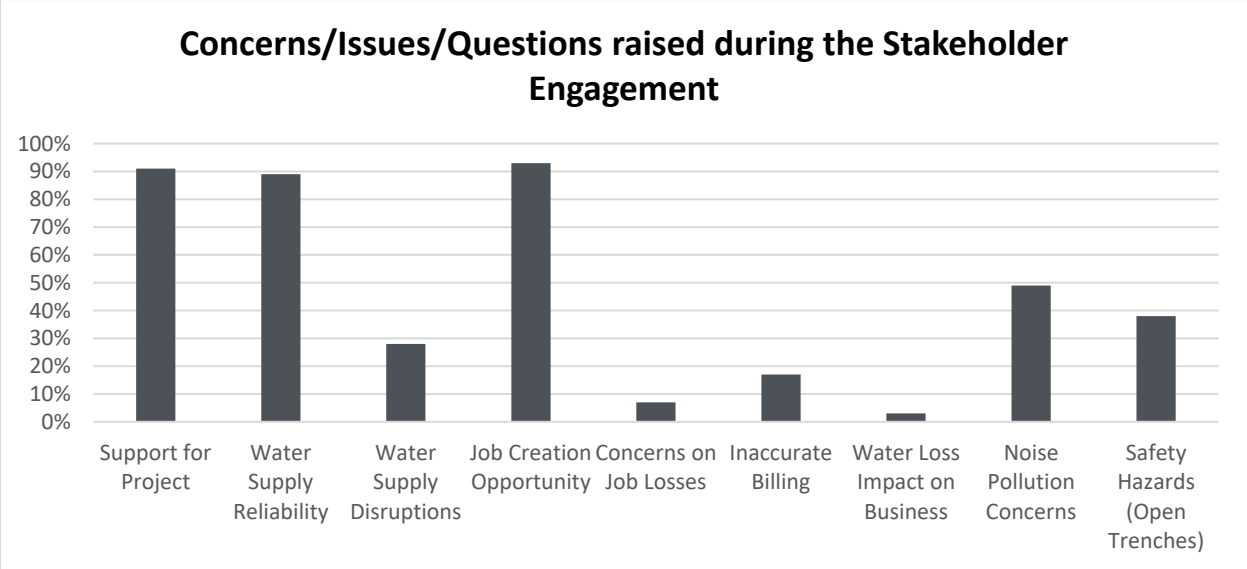
Table 18: Concerns/Issues/Questions raised during the Stakeholder Engagement

Issue Raised	Findings	Expert Response
Support for the Project	91% of respondents supported the installation of insertion electromagnetic flow meters. However, 7% rejected the project due to concerns about job losses among meter readers.	The expert team clarified that there will be no job losses because the purpose of the new meters is not to replace manual jobs but to enhance the efficiency of water distribution. The meters will primarily help detect water loss between raw and treated water, reducing non-revenue water. This improvement is aimed at boosting operational efficiency rather than displacing existing meter-reading staff.
Sufficient and Consistent Water Supply	89% of the respondents agreed that the project would improve water supply reliability and consistency in their area by enhancing water distribution system management.	The expert team explained that the project is designed to increase operational efficiency and reduce non-revenue water losses, ensuring that the water supply is more consistent and reliable. The installation of these master meters in areas where there were previously no meters will provide more accurate data on water flow. This improvement will allow Nairobi City Water and Sewerage Company (NCWSC) to better monitor the supply system and quickly identify and fix any discrepancies, thus enhancing water availability for the community.
Temporary Water Shortages	28% of the respondents were concerned about potential water supply disruptions during the installation phase and their impact on daily life and businesses.	The expert team assured that there will be no water supply disruptions during the installation of the meters because they will be installed under pressure. This means that the installation process will not require the water flow to be shut off, allowing the water supply to continue uninterrupted. Additionally, the team will implement contingency plans and ensure proper communication with residents to address any concerns proactively, ensuring minimal disturbance to their daily routines and businesses.
Job Creation During the Project	93% of the respondents viewed the project as an opportunity for job creation, particularly in construction, installation, and technical support for local workers.	The expert team confirmed that the project will create temporary job opportunities during the construction and installation phases, with a strong emphasis on hiring local workers. The team will prioritize employing residents from the surrounding areas to support the local economy and ensure that the community directly benefits from the project. Additionally, the project will emphasize gender balance in its recruitment process, offering equal employment opportunities to men and women. Furthermore, workers will gain valuable skills in

Issue Raised	Findings	Expert Response
		technical fields, potentially improving their future job prospects.
Loss of Jobs	7% respondents raised concerns about job losses among current meter readers due to the automation of meter readings.	The expert team addressed this concern by explaining that there will be no job losses, as the meters are not intended to replace manual meter-reading jobs but to enhance overall system efficiency. The new meters are designed to measure water flow at specific points in the system (e.g., treatment works and reservoirs), which will help reduce water losses and improve billing accuracy for NCWSC. Current meter readers will continue to play an essential role in monitoring household connections and may receive training to manage new tasks or higher-level responsibilities within the upgraded system. By enhancing efficiency, the project supports a more sustainable operational model without causing unemployment.
Improved Meter Reading and Accountability	17% respondents highlighted issues with inaccurate billing and expected the new technology to improve meter reading accuracy and billing transparency.	The expert team clarified that the new insertion electromagnetic flow meters will be installed only on major pipelines at the treatment works and reservoirs and are not connected to household meters. These master meters will help NCWSC monitor the amount of water treated and distributed more accurately, leading to better management of water resources. However, for improved household billing accuracy, NCWSC has already introduced a USSD code (888) and online platform that allows customers to read their meters and submit data after the 15th of every month. This feature helps minimize billing errors and improves transparency between the utility company and its customers.
Loss of Revenue Due to Water Loss	3% respondents, mainly business owners (Food joints near Central Police station), were concerned about potential water loss during the installation process, which could reduce their revenue from their businesses.	The expert team reassured respondents that there will be no loss of water during the installation process because the meters will be installed under pressure. This installation method ensures that the flow of water is maintained throughout the process, without requiring any shutoff or interruptions. Furthermore, rigorous quality control measures will be implemented during installation to ensure that the new meters are functioning accurately from the start.
Noise Pollution	49% respondents expressed concerns about	The expert team explained that noise pollution will be kept to a minimum during the installation process.

Issue Raised	Findings	Expert Response
	noise pollution during the construction phase, fearing it could disrupt their daily lives.	Hand excavation methods will be used to dig sections of the pipeline where the meters will be installed, which significantly reduces noise compared to heavy machinery. In addition, construction activities will be scheduled during times that are least disruptive to residents, and efforts will be made to use quieter equipment where possible. Noise levels will be monitored to ensure that they remain within acceptable thresholds, minimizing disturbances to the community.
Open Trenches	38% respondents were concerned about the safety hazards posed by open trenches during the installation process, especially for pedestrians.	The expert team assured respondents that safety measures will be prioritized to avoid any accidents or hazards. There will be no open trenches during the installation, as any section of the pipeline that is excavated for meter installation will be immediately backfilled to restore the area to its original state. Additionally, barriers, warning signs, and appropriate lighting will be placed around the work areas to ensure the safety of pedestrians and minimize the risk of accidents. Public safety is a key concern, and all necessary precautions will be taken to secure the installation sites.

A graphic presentation of the issues raised is presented below:



6. Project Alternatives

6.1. No Project Alternative

The "No Project" alternative involves maintaining the status quo, where no new water meters are installed, and the existing system continues without enhancements. This option means that the operational inefficiencies within the water supply system, such as high levels of non-revenue water due to undetected leaks or losses, will persist. It would delay the financial recovery of NCWSC. Without addressing water loss issues, the burden on the WSP, especially post-COVID-19, would remain, hampering their ability to achieve financial stability. Additionally, the local community would not benefit from the job opportunities or the increased water supply reliability that the project aims to deliver.

6.2. Project Design Technology Alternative

This alternative focuses on evaluating different technological solutions other than the insertion electromagnetic flow meters. For instance, ultrasonic or mechanical meters could be considered. However, these alternatives may not offer the same level of accuracy in detecting water losses between raw and treated water, as electromagnetic meters are known for their precision in measuring water flow. The electromagnetic technology is also more suited for the large-diameter pipelines used in the project's interventions. Opting for a different technology might reduce the effectiveness of the system in achieving its goal of reducing non-revenue water, potentially hindering the financial recovery of WSPs. Thus, while other technologies exist, electromagnetic meters present the most viable option for achieving the project's objectives.

6.3. Location Alternative

The project targets regions with significant water distribution challenges, such as Ngethu Treatment Works, Kabete Treatment Works, and the Gigiri and Kiambu Reservoirs, where some areas are not currently metered. An alternative would be to implement the project in different regions, but this would overlook the urgent needs of the selected areas. Locations like the Loresho Reservoir and Showground site have critical gaps in their metering infrastructure that must be addressed to improve water management and financial stability. Shifting the project to other areas would delay addressing the existing inefficiencies and miss the opportunity to enhance water supply reliability in these crucial locations.

6.4. Layout Alternative

The layout alternative involves reconfiguring the project's design, such as installing meters at different points in the water transmission system or modifying the scope of installation sites. For example, the project could choose to focus only on treated water meters or limit the installations to smaller pipelines. However, this would undermine the comprehensive approach designed to

monitor both raw and treated water. By only partially addressing water flow issues, the system would still suffer from inefficiencies and inaccuracies in water usage data, thereby compromising the goal of reducing non-revenue water. The current layout is designed to offer the most holistic solution, ensuring accurate tracking of water from source to distribution.

6.5. Preferred/Selected Alternative

The preferred alternative is the installation of insertion electromagnetic flow meters at both the raw and treated water points in the identified treatment works and reservoirs. This option has been selected because it provides a targeted and efficient solution to reduce water losses, ensuring accurate measurement of water flow. The installation will improve the financial performance of the WSP, assist in water conservation, and enhance the reliability of water supply for local communities. Additionally, this alternative offers job opportunities for local workers during installation, while maintaining water supply continuity and minimizing disruptions. By enhancing operational efficiency and reducing non-revenue water, this alternative aligns with the project's broader objectives of sustainable water management and financial recovery of the WSP.

7. Potential Environmental & Social Impacts and Mitigation Measures

This chapter describes possible impacts during construction, operation and decommissioning phases as well as corresponding mitigation measures to minimize the negative impacts of the proposed project. The identified impacts/risks are further analyzed and evaluated based on the nature of impacts in terms of their occurrence, extent, duration, probability and intensity apart from the stakeholders and/or values affected.

7.1. Methodology for Impact Assessment

Environmental assessment was carried out to identify potential impacts of the project on the environment, biodiversity and the community. The assessment was carried out in three main steps, as follows:

- Prediction of potential impacts
- Execution of specialised ecological studies on biodiversity and evaluation and assessment of the impacts in terms of their significance
- Identification/ proposing mitigation measures for minimizing the effects of the significant impacts.

After exclusion of the negligible impacts, the remaining aspects were assessed based on the following criteria:

- Magnitude of the impact;
- Duration: period of time that impact lasts;
- Mitigation measures; its availability whether integrated in the project design or implemented as management measures;
- Residual impacts.

Where negative environmental impacts are expected, majority of them will be experienced during the construction phase. To help offset the potential negative impacts, mitigation measures are suggested and the residual impact evaluated.

7.1.1. Identification of Project Impacts

The identification of project impacts was by subjecting the project activities to a process of screening. This was an iterative process that comes to an end only when the effects of all the identified impacts generated by the project, including residual impacts have been assessed and assigned a mitigation strategy. The process involved the following steps:

- Impact Prediction and evaluation
- Mitigation and Enhancement
- Residual Impact Evaluation

7.1.2. Impacts that will occur during Installation

The insertion of flow meters is a relatively non-invasive process that requires access to pre-existing pipeline structures. Any disruptions will occur in designated wayleaves or access routes. Due to the absence of extensive digging or major earthworks, the environmental impacts are expected to be

low, localized, and reversible. However, minor disturbances such as vegetation clearing, soil compaction, and equipment traffic may affect the immediate surroundings.

Evaluation was carried out on the positive and negative impacts considering the following:

- The Health and Safety Aspects
- Ecological Aspects
- Environmental Aspects
- Social Aspects

7.1.3. Categorization of Impacts

The key issues identified during the assessment were evaluated using various components that individually or in combination with others give rise to impacts that require mitigation measures and monitoring. The significance of the potential impacts has been considered before and after mitigation measures have been applied. The following criteria was used to evaluate the significance of impact of the project on the physical environment, community and the biological environment.

Table 19: Categorization of Impacts

No	Impact	Criteria	Classification
1	Impact Nature	An assessment of the type of effect the activity is likely to have on the surrounding project's environment	***Positive*** *– Affecting the environment positively*
			Negative *– Affecting the environment negatively*
			Neutral *– No effect on the environment*
2	Impact Type	Evaluation of how the impact will affect the project's environment	***Direct*** *– Impacts will be generated directly from project activities*
			Indirect – *Impact generated from secondary sources*
3	Impact Severity	This defines the degree to which the project affects the environment	***Insignificant****– Potential impacts are minor. The natural environment is not affected by the project*
			Low *– There is minimal effect on the natural environment. The social, cultural and natural, cultural and social functions and processes can be reversed to their original state if mitigation measure are applied*
			Medium *– Environment is Impacted but can still function. Negative impacts can only be partially reversed*
			High *– Environmental, Cultural and social functions and processes are*

No	Impact	Criteria	Classification
			Impacted and cannot be fully reversed
			Very High *- Environmental, Cultural and social functions and processes are* *Permanently Impacted and cannot be reversed*
4	Impact Duration	The period of time that the impact lasts on the environment	***Short Term*** *– The potential impacts only last for a short time - the period of construction or less.*
			Medium – Term *– The potential impacts last for approximately 10 years or half the lifetime of the project*
			Long – Term *–potential impacts can last for complete life cycle of the project*
			Permanent But Mitigated - *Impact will remain after operational life of project but appropriate mitigation measures have been used to reduce the impacts*
			Permanent But Not Mitigated - *Impact will remain after an operational life of the project. No mitigation measures will reduce impact after implementation*
5	Impact Extent	Defines the spatial or geographical extent that may be affected by the project or associated facilities	***Project Site*** *– Within the project boundary*
			Local *– Impacts extend beyond the project site*
			Regional *– Impacts extend beyond the administrative area*
			National *– Impacts are considered nationally*
			Transboundary *– impacts are considered beyond the nation's boundary*
6	Likelihood of Occurrence	Defines the chances that the impact will take place	***Unlikely*** *– No chance that impact will occur*
			Likely *– There is a good chance that the impact will occur*
			Certain *– The impact will occur whether mitigation measures are implemented or not*
7	Potential for irreplaceable loss of resource	This defines the degree to which the project can cause the loss of a resource that cannot be replaced	***Low*** *– No or minimal impact will occur on irreplaceable resource*
			Medium *– Impacted unique resource can be replaced with mitigation measures after a period of time*
			High *– A high chance the irreplaceable resource will be impacted*
8	Impact Magnitude	This defines the intensity of the	***Insignificant*** *– The magnitude of the impact has no effect on the environment*

No	Impact	Criteria	Classification
		change that has the potential to occur	***Low*** *- There is magnitude of the impact has minimal effect on the natural environment*
			Medium-Low *– The magnitude of the impact has some effect on the environment but can be easily reversed with mitigation measures*
			Medium-High *– The magnitude of impact is significant and requires more effort to reverse them through mitigations*
			High *– The intensity of the impact high and only a small and mitigations can only reverse a very small portion.*
			Very High *– The environmental, social and cultural aspects of the project are permanently impacted and mitigation measures cannot reverse the impacts*
9	Impact Significance	The significance will be rated by combining the consequence of the impact and the probability of occurrence	***Negligible – No Action required***
			Low *– The impacts are within the acceptable range*
			Medium-Low *- Impacts are within the acceptable range but should be mitigated to lower significance levels wherever possible*
			Medium-High - Impacts are significant and require attention
			High *- Impacts are of great importance, mitigation is crucial*
			Very High *– Impacts are very significant. Potential impacts such as loss of a significant portion of a valued species or loss of effective ecosystem function*

7.2. Positive Impacts

7.2.1. Creation of employment

The project will generate temporary employment opportunities during both the construction and installation phases, with a strong focus on engaging the local workforce. The project will prioritize the recruitment of residents from the surrounding areas, ensuring the local community benefits directly. This will not only support the local economy but also provide workers with valuable technical skills that can enhance their future employability.

7.2.2. Efficiency in water supply

The installation of insertion electromagnetic flow meters will enhance the efficiency of the water distribution system by providing precise measurements of water flow. These master meters will be

installed at key locations, including treatment works and reservoirs, where some stations currently lack meters. By improving data accuracy and consistency, the new meters will help reduce non-revenue water and ensure that the system operates more effectively. This will ultimately increase the confidence in the data collected, leading to a more reliable and stable supply of treated drinking water for residents.

7.2.3. Injection of money into the local economy

The project will also inject significant financial resources into local economies. The implementation of this project will create a ripple effect in the local economy. By hiring locally and sourcing supplies within the region, the project will stimulate economic activity, benefiting businesses and households in the project area. Contractors, suppliers, and vendors involved in the procurement of materials and equipment will benefit directly, while other local businesses will experience increased demand due to project-related activities. This financial injection will stimulate economic growth in the areas where the project is implemented, providing a temporary but significant boost to local markets, retail businesses, and service providers. The improved water supply system may also foster economic activities such as small-scale agriculture, where access to water is crucial.

7.3. Negative Impacts during installation

7.3.1. Vegetation Disturbance

The movement of equipment and personnel may lead to localized trampling or clearing of vegetation, especially in densely vegetated areas such as Sasumua, Kikuyu Springs, and Langata Line. This could result in the loss of individual plants, particularly small shrubs, grasses, and ground cover plants. In forested areas, such as those near Kikuyu Springs and Showground, any temporary clearing could disrupt the integrity of plant communities, although these disturbances are expected to be localized and short-term.

Impact	Vegetation Disturbance
Impact Nature	Negative
Impact Type	Direct
Impact Severity	Low
Impact Duration	Short Term
Impact Extent	Project Site
Likelihood of Occurrence	Low
Potential for Irreplaceable loss of resource	Medium
Impact Magnitude	Medium Low
	The impact magnitude is considered medium-low because the activities will be localized.
Impact Significance	Low
	The impact significance is considered low because small areas will be disturbed.

Mitigation Measures:

- Conduct thorough site assessments to identify sensitive areas and plan access routes to minimize disturbance.
- Utilize existing access paths and minimize new clearing to preserve natural vegetation.
- Limit vegetation clearing to only what is necessary for equipment placement and access.
- Handle soil and vegetation carefully to avoid unnecessary disturbance and ensure minimal impact on root systems.

7.3.2. Waste disposal

The installation activities will generate solid and liquid waste. At the end of construction, the demobilisation will also generate significant waste from demolishing laydown areas, other construction wastes. This impact is short term. However, the disposal mechanism of the wastes can have long term consequences. Solid waste like packing materials, cables, and steel generated during construction will be carefully handled and removed from the sites periodically to avoid any contamination.

The above wastes include the following:

Domestic waste – Waste food, food wrappings, cans, bottles and other spoilt containers. Sanitation wastewater.

Construction wastes – Packaging waste, scrap metals, installation debris, disused parts.

Receptors

The improper handling of domestic solid waste that includes papers and food wrappings may lead to them littering the site compound and being blown away to neighbouring areas. The other domestic solid wastes may litter the site compound and make it unhealthy for workers. Waste from construction activities if not well handled may pose health and safety risk to workers and other persons visiting the site.

The sanitation facilities at the site must be made to work properly. Sanitation waste can also overflow and cause health risk to workers and people visiting the site.

Impact	Waste Impacts from installation Activities
Impact Nature	Negative
Impact Type	Direct
Impact Severity	Low
Impact Duration	Short Term
Impact Extent	Project Site
Likelihood of Occurrence	Medium
Potential for Irreplaceable loss of resource	Low
Impact Magnitude	Low The impact magnitude is considered low since the installation waste will be minimal
Impact Significance	Low

Mitigation measures

- Providing waste collection bins at designated points on site for purposes of waste segregation
- All solid waste should be collected at a central location at each site and will be stored temporarily until removal to an appropriately permitted disposal site. The approved disposal sites are available in Nairobi County and the contractor will choose the nearest disposal site.
- No dumping within the surrounding area is to be permitted unless at designated disposal sites.
- Waste generated at the site should be segregated by the contractor and disposed of in recommended manner. Wherever possible recycling should be carried out.
- Following EMCA regulations on Waste Management, 2006 Legal Notice 121, the Contractor should prepare for use an elaborate Waste Management Plan
- Reducing material residual wastes through accurate estimation of size and quantity.
- Reuse of materials and packaging material to reduce waste.
- Disposal of waste to be done by a NEMA licensed waste handler.
- Appropriately positioned waste bins shall be provided (easy to locate and near areas where waste is generated)

7.3.3. Noise & Air pollution

During installation, noise from machinery and equipment could temporarily disturb local wildlife, particularly in quieter, more natural settings such as Kikuyu Springs and Sasumua. Additionally, dust and emissions from excavation may affect air quality in the immediate vicinity, which could have minor impacts on sensitive flora and fauna.

Impact	Noise & Air pollution Impacts from installation Activities
Impact Nature	Negative
Impact Type	Direct
Impact Severity	low
Impact Duration	Short Term
Impact Extent	Local
Likelihood of Occurrence	Low
Potential for Irreplaceable loss of resource	Low
Impact Magnitude	Low
	The impact magnitude is considered Low in quieter, more natural settings in the project site.
Impact Significance	Low
	The impact significance is considered low due to no settlements within the project site.

Mitigation measures

- Select and use equipment designed to operate at lower noise levels where possible.

- Restrict noisy activities to daytime hours to minimize disturbance to local communities and wildlife.
- Inform local communities about the project schedule and potential noise impacts in advance.
- Implement dust control measures such as water spraying or using dust suppressants to minimize airborne dust.

7.3.4. Soil Compaction

Installation activities, particularly the movement of heavy equipment, could lead to soil compaction around access routes and installation sites. Soil compaction can hinder root growth, reduce water infiltration, and disrupt soil ecosystems. This is a potential risk in areas such as Ngethu, Loresho Reservoir and Kabete T. Works, where the landscape includes cultivated land and natural vegetation. Compaction may affect the recovery of disturbed vegetation after installation.

Impact	Impact on soil compaction
Impact Nature	Negative
Impact Type	Direct
Impact Severity	Medium -Low
	The impact severity is medium- low since the project area is located in the disturbed areas.
Impact Duration	Long Term
Impact Extent	Project site
Likelihood of Occurrence	Medium
Potential for Irreplaceable loss of resource	Medium
Impact Magnitude	Low
	The impact magnitude is considered low since the area affected is small and confined to the immediate surroundings of the insertion sites.
Impact Significance	Low
	The significance of the impact is low. While localized compaction may temporarily affect soil aeration and water infiltration, the overall impact on soil health is minimal.

Mitigation Measures

- Designate specific routes for machinery to minimize soil disturbance and compaction.
- In areas where soil compaction is detected, use soil aerators or subsoilers to alleviate compacted layers and restore soil porosity.
- Replant native vegetation and monitor disturbed areas to ensure successful recovery of the ecosystem.

7.3.5. Potential for Invasive Species

The movement of equipment and personnel between project sites increases the risk of introducing non-native or invasive plant species. In areas with sensitive ecosystems, such as Ngethu, Sasumua T. Works and Kikuyu Springs, invasive species could outcompete native flora and disrupt the

ecological balance. The introduction of invasive plants could have long-term consequences on the health and biodiversity of the affected areas if not managed properly.

Impact	Potential for Invasive Species
Impact Nature	Negative
Impact Type	Direct
Impact Severity	Medium
	The impact severity is low since the project area has few vegetation (trees).
Impact Duration	Long Term
Impact Extent	Project site
Likelihood of Occurrence	Low
Potential for Irreplaceable loss of resource	Low
Impact Magnitude	Medium Low
	The magnitude of introducing invasive species is considered low. The risk of non-native species being introduced through equipment and personnel is limited due to the controlled nature of the project.
Impact Significance	Low
	The impact significance is considered low.

Mitigation Measures

- Conduct periodic monitoring of areas like Sasumua T. Works and Kikuyu Springs to identify invasive species early and implement rapid removal or control strategies.
- Prioritize replanting with indigenous species to outcompete invasive plants, thus preserving local biodiversity.

7.3.6. Temporary Habitat Disruption

The project could temporarily disrupt the habitats of small wildlife species and plant communities that rely on specific microhabitats. The installation work may interfere with the habitats of ground-dwelling animals and insects, especially in areas with dense vegetation, such as forested sections near Sasumua T. Works, Kikuyu springs and Showground. Although these disruptions are expected to be brief, they could cause temporary displacement or changes in the local biodiversity.

Impact	Temporary Habitat Disruption
Impact Nature	Negative
Impact Type	Direct
Impact Severity	Medium
Impact Duration	Long Term
Impact Extent	Local
Likelihood of Occurrence	Medium

Potential for Irreplaceable loss of resource	Medium
Impact Magnitude	Low
	Temporary habitat disruption is expected to be localized and short-term. The disturbances will be confined to the immediate area around the installation sites and will last only for the duration of the installation process.
Impact Significance	Low
	Although there may be short-term effects on local fauna and flora, these are expected to be minor and temporary. Restoration of disturbed areas and the relatively small scale of the project will contribute to the quick recovery of local habitats.

Mitigation Measures

- Conduct installation work during seasons when local wildlife is less vulnerable (e.g., outside breeding or hibernation periods).
- Mark and protect sensitive habitats to minimize disruption to wildlife, ensuring that no unnecessary damage occurs.
- After installation, restore disturbed habitats promptly, such as replanting native vegetation and ensuring minimal impact on local wildlife.

7.3.7. Disruption to Agricultural Activity

In areas like Kiambu Reservoir and Ngethu T. Works, where agricultural activities are present, there may be temporary disruption to farming operations. Installation near cultivated crops such as maize could lead to minor losses in yield due to localized trampling or disturbance to soil and access. However, since the project does not involve extensive excavation, these impacts are expected to be minimal and recoverable post-installation.

Impact	Disruption to Agricultural Activity
Impact Nature	Negative
Impact Type	Direct
Impact Severity	Low
Impact Duration	Short Term
Impact Extent	Local
Likelihood of Occurrence	Low
Potential for Irreplaceable loss of resource	Low
Impact Magnitude	Low
	The impact magnitude is low, as the project involves minimal excavation and only affects localized areas near agricultural activities, leading to minor disruptions such as trampling or soil disturbance.
Impact Significance	Low
	The significance is low because the temporary disruption is unlikely to result in substantial yield loss or long-term effects on agricultural productivity, with

	quick recovery expected once the installation is completed.

Mitigation measures

- Coordinate project timelines with farmers to avoid peak growing seasons or harvesting periods, minimizing the impact on agricultural yield.
- Ensure the agricultural land is restored to its original condition post-installation by levelling disturbed areas and addressing any compaction issues.

7.3.8. Health and safety risks to residents

The public as well as workers are at risk from projects such as this project, particularly from construction traffic. The project will generate substantial amount of traffic compared to the non-project situation. This traffic will be travelling on the public roads within the project area. Accidents could occur due to excessive speeds, unsafe loading, poor road surfaces, poor vehicle maintenance, and unwary pedestrians, especially drunken men, and children.

Significance of impact

Mitigation status	Spatial extent	Duration	Severity	Frequency of activity	Frequency of Impact	Consequence	Likelihood	Significance
Without Mitigation	3	2	4	5	4	9	9	81
	Whole site	One month to one year	Harmful	Daily	Likely			Medium-high
Mitigation Measures	• Establish and enforce a strict code of conduct for all project drivers including outside suppliers delivering materials. The code should focus on safety, especially speed, and loading, especially banning all carriage of staff, workers and passengers except in seats. • Same-day backfilling of trenches; covering/barricading of open chambers; sequential construction (excavation and immediate backfilling of trenches; excavation of chambers, immediate construction and covering of the chambers)							
With mitigation Measures	1	2	1	5	1	4	6	24
	Activity specific	One month to one year	Non-harmful	Daily	Almost impossible			Very Low

7.3.9. Sexual exploitation and abuse of community members by project workers

This impact refers to sexual exploitation and abuse committed by Project staff against communities, and represents a risk at all stages of the Project, especially when employees and community members are not clear about prohibitions against SEA in the Project. The project will experience the influx of people who will be seeking employment during construction phase, therefore, SEA will be a critical aspect to be monitored.

Mitigation:

- Develop and implement and SEA action plan with an accountability and Response Framework as part of the C-ESMP. The SEA action plan will follow guidance on the World Bank's Good Practice Note for Addressing Gender-based Violence in Investment Project Financing involving Major Civil Works (Sept 2018).
- The SEA action plan will include how the project will ensure necessary steps are in place for:
  - ✓ *Prevention of SEA*: including Code of Conducts (CoC) and ongoing sensitization of staff on responsibilities related to the COC and consequences of non-compliance;
  - ✓ *Response to SEA*: including survivor-centered multi-sectoral referral and assistance to complainants; staff reporting mechanisms; written procedures related to case oversight, investigation and disciplinary procedures at the project level
  - ✓ *Engagement with the community*: including development of confidential community-based complaints mechanisms discrete from the standard GRM; mainstreaming of PSEA awareness-raising in all community engagement activities; IEC materials; regular community outreach to women and girls about social risks and their PSEA-related rights;
  - ✓ *Management and Coordination*: including integration of SEA in job descriptions, employments contracts, performance appraisal systems, etc.; development of contract policies related to SEA, including whistleblower protection; training for all project management; management of coordination mechanism for case oversight, investigations and disciplinary procedures; supervision of dedicated Prevention of Sexual Exploitation and Abuse (PSEA) focal points and trained community liaison officers.

7.3.10.Gender-based violence at the community level:

GBV constitutes acts of gross misconduct and are therefore grounds for sanctions, penalties and/or termination of employment. This impact refers to gender-based violence at the community level that women and girls may experience as a result of Project implementation. This includes, for example, an increase in intimate partner violence (IPV) when compensation schemes that share funds equally among husband and wife at the household level do not provide adequate sensitization and safety measures to reduce potential for increased tensions due to females receiving funds. This also refers to other GBV-related risks incurred as a result of project implementation that do not adequately consult women and adolescent girls in the community about safety and security issues related to the delivery of water services.

Mitigation:

- Develop and implement provisions that ensure that gender-based violence at the community level is not triggered by the Project, including:
  - ✓ effective and on-going community engagement and consultation, particularly with women and girls;
  - ✓ review of specific project components that are known to heighten GBV risk at the community level, e.g. employment schemes for women; delivery of supplies; etc.

- ✓ Specific plan for mitigating these known risks, e.g. sensitization around gender-equitable approaches to employment; supply services; etc
- Ensure adequate referral mechanisms are in place if a case of GBV at the community level is reported related to project implementation.

7.3.11. Violation of children rights by contractor and labour force on site:

Violence against Children (VAW) is defined as physical, sexual, emotional and/or psychological harm, neglect or negligent treatment of minor children (i.e. under the age of 18), including exposure to such harm, that results in actual or potential harm to the child's health, survival, development or dignity in the context of a relationship of responsibility, trust or power. This includes using children for profit, labor, sexual gratification, or some other personal or financial advantage. This also includes other activities such as using computers, mobile phones, video and digital cameras or any other medium to exploit or harass children or to access child pornography.

The Children Act of Kenya prohibits contractors from "employing children in a manner that is economically exploitative, hazardous, and detrimental to the child's education, harmful to the child's health or physical, mental, spiritual, moral, or social development. The possibility of contractor children abuse is through hiring of child labour, also labour force on site might abuse children within the Project area through sexual advance that could lead to early pregnancies and school dropout including exposure to communicable diseases such as HIV and AIDS. It is also important to be vigilant towards potential sexual exploitation of children, especially young girls. The contractor should adopt a 'Child Protection Code of Conduct'; that all staff of the contractor must sign, committing themselves towards protecting children, which clearly defines what is and is not acceptable behaviour. That notwithstanding, the contractor should take responsibility if any of the suppliers and subcontractors contravene this law.

The contractor will undertake the below listed mitigation measures.

Mitigation:

- Develop and implement a Children Protection Strategy that will ensures minors are protected against negative impacts associated by the Project.
- All staff of the contractor must sign, committing themselves towards protecting children, which clearly defines what is and is not acceptable behavior
- Children under the age of 18 years shall not be hired on site as provided by Child Rights Act (Amendment Bill) 2014.

7.3.12.Spread of HIV/AIDS, STIs and other communicable diseases

The project will bring together groups of people, such as workers, community members, or visitors, which can lead to increased social interactions and mobility, contributing to the spread of HIV/AIDS and STIs. Economic development may also encourage behaviors associated with higher risk, such as multiple sexual partnerships. Migrant workers could introduce new infections or increase the transmission rates of existing diseases, while women and young girls may be more vulnerable due to gender inequalities and transactional relationships.

Mitigation Measures:

- Carry out periodic HIV/AIDS awareness training for workers and the beneficiary community.
- Distribution of condoms to workers and beneficiary communities, especially the CIGs.
- Carryout voluntary HIV/AIDS testing for workers and community members.
- If tested positive, further guidance will be offered and directed to the nearest public hospital to receive free antiretroviral (ARVs) drugs and other services.
- The project team should use the services of contracted GBV/SEAH service providers to undertake community outreach activities.
- Hire local workers where possible to minimize the extent of any influx.
- All workers shall sign CoC/ contract that has provisions on GBV/SEAH.

Impact Criteria	Spread of HIV/AIDS, STIs, and Other Communicable Diseases
Impact Nature	Health-related, social, and cultural impacts
Impact Type	Negative impact
Impact Severity	High – the spread of communicable diseases can lead to significant morbidity and mortality
Impact Duration	Long-term – may persist for years or even decades if not addressed
Impact Extent	Local to regional – affects the immediate project area and potentially surrounding areas
Likelihood of Occurrence	High – given the increased social interactions, migration, and possible gaps in health systems
Potential for Irreplaceable Loss of Resource	Moderate to high – the loss of health and well-being can have long-lasting effects on the community's development
Impact Magnitude	Large – can significantly affect the overall health of the community and hinder project success
Impact Significance	Very high – can affect community stability, project outcomes, and public health in the region

7.3.13.Workers/Labour Influx Impacts

The project will attract an influx of workers and laborers to the area, which could lead to increased pressure on local resources such as housing, water, and food supply, potentially resulting in higher costs for community members. This influx may also strain local infrastructure, including transportation and healthcare services, as the population temporarily grows. Additionally, there may be social tensions between local residents and the incoming workforce, especially if there is perceived inequity in job opportunities or access to benefits. The potential for increased incidences of crime and conflicts may arise, as well as concerns about the impacts of a transient labor force on the local culture and social dynamics.

Impact Criteria	Workers/ Labour Influx Impacts

Impact Nature	Social and economic strain
Impact Type	Negative
Impact Severity	Moderate to High
Impact Duration	Temporary to Medium-term
Impact Extent	Localized to project area, but could spill over into surrounding communities
Likelihood of Occurrence	Likely
Potential for Irreplaceable Loss of Resource	Low to Moderate (depends on resource strain)
Impact Magnitude	Moderate to High
Impact Significance	High due to potential for social unrest and resource scarcity

Mitigation measures:

- Ensure that locally available labour force is given priority during recruitment. Especially for casual and unskilled positions.
- Providing accommodation for workers in camps if the workforce is large

7.4. Assessment of climate risks

Kenya's changing climate poses significant risks to water infrastructure, including the installation of insertion electromagnetic flow meters. According to the **Climate Change Act, 2016 (No. 11 of 2016)**, all public and private entities must integrate climate resilience measures into development planning and activities. The water sector is particularly vulnerable to climate variability, especially in terms of water availability, quality, and infrastructure integrity.

Key climate risks for the installation of flow meters in the project areas include:

- **Increased Temperature**: Rising temperatures, especially in the highland areas like Ngethu and Sasumua, could lead to higher evaporation rates from water sources and reservoirs, reducing raw water availability for treatment and consumption. Additionally, the heat could affect the performance and lifespan of infrastructure like flow meters.
- **Variable Rainfall Patterns**: The project areas, particularly those relying on rivers and streams from the Aberdare Ranges, face risks from irregular and extreme rainfall events. Prolonged dry periods may lead to reduced water flow, while heavy rainfall can cause flooding, which may damage pipelines and flow meters or cause erosion around installation points, increasing maintenance costs.
- **Flooding**: The Aberdare Ranges and surrounding areas, such as Kiambu and Sasumua, are prone to flash floods, which can disrupt the function of raw water pipelines, damage flow meters, and cause sediment buildup. Flooding could also cause contamination of raw water sources, requiring more intensive treatment.
- **Water Scarcity**: Climate-induced water scarcity could affect the quantity and consistency of raw water intake, particularly in regions like Kabete and Sasumua, where water extraction

depends on fluctuating stream flows. This could complicate flow meter readings and undermine the ability to monitor and distribute water efficiently.

- **Drought**: Prolonged drought periods, expected to become more frequent due to climate change, pose a threat to raw water availability from rivers such as Chania and Sasumua, leading to reduced water levels and affecting meter readings, possibly skewing data critical for water management.

Measures to Protect Infrastructure from Climate Extremes:

To ensure the long-term resilience of water infrastructure and flow meters against these climate risks, several measures can be implemented:

- **Elevating Flow Meter Installations**: In flood-prone areas, such as Ngethu and Sasumua, the installation of flow meters should consider elevated platforms or enclosures to protect the meters from floodwaters and debris. Ensuring that meters are installed above projected flood levels will reduce the risk of damage from extreme weather events.
- **Reinforced Pipeline and Meter Structures**: Pipelines, especially those traversing vulnerable terrain like mountainous or riverbank areas, should be reinforced to withstand flooding and erosion. This can involve the use of resilient materials or added protection, such as concrete encasements for the meters and nearby pipeline sections.
- **Regular Climate Risk Assessments and Monitoring**: Implement a climate risk monitoring system that continuously evaluates the impact of climate change on water resources and infrastructure. This can include monitoring water levels, rainfall patterns, and temperature variations, allowing the adjustment of water management strategies to mitigate risks.
- **Use of Climate-Resilient Technologies**: Flow meters should be sourced with components that can endure extreme temperatures and humidity fluctuations. Using corrosion-resistant materials, such as stainless steel or specialized coatings, can prolong the lifespan of the meters and maintain accurate measurements under varying environmental conditions.
- **Drainage and Flood Control**: Adequate drainage systems should be installed around critical infrastructure, particularly in flood-prone areas like Sasumua. This will divert floodwaters away from the pipelines and meter installations, reducing the risk of water damage and sediment accumulation.
- **Emergency Preparedness and Contingency Planning**: A climate emergency preparedness plan should be developed for the water service providers (WSPs), focusing on quick-response mechanisms in case of extreme weather events. This includes having spare parts and maintenance teams ready to repair or replace damaged flow meters promptly.
- **Erosion Control Measures**: In areas susceptible to soil erosion, such as the Ngethu and Sasumua project sites, vegetative cover or engineering solutions like gabions should be implemented to prevent soil from washing away and destabilizing the ground around meter installations.

7.5. Cumulative Impacts

Environmental Topic	Potential Cumulative Impacts and Long-Term Management (10-20 Years)
Water Resources	**Reduced water wastage**: The installation of master meters will significantly reduce non-revenue water by detecting and correcting water losses. This will ensure more efficient water use and reduce strain on water resources. Over 10-20 years, NCWSC can progressively upgrade more segments of the distribution network with similar technologies to further minimize losses. **Competition for water resources**: As the city's population grows and climate change impacts water availability, there may be increased competition for water resources. NCWSC should proactively manage this by collaborating with other users (agricultural, industrial) and continuing to improve system efficiency to ensure equitable water access. **Climate resilience**: Improved monitoring of water flow will allow NCWSC to better respond to droughts or seasonal variability. Over time, this data will help in forecasting water availability and planning accordingly, possibly by integrating more sustainable water supply options like rainwater harvesting and aquifer recharge systems.
Employment and Local Economy	**Temporary job creation**: During the installation phase, temporary employment for local workers will boost the local economy. Over the long term, NCWSC can continue hiring local workers for future maintenance and upgrades, offering stable job opportunities. **Skill development**: Workers trained on the management of the master meters will acquire valuable technical skills. Over time, this skilled labor force could be involved in other infrastructure projects or in the continuous monitoring and upgrading of the water system, improving their long-term employability.
Upstream and Downstream Impacts	**Positive downstream effects**: Accurate data from the master meters will help NCWSC balance water distribution and reduce inefficiencies, benefiting downstream users by ensuring a more reliable supply. Over the next 10-20 years, NCWSC can use this data to optimize the entire water distribution network, ensuring that both upstream and downstream areas have equitable water access. **Competition for resources**: In the long term, the project must factor in possible competition for water. Developing water-sharing agreements and continuous monitoring will help address these challenges while promoting water conservation programs in both urban and rural sectors.
Competition for Services	**Potential infrastructure competition**: As Nairobi continues to urbanize, new housing and industrial developments may increase demand for water services, creating competition for NCWSC's resources. Over 10-20 years, NCWSC should invest in expanding its infrastructure to meet growing demand while maintaining service quality. Collaboration with city planners and policymakers will be essential to

Environmental Topic	Potential Cumulative Impacts and Long-Term Management (10-20 Years)
	ensure that NCWSC's water management capabilities scale appropriately with urban growth. **Synergies with other projects**: The master meter project aligns well with future infrastructure modernization efforts. NCWSC can partner with other infrastructure projects (e.g., roadworks, energy grids) to streamline construction and minimize disruptions, while also promoting water-efficient practices in other sectors.
Natural Resources and Business	**Improved business opportunities**: With a more reliable and efficient water supply, local businesses that rely on consistent water availability will benefit. Over time, businesses may expand due to better water management, stimulating the local economy. NCWSC could further facilitate this growth by encouraging businesses to adopt water-saving technologies and strategies.
Climate Resilience	**Long-term resilience to climate variability**: By improving the accuracy of water flow data, NCWSC can better plan for periods of drought or water scarcity. Over the next 10-20 years, integrating climate forecasts with water management data will allow the company to optimize its distribution networks in response to changing conditions, ensuring long-term resilience. NCWSC could also invest in alternative water sources, such as desalination or advanced water recycling systems, to reduce reliance on traditional water sources vulnerable to climate change.
Sustainability Initiatives	**Water conservation and recycling**: NCWSC can leverage data from the new meters to promote water conservation programs among consumers and businesses, reducing long-term demand on the water supply. Over the next two decades, the company could introduce rainwater harvesting, greywater recycling, and more efficient systems, which would contribute to more sustainable water usage. Collaborating with local government and environmental organizations will help amplify these efforts.
Infrastructure Resilience	**Upgrading water infrastructure**: To manage increasing demand, NCWSC will need to expand and upgrade its water and wastewater facilities over the next 10-20 years. Investment in new technologies, such as smart water networks and IoT-based monitoring systems, will ensure that infrastructure remains resilient to future challenges such as urban growth and climate variability. **Coordination with city planners**: To avoid competition for infrastructure, NCWSC should collaborate closely with city authorities on long-term urban planning projects. This will ensure that future developments are integrated smoothly into the existing water distribution network, reducing the risk of resource competition.
Monitoring and Adaptive Management	**Long-term data-driven management**: Continuous monitoring of water flow data will allow NCWSC to detect trends and adjust its management strategies accordingly. Over the next two decades, adaptive management frameworks should be established, allowing NCWSC to refine its operations based on real-time data and environmental conditions. **Periodic reviews and stakeholder engagement**:

Environmental Topic	Potential Cumulative Impacts and Long-Term Management (10-20 Years)
	Regular environmental and social impact assessments should be conducted every 5-10 years to evaluate the cumulative effects of the project. Transparent reporting and community engagement will foster trust and enable NCWSC to adjust its strategies as necessary to ensure sustainability.

8. Environmental & Social Management and Monitoring Plan

8.1. Introduction

The purpose of developing an Environmental and Social Management Plan (ESMP) for the proposed project is to initiate a mechanism for implementing mitigation measures for the potential negative environmental impacts and monitor the efficiency of these mitigation measures based on relevant environmental indicators. The ESMP identifies certain roles and responsibilities for different stakeholders for implementation, supervision and monitoring.

The objectives of the ESMP are:

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

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

8.2. Management Responsibilities

In order to implement the management plan, it is recommended that NCWSC, oversee environment and management aspects including pollution control, water loss control and equity access, throughout the project area. The supervisor would also be expected to co-ordinate and monitor environmental management during construction and provide monitoring schedules during operations. Other recommended participants could include the respective NCWSC Environmental Officers, Water Offices and the Physical Planning Offices among others.

8.3. Environmental Management Guidelines

Upon completion and commissioning of the project, it will be necessary to establish appropriate operational guidelines on environmental conservation and social linkages to enable the operations' management to identify critical environmental and social issues and institute appropriate actions towards minimizing associated conflicts. Basically, the guidelines should cover among other areas environmental management progammes, standard operation procedures, compliance monitoring

schedule and environmental audit schedules as required by law. Social harmony of the facilities and associated component will be achieved through collaborations with the stakeholders or community management committees at various water points. It is recommended that the communities' in-charge of the water intervention facilities must have an accountable structure. While appreciating that there is an existing social framework, it should be recognized that they lack in organizational capacity to manage water facilities at a commercial level. The groups will therefore, need to get re-organized to provide for clear responsibilities, documentation and record keeping as well as resource accounting.

8.4. Environmental Education and Awareness Raising

NCWSC field staff and the beneficiaries will need to understand the basic environmental, water use principles associated with the projects. In this regard, therefore, the following steps will need to be considered.

(i) Creation of liaisons on all matters related to environment, utilization of water, issues of the water resource development,
(ii) Encourage contribution of improvement ideas from the beneficiaries on specific issues related to the management of the facilities, water accessibility, water availability, sharing, etc. say through a questionnaires or direct interactions,
(iii) Establish initiatives that would instil a sense of ownership of the facilities and related components to all beneficiaries,

8.5. Decommissioning Process

Due to the long-term life of the intervention facilities and related components, a decommissioning audit will be undertaken before the process for any of the components commences, following a notice to decommission. The decommissioning process will be guided by a comprehensive decommissioning plan developed through the decommissioning audit process. However, the following features will need to be decommissioned upon completion of the works.

(i) Contractor's installations that will need to be removed without compromising on the safety and general welfare of the immediate residents. Special care to be given to associated wastes and dust emitted in the process,
(ii) Materials stores that will comprise fresh materials and used items. Each category will be moved safely out of site ensuring minimal or no impacts to the related environment and social setting,
(iii) Wastes and debris holding sites will be cleared with maximum re-use of the debris either on surfacing the passageways or other grounds such as schools and church compounds.

8.6. Environmental & Social Management Plan (ESMP)

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

i. Installation Phase ESMP.

ii. Operation Phase ESMP; and

iii. Decommissioning Phase ESMP.

Table 20: ESMP

Activity / Issue	Action required	Responsibility	Parameters to monitor	Monitoring Means	Frequency of monitoring	Estimated cost (Kshs)
Construction Phase ESMP						
Vegetation Disturbance	- Conduct thorough site assessments to identify sensitive areas and plan access routes to minimize disturbance - Utilize existing access paths and minimize new clearing to preserve natural vegetation - Limit vegetation clearing to only what is necessary for equipment placement and access - Handle soil and vegetation carefully to avoid unnecessary disturbance and ensure minimal impact on root systems	Contractor	-Area of vegetation cleared -Condition of vegetation in adjacent areas	-Visual inspections -Photographic documentation	Weekly during installation	10,000
Waste Disposal	- Provide waste collection bins at designated points on site for purposes of waste segregation - Collect all solid waste at a central location and dispose of at an approved disposal site - No dumping within the surrounding area, only at designated disposal sites - Segregate waste and dispose/recycle appropriately - Prepare a comprehensive Waste Management Plan	Contractor	- Waste segregation practices - Waste collection and disposal records - No. of unauthorized dumping incidents	-Visual inspections -Review of waste management records	Monthly	10,000
Noise & Air Pollution	- Select and use equipment designed to operate at lower noise levels - Restrict noisy activities to daytime hours - Inform local communities about the project schedule and potential noise impacts	Contractor	- Noise levels at sensitive receptors - Dust levels at site boundaries	-Noise and dust monitoring -Community feedback	Weekly	5,000

Activity / Issue	Action required	Responsibility	Parameters to monitor	Monitoring Means	Frequency of monitoring	Estimated cost (Kshs)
	- Implement dust control measures such as water spraying or using dust suppressants					
Soil Compaction	- Designate specific routes for machinery to minimize soil disturbance and compaction - In areas where soil compaction is detected, use soil aerators or subsoilers to alleviate compacted layers and restore soil porosity - Replant native vegetation and monitor disturbed areas to ensure successful recovery	Contractor	- Soil compaction levels - Vegetation recovery in disturbed areas	-Visual inspections - Soil testing	Monthly	5,000
Invasive Species	- Conduct periodic monitoring of sensitive areas to identify invasive species early - Prioritize replanting with indigenous species to outcompete invasive plants	Contractor	- Presence of invasive species - Success of native plant re-establishment	-Visual inspections -Photographic documentation	Quarterly	5,000
Temporary Habitat Disruption	- Conduct installation work during seasons when local wildlife is less vulnerable - Mark and protect sensitive habitats to minimize disruption to wildlife - Restore disturbed habitats promptly, such as replanting native vegetation	Contractor	- Condition of sensitive habitats - Evidence of wildlife presence/displacement	-Visual inspections -Photographic documentation	Monthly	5,000
Total						**40,000**

Impact	Mitigation/ incremental impact measures	Responsible for implementation	Monitoring	Periodicity	Estimated Amount (Kshs)
Operation Phase					
Water system leaks and loss of pressure	• Ensure installation meets applicable standards and industry best practice; • Conduct regular inspection and maintenance; • Implement a leak detection and repair program (including records of past leaks and unaccounted- for water to identify potential problem areas); • Consider replacing mains with a history of leaks or with a greater potential for leaks because of their location, pressure stresses, and other risk factors.	NCWSC	Verify the degree of compliance in implementing the proposed mitigation measures	Weekly	Use internal capacity
Discharge of flushed water that may contain suspended solids and residual chlorine into the environment	• Where possible, flushed water should be carried in bowsers for discharge into a municipal sewerage system. • Discharge the flush water into a separate storm sewer system with storm water management measures such as a detention pond, where solids can settle, and residual chlorine consumed before the water is discharged; • Where water is flushed into the environment, erosion should be minimised during flushing by avoiding discharge into areas that are susceptible to erosion and spreading the flow to reduce flow velocities.	NCWSC	Verify the degree of compliance in implementing the proposed mitigation measures	Quarterly	Use internal capacity
Exposure of water to pathogens from storage facilities and from external sources	• Construct, operate, and manage the water distribution system in accordance with applicable national requirements and internationally accepted standards. • Construct and maintain the distribution system so that it acts as a barrier and prevents external contamination from entering the water system	NCWSC	Carry out analysis of physico-chemical and bacteriological parameters for water quality.	Quarterly	Operation costs

Impact	Mitigation/ incremental impact measures	Responsible for implementation	Monitoring	Periodicity	Estimated Amount (Kshs)
	by: ➢ Inspecting storage facilities regularly and rehabilitate or replace storage facilities when needed. This may include draining and removing sediments, applying rust proofing, and repairing structures ➢ Testing material, soil, and water quality and implementing best practices to prevent corrosion, such as cathodic protection ➢ Preventing cross-connections with sewerage systems. • Maintain adequate water pressure and flow throughout the system by: ➢ Implementing a leak detection and repair program ➢ Reducing residence time in pipes ➢ Maintaining positive residual pressure of at least 20 pounds per square inch (psi) ➢ Monitoring hydraulic parameters, such as inflows, outflows, and water levels in all storage tanks, discharge flows and pressures for pumps, flows and/or pressure for regulating valves, and pressure at critical points, and using system modelling to assess the hydraulic integrity of the system. • Prevent introduction of contamination from the distribution system itself by: ➢ Minimizing microbial growth and biofilm		Verify the degree of compliance in implementing the proposed mitigation measures		

Impact	Mitigation/ incremental impact measures	Responsible for implementation	Monitoring	Periodicity	Estimated Amount (Kshs)
	development (e.g. by ensuring adequate residual disinfection levels). Collect samples from several locations throughout the distribution system, including the farthest point, and test for both free and combined chlorine residual to ensure that adequate chlorine residual is maintained ➢ Using installation materials that do not contribute to release undesirable metals and other substance or interact with residual disinfectants.				

Decommissioning Phase						
De-mobilisation	The site is to be cleared of all installation materials, including litter prior to hand over.	Contractor, NCWSC	• Evidence of clearance of site	Observation at the end of installation phase	One off at the end of installation phase	To be determined
	Fences, barriers and demarcations associated with the installation phase must be removed from the site.	Contractor	• Evidence of removal fences, barriers and demarcations associated with installation phase	Observation at the end of installation phase	One off at the end of installation phase	Ditto

8.7. Environmental & Social Monitoring

The management of environment and social impacts and consequences of every proposed project is a regular, all purpose and continuous activity, which commences from the beginning of the project and the initial plan of its establishment, and until termination of the project life and thereafter. The performance of this management rests on an appropriate administrative structure, known as the environmental & social management unit, which is a section of the management and operation aggregate of the plan. Outlooks and the principals of environmental conservations must proceed in all the various angles of management.

The objectives of this plan is to render suitable methods and perform effective measures of acceptable costs, to reduce the destructive impacts arising from the establishment and operation of the proposed project in regards the regional environment and its accordance with the standard and desirable conditions, in rendering monitoring and control plans, public participation and environmental training. Hence, in this section, in addition to rendering the plan for each monitoring index, by specifying the responsible or relative organizations and estimating the organizational and implementation requirements, conditions for the execution of environmental plan are alleviated.

8.7.1. Internal Monitoring

Though most of the mitigation measures will be implemented by the contractor as per contract condition, the overall responsibility related supervision and monitoring of ESMP implementation and compliance of HSE requirement lies with project proponent. The evaluation of compliance of ESMP implementation and HSE management will be guided by Construction ESMP (CESMP) to be prepared by the contractor based on site specific conditions before start of construction and approved by Project proponent. The CESMP shall comprise of relevant sub-plans such as Erosion control and site restoration, biodiversity protection, Air Quality, Noise & Vibration, Waste Management, Traffic Management apart from Health & Safety Plan and emergency preparedness plan in line with mitigation measures suggested in ESIA.

The objective of internal monitoring and audit will be:

- To identify gaps in implementation of the ESMP by the contractor
- Ensure compliance to legal requirements provided in EMCA 1999
- Guide the contractor's management of HSE requirements from time to time where unforeseen impacts are encountered

The proponent will continue the monitoring process during the operation and decommissioning phases of the projects ensuring that the minimum allowable Environmental parameters are maintained. These parameters include,

1. Workforce Training

The contractor shall provide induction of workers to ensure they are adequately trained on HSE management on top of the specific skills required for their job description. The proponent should

monitor induction training and toolbox talks records regularly. The contractor shall also train site specific HSE supervisors to enforce the trainings.

2. Monitoring of Accidents Prevention/ Health Management

The Proponent will procure services of an independent environmental, health and safety (HSE) consultant to undertake frequent audits on the contractor during project implementation. The consultant will undertake regular site inspection visits (frequency shall be agreed upon with Contractor) to monitor how the contractor is managing his work force and activities with regard to accident prevention and health management.

The contractor's safety manager on the other hand shall ensure that appropriate safety signage and personal protective equipment is availed to the construction workers at all times.

Indicators that will be used in evaluation of accident prevention and health risks management includes.

- Provision of adequate personal protective equipment to workers at all phases of the project
- Presence of displayed safety warning signs and markings at active sites and on tower structures on completion
- Adequate human waste disposal and sanitation facilities are present at active sites
- Community awareness on safety risks associated with the project
- Compiled records of actual accidents/ incidences that have been encountered
- Report health cases that are related to the project

3. Soil Erosion and Conservation Monitoring

Construction activities such as excavations and transportation of construction materials within the project areas may lead to loose soil structure thereby resulting in erosion. The contractor will be responsible for ensuring that appropriate soil conservation and erosion prevention measures are practiced throughout the construction phase.

4. Noise Levels Monitoring

Emission of noise is expected during the construction phase. Major sources of noise will be from machinery such as excavators. However, the noise levels may not be an issue as emission is site specific and low Regular monitoring of these noise levels by the Contractor should be conducted to ensure that they recommended limits are not exceeded. Consultation with the neighbouring communities will aid in establishing the extent of this impact

5. Air Quality Protection

Dust and emissions from machinery should be monitored by the contractor and adequate measures employed in ensuring air quality. This will include watering down of active sites/ roads and other areas generating the dust or maintenance of machinery with excessive smoke emissions. In addition, where excessive wind is observed, dust generating activities can be halted for some time.

6. Solid and Liquid Waste Management Monitoring

Monitoring of waste generated at both the site and workers campsite during the construction phase shall be done by the contractor's HSE manager. He will ensure that;

- Records of the type and waste amounts generated at the sites is kept
- Adequate and separate waste management facilities are provided at each site. The equipment shall be such that it aids in waste segregation
- All generated waste is bound to the specific sites boundary and littering of the environment is discouraged
- Human waste disposal facilities are provided at each site
- Collected waste is properly disposed away from site at dumping sites approved by the county government

7. Biodiversity monitoring
    - Monitor invasive species as they appear for timely control and physical removal

8.7.2. External Monitoring

The Kenyan government's environment management body NEMA shall issue approval for the implementation of the proposed project. Moreover, it shall ensure that the provided mitigation measures are implemented in implementation of the project. NEMA shall offer oversight of the implementing bodies through review of monitoring reports. The proponent shall therefore provide the agency with annual progress reports on environment, health and safety management.

8.7.3. Environmental Audits (EA)

Environmental audits during all phases of the project implementation are key in ensuring full compliance to ESMP requirements. The goal of EA will be to establish if the proponent is complying with environmental requirements and enforcing the existing legislation. The purpose of EA is to determine the extent to which the activities and programs conform to the approved environmental management plan. The Consultant recommends that an independent consultant will be sourced to oversee environmental management throughout the construction phase and during the operational phase and decommissioning phase. He will provide Environmental audits in line with NEMA's requirement.

8.8. Grievance Management/Redress Mechanism

A Grievance Redress Mechanism GRM has been established to receive and facilitate resolution of complainants (project affected people, local community and workers) concerns and grievances regarding the project's performance during the construction, operation and decommissioning phases of the project. The mechanism should be able to address the concerns and complaints in a timely fashion by using an easy to understand, transparent and effective grievance redress process that is readily accessible to all segments of the project area population including workers and community members.

This GRM has been developed with the intention of providing an effective tool for early identification, evaluation and resolving of grievances during the full cycle of the project. The range of issues that are likely to arise requiring this process include:

- Unfair or biased job allocations.
- Poor management of construction activities.
- Compensation payment for services rendered.
- Failure to fulfil commitments.
- Interference with public utilities.
- Accidents due to inappropriate planning of vehicle movement.
- Conflicts between migrant workers and local communities.
- Disturbance due to excessive noise or other nuisance during construction or operation.
- Unfair treatment of workers or unsafe working conditions.
- Issues related to Gender (GBV, SEA and VAC).
- Any other issues related to environment, health and safety issues.

Since the range of issues is diverse, the GRM should be comprehensive enough to tackle complaints without any costs and also provide privacy to complainants especially gender issues.

An effective GRM should have the following:

- Identification of personnel (Grievance Officer who will be receiving and recording grievances at the site level).
- Process of evaluating grievances and determining which process to follow.
- Process of making decisions on providing resolutions.
- Notification procedures.
- Timeframes within which issues are to be resolved.
- Procedure for escalation of issues that cannot be resolved at the site level.

Publicizing of the GRM

The developed GRM should be publicized to ensure that all stakeholders (workers, community members, contractor, project management etc) are aware of the existence of the GRM and how it shall be used to resolve grievances.

Grievance Redress Committee (GRC) and Meeting Calendar

The GRC

The developer shall facilitate the formation of a two-tier Grievance Redress Committee (GRC) both at village level and project level. This committee shall comprise of the following representatives:

Level 1

- Affected persons
- Location Chief
- A Representative from the Community (Male and Female)
- Community liaison officer
- Youth Representative

Level 2

- Project manager/GRC officer
- Community liaison officer
- EHS Officer;
- Contractor EHS representative

GRC Meeting Calendar

The GRC shall roll out its meeting calendar to the stakeholders so that they are aware of when to expect their issues resolved. It should endeavour to meet as often as possible so that grievances do not remain unresolved for a long period. Other than the issues that the GRC Officer will be able to provide immediate solution when the complainants come lodge their complaints, the registered complaints will take between 21-45 days for resolution. It is therefore suggested that the GRC meets monthly or as dictated by any registered urgent grievance. In case complainant/ appellant is not satisfied with the decision of GRC they can approach court of law for resolution.

Special Representatives in the Committee

The proponent to consider having special representatives in the grievance committee (Female Members) who can deliberate and resolve grievances touching on gender issues like sexual harassment, rape etc). This will help in safeguarding privacy of victims of rape and sexual harassment. It will also provide confidence to victims to come forth and register their complaints no matter how personal.

The Committee shall have the following functions:

- To keep a live register of all grievances lodged by complainants.
- To provide support to affected communities on issues arising from environmental or social impacts.
- To record grievances of the affected community by categorizing and prioritizing them, and providing solutions within a stipulated time period.
- To report to the aggrieved parties regularly and in a timely fashion, developments regarding their grievances and decisions of the GRC.

- To escalate any unresolved issues to the management in a timely fashion so that solutions are reached in good time.

Training Workshop

The project proponent shall hold a training workshop for stakeholders (workers and community members) to educate and sensitise them regarding the operations of the GRM. This training shall be carried out before rolling it out so that the team is ready to receive and resolve grievances immediately stakeholders get to know of its existence.

Receiving and Recording of Grievances

The Grievance Officer (Proponent E&S Officer) shall receive anonymously record the grievance in a grievance form and assess the type of grievance.

If it is an issue that can be resolved immediately then a solution shall be provided by the Grievance Officer. If it requires deliberation of the GRC then the Grievance Officer shall indicate the timeframe when the complainant should expect the issues to be resolved.

The Grievance form that shall be used to record grievances shall contain the following information:

- Unique Serial number of the complaint.
- Date of receipt of the complaint.
- Particulars of the complainant (Name, Address, Contact details).
- Nature of Complaint (Subject of the complaint, Brief description of the complaint, where the issue occurred and when, suggestion on what the complainant wants done).

GRC Reports

The GRC shall prepare detailed monthly reports that shall be submitted to the management. The reports shall contain the following among other issues:

- The grievances recorded during the reporting period
- The resolutions provided to the complainants
- The period taken to resolve the issue
- The response received from the complainant after receiving feedback from the GRC
- Escalated Grievances and the timeframe taken to provide solution from the management
- Classification and Analysis of the grievances for lessons learnt and improvement of project operations
- Minutes of all the meetings of the GRC.

8.9. Framework for Implementation of the ESMP

The Contractor will be expected to address all aspects of the construction activities in compliance with all laws and regulations, approvals, licenses and permits which are applicable to the proposed project. The Contractor shall ensure that he is familiar with the ESMP for the project. He shall prepare the work plan and strategy taking into account the relevant provisions of the ESMP. The prepared Management plans shall be reviewed and approved by Environment and Social Safeguards Officer of the project implementor.

The Contractor will also be expected to evaluate the construction activities/components and prepare appropriate project Construction Environment and Social Management Plan including:

1) Waste Management Plan.
2) Waste and Materials Management Plan.
3) Occupational Safety and Health Management Plan (OSHMP).
4) Traffic Management Plan.
5) Workers Code of Conduct.
6) Grievance Redress Mechanism.
7) Prevention and Protection Against GBV and Sexual Exploitation.

8.9.1. Institutional Framework for implementation of ESMP

Project Proponent Obligations & Responsibilities

Project proponent will maintain a monitoring and oversight capability to ensure that the contractor and its subcontractors are fulfilling their E&S obligations. Responsibility for implementing the environmental and social mitigation and monitoring actions included in the ESMP will be passed on to contractor and its constructors.

Contractor upon issue of the 'notice to proceed' (NTP).

Proponent will:

- ensure that contracts with contractor and its sub-contractors are consistent with the components of the ESMP that are within their scope of responsibility and have the capacity to fulfil these requirements.
- review CESMP, including standard environmental and social protection procedures prior to starting construction; and
- maintain oversight of their ESMP performance. A monitoring process to track the contractor's compliance with the approved CESMP will be implemented during construction phase and the results reported.

Contractor Obligation and responsibilities

During the construction phase, responsibility for many of the environmental and social mitigation and monitoring actions will be passed on to the construction contractors. In these situations, Proponent will maintain a monitoring and oversight capability to ensure that contractors are fulfilling their obligations.

Contractor and their sub-contractors will prepare a CESMP, which will include:

- Sub plans for environmental management in line with the project ESMP as well as the mitigation measures proposed in the project EIA and any conditions imposed by NEMA to the potable water networks project;
- Site specific plans to apply in the field, including EHS Plan, emergency response and contingency plans, as appropriate; and
- proposed mitigation programme for identified sensitive areas.

8.9.2. Organization Roles and Responsibilities

The Contractor will be expected to engage the following safeguards officers on a full-time basis for the period of the project.

- EHS Expert (Environmentalist).
- CLO (Community Liaison Officer – Community Representative).

Before commencement of construction process, the Contractor will be expected to show familiarity with the methodology on the implementation of Environmental and Social Safeguards.

The above officers will have the responsibility of assisting the Contractor to comply with the safeguard's requirements. Among other duties, the safeguards officers will be responsible for carrying out roles as listed in Table below.

The Safeguards Team will be reporting to the Project Manager/Supervisor on Safeguards achievements, issues and challenges on regular basis.

Table 21: Roles of Safeguards Officers Engaged by the Contractor

Title/Designation	Duties/Roles
EHS Officer	• Assist the Contractor to Develop CESMPs • Supervision of Health and Safety and implementation of Tool Box Talks • Implement Environmental Safeguards in the project to protect people and the environment • Ensure timely approvals and permits, wherever required • Coordinate environmental compliance in the project • Oversight waste management • Ensure environmental information reaches team leaders • Carry out surveillance on safety issues and safety training

	• Interface between the Contractor and the workers and Community • Support on social safeguards and helps mobilize and organize Community and other stakeholder meetings. • Record incidences taking place during construction work and liaises with the Project Supervisor to address the emerging issues. • Record Grievances • Assist the Grievance/EHS Officers with communicating safeguards issues to the community • Attend Grievance Redress Committee (GRC) Meetings • Preparation of Environmental, Health and Safety Reports

8.9.3. Training, Education and Competency

Site Supervisor shall ensure that every employee/worker (direct or contractual) is aware of the EHS risks associated with the work being carried out at the site and is trained and competent in the relevant work practices and maintenance procedures. Training needs shall be identified and executed to ensure all staff are provided with adequate safety training for all levels of employees. The safety training should provide staff with the knowledge and skills necessary for organizing and managing occupational safety and health programmes. The team leaders with leadership skills and knowledge to lead should be supported to implement and apply occupational safety and health activities. Workers with the knowledge, skills and right attitudes should be encouraged/supported to enable them to work safely.

Areas that could be considered for training of various cadres of workers are:

- HSE Policy and how it applies to the workplace;
- Hazards/Risks and Emergency Response Procedures;
- Importance of Safety Induction and Toolbox Talks;
- Appropriate use of Personal Protective Equipment (PPE).

The above inductions and trainings will improve on competency of the workers and lower incidence of injury and improvement on working safely.

8.9.4. Assessment and Improvement

It is noted that often projects collect data on environment, safety and social aspects of the project however this data is never evaluated for improvement on the implementation of the ESMP. Data on injury incidences should periodically analysed considering source of injury, frequency of occurrence and whether any safety measures were overlooked so that improvements can be made on lessons learnt.

8.9.5. Incident Management

All incidences occurring within the project shall be managed through the incident management procedure that has been put in place and conforms with DOSHS. Every team that is carrying out a task must have a person appointed to be in charge. The officer in charge shall be familiar with all

incident management protocols All the procedures for different occurrences shall be documented using appropriate forms as guided by DOSHS. Team leaders shall be sensitized on the use of the forms and the required protocols of reporting incidences and timeframe in which all incidences must be reported. The incident reporting forms must always be within reach of the team leader or EHS Officer.

8.9.6. Reporting

It should be ensured that provisions for reporting incidents, accidents and dangerous occurrences during construction are promptly done using prescribed forms obtainable from the local Occupational Health and Safety Office (OHSO). The team leader or Officer in charge of a Task Team shall be inducted on the reporting protocols and requirements. The training or induction shall include:

- Procedure of making a report on incidences;
- The protocol to be followed and reporting hierarchy;
- How the forms should be filled (without errors or omissions);
- Reporting timeframe.

8.9.7. Management Review

The project Environmental and social Management and Incident reports shall be prepared and submitted on a monthly basis. Review by management shall be done on a quarterly basis and feedback given to the safeguard's teams.

8.9.8. Liaison and Communication to Stakeholders

Regular transparent communication between the project and the community and other stakeholders and vice versa is critical in building a good understanding between the parties involved. This good understanding shall be very important in managing unexpected situations that might arise during project implementation.

9. Conclusions and Recommendations

9.1. Conclusions

The Project's impact on the physical environment will be manageable, mostly short-term installation-related impacts, which will be mitigated. The report has outlined mitigation measures in the ESMP matrix in chapter 8 to be implemented during the various project phases. Given that the Environmental Assessment undertaken under this Project, and considering the Project's strong economic justification, the Project satisfactorily meets environmental protection requirements provided that the mitigation, monitoring, and reporting plans are carried out. The environmental, and social Impact Assessment (ESIA) of the proposed project has been conducted in accordance with national legislative requirement, county by-laws; World Bank Operational Policies; and World Bank Group/IFC EHS guidelines. The ESIA study has been carried out based on the site visit, baseline environmental and social condition survey including stakeholder consultation, analysis of the possible project intervention. The experts identified and evaluated potential environmental impacts associated with all aspects of the proposed project.

The key potential environmental impacts due to the project as established by the ESIA study are some Vegetation Disturbance, Waste disposal, Noise & Air pollution, Soil Compaction, Potential for Invasive Species, and Temporary Habitat Disruption, Disruption to Agricultural Activity. The economic opportunities in terms of local employment and provision of services during installation and operation phases are assessed as positive impacts. The Environmental and Social Management Plan (ESMP) has described mitigation measures for impacts specific to the project activities and also discuss implementation mechanism for recommended mitigation measures along with a monitoring plan. Implementation of the ESMP will help the proponent to comply with the national regulatory framework as well as to meet World Bank Operational Policies.

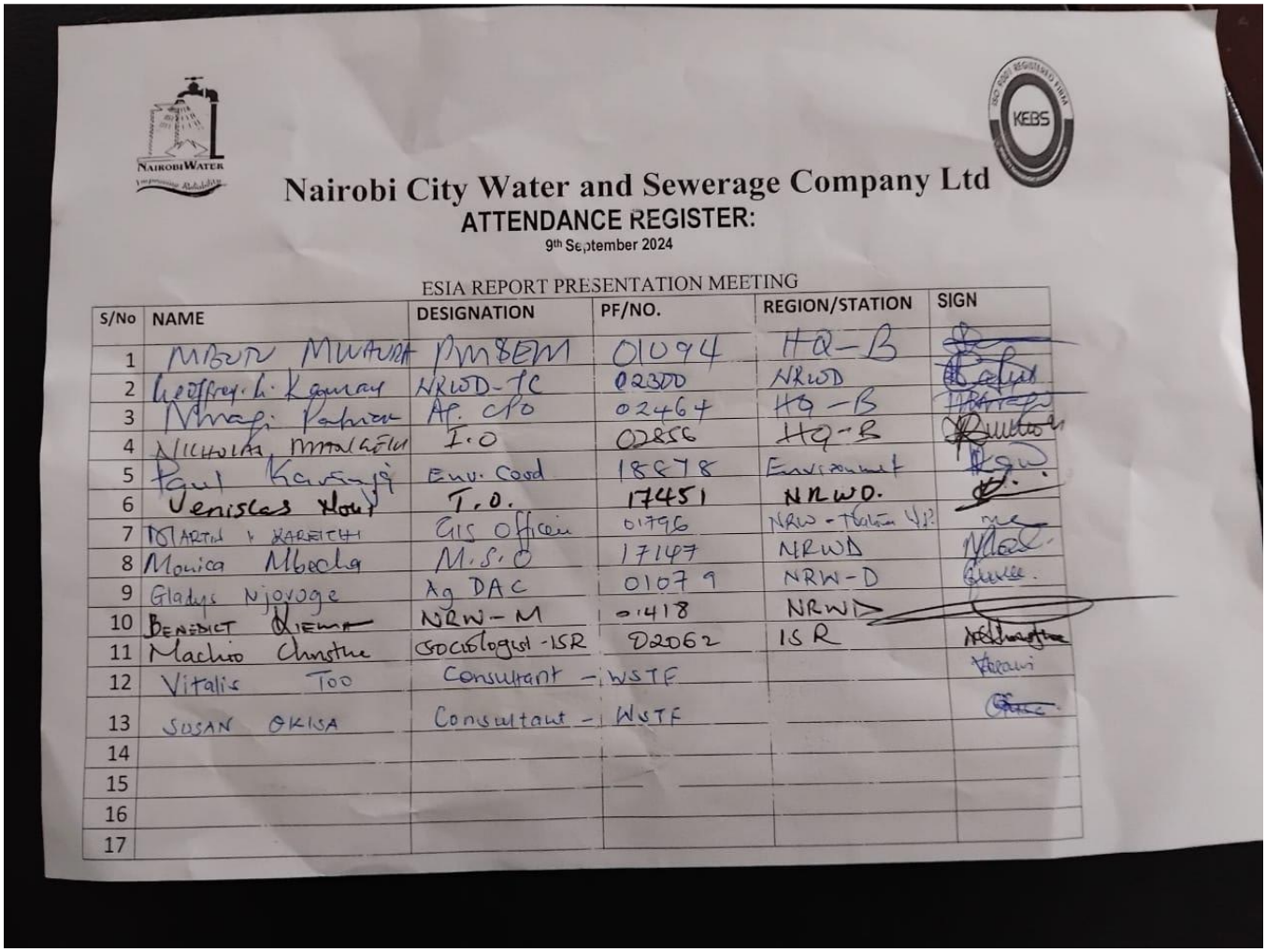
9.2. Recommendations

The following are also recommended with respect to the proposed Project.

- That strict adherence to the Environmental Management Plans should be observed;
- That any unforeseen impacts shall be immediately notified to the environmental assessor to ensure that they are immediately addressed and mitigated;
- Project Construction works to commence after approval and issuance of the license;
- The project contractor shall need to hold meetings with NWSC before commencement of installation to firm up agreements of engagement since all the works will be within company-protected area.

Appendices

Appendix 1: Attendance List for Consultation with WSP (NCWSC)



Nairobi City Water and Sewerage Company Ltd

ATTENDANCE REGISTER:

9th September 2024

ESIA REPORT PRESENTATION MEETING

S/No	NAME	DESIGNATION	PF/NO.	REGION/STATION	SIGN
1	MIGUN MUATHA	PM SEM	01094	HQ-B	
2	Geoffrey L. Kamau	NRWD-TC	02300	NRWD	
3	Mwaji Patrick	Ag. CPO	02467	HQ-B	
4	NICHOLAS MWANGEKI	I.O	02856	HQ-B	
5	Paul Kavinji	Env. Coord	18678	Environment	
6	Venisclas Mout	T.O.	17451	NRWD.	
7	MARTIN KARIITHI	GIS Officer	01796	NRW - Thika Rd	
8	Monica Mbocha	M.S.O	17147	NRWD	
9	Gladys Njoroge	Ag DAC	01079	NRW-D	
10	BENEDICT KIEMA	NRW-M	01418	NRWD	
11	Machio Christine	Sociologist-ISR	02062	ISR	
12	Vitalis Too	Consultant -	WSTF		
13	SUSAN OKISA	Consultant -	WSTF		
14					
15					
16					
17					

Appendix 2: Photos of Public Consultation with WSP NCWSC



Appendix 3: Stakeholders' consultations Questionnaires Responses

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED INTERVENTIONS FOR NAIROBI CITY WATER AND SEWERAGE COMPANY FOR THE INSTALLATION OF INSERTION ELECTROMAGNETIC FLOW METERS.

QUESTIONNAIRE

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1. **Details of the respondent**

   Name of respondent: ERICK OTIENO Village: KABETE

   Phone No. 0717100433 ID No. 34974423 Location NAIROBI (KABETE TREATMENT)

2. **Do you support the proposed project? YES ☐ /NO ☑ (tick one)**

   Do you have any reasons for your answer above? Please state

   It will render meter readers Jobless.

3. **Please state any positive/negative environmental and social impacts caused by the proposed project.**

   (a) Positive Impacts

   Will make work easy i.e: meter reading and Billing.

   (b) Negative impacts

   It will render meter readers Jobless.

   What would you propose as measures to mitigate the above negative impacts?

   Should be installed in areas like informal settlements where marketing assistants can't get access to meters.

   Give any relevant additional comments

   Regular maintenance of the existing meters and service would go a long way.

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Vitalis Too
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Tel: 0720283797

(Signature)

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED INTERVENTIONS FOR NAIROBI CITY WATER AND SEWERAGE COMPANY FOR THE INSTALLATION OF INSERTION ELECTROMAGNETIC FLOW METERS.

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1. **Details of the respondent**

   Name of respondent: FLORENCE MACHARIA Village: KABETE VILLAGE

   Phone No. 0715588998 ID No. 31531886 Location K. T. PLANT

2. **Do you support the proposed project?** YES ☐ /NO ☑ **(tick one)**

   Do you have any reasons for your answer above? Please state

   Lot's of people will lose their source of income.

3. **Please state any positive/negative environmental and social impacts caused by the proposed project.**

   (a) Positive Impacts

   It makes work easier.

   (b) Negative impacts

   Lots of people in water sector will have no work to be done.

   What would you propose as measures to mitigate the above negative impacts?

   The meters to be placed at places that are vulnerable for workers who read the meters (informal settment)

   Give any relevant additional comments

   N/A

(Signature)

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ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED INTERVENTIONS FOR NAIROBI CITY WATER AND SEWERAGE COMPANY FOR THE INSTALLATION OF INSERTION ELECTROMAGNETIC FLOW METERS.

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1. **Details of the respondent**

   Name of respondent: Fidel Awgo Village: .....

   Phone No. 0724000647 ID No. ..... Location Police lines

2. **Do you support the proposed project? YES ☑ /NO ☐ (tick one)**

   Do you have any reasons for your answer above? Please state

   Technology has changed. Everything is automated.

3. **Please state any positive/negative environmental and social impacts caused by the proposed project.**

   (a) Positive Impacts

   It is acceptable because customers will be able to call through phones/msgs

   (b) Negative impacts

   too much dust which might cause flu/coughs because of drilling.

   What would you propose as measures to mitigate the above negative impacts?

   Should check the time when drilling is done.

   Give any relevant additional comments

   .....

   .....

(Signature)

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ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED INTERVENTIONS FOR NAIROBI CITY WATER AND SEWERAGE COMPANY FOR THE INSTALLATION OFINSERTION ELECTROMAGNETIC FLOW METERS.

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1. **Details of the respondent**

   Name of respondent: Frank Bubali Village:.....

   Phone No. 0734773349 ID No. ..... Location .....

2. **Do you support the proposed project? YES☑/NO ☐ (tick one)**

   Do you have any reasons for your answer above? Please state

   Easy access to meter reading

3. **Please state any positive/negative environmental and social impacts caused by theproposed project.**

   (a) Positive Impacts

   - Job creation during the project
   - Reduced water revenue

   (b) Negative impacts

   - Noise pollution during drilling

   What would you propose as measures to mitigate the above negative impacts?

   Sprinkling water to prevent dust

   Give any relevant additional comments

   - Employment creation to the people living around

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Tel: 0720283797

(Signature)

Bubali

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED INTERVENTIONS FOR NAIROBI CITY WATER AND SEWERAGE COMPANY FOR THE INSTALLATION OF INSERTION ELECTROMAGNETIC FLOW METERS.

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1. **Details of the respondent**

   Name of respondent: MR. MALIKA ROTAS Village: Kikuyu

   Phone No. 0720384864 ID No. 1920282 Location Kikuyu

2. **Do you support the proposed project? YES ☑ /NO ☐ (tick one)**

   Do you have any reasons for your answer above? Please state

   With increasing population we need to have enough water all round.

3. **Please state any positive/negative environmental and social impacts caused by the proposed project.**

   (a) Positive Impacts

   We need full time occupation hence leading to work opportunity

   (b) Negative impacts

   Health hazard.

   What would you propose as measures to mitigate the above negative impacts?

   Research need to be conducted to avoid unnecessary negative rebound.

   Give any relevant additional comments

   -

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ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED INTERVENTIONS FOR NAIROBI CITY WATER AND SEWERAGE COMPANY FOR THE INSTALLATION OF INSERTION ELECTROMAGNETIC FLOW METERS.

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1. **Details of the respondent**

   Name of respondent: FREDRICK O.OKAPES Village: .....

   Phone No. 0722-300551 ID No. 14663366 Location CENTRAL P/STATION

2. **Do you support the proposed project?** YES ☑/NO ☐ **(tick one)**

   Do you have any reasons for your answer above? Please state

   Everything is going digital Now and the Customers can Access their Meter Readings digitally.

3. **Please state any positive/negative environmental and social impacts caused by the proposed project.**

   (a) Positive Impacts

   It brings Services Nearer and Closer to the Customers through their Mobile phones/Laptops.

   (b) Negative impacts

   The Drilling of the said Water projects might bring Noise pollution & Maybe Air pollution (DUST)

   What would you propose as measures to mitigate the above negative impacts?

   They should Avail Silencer (To Top the Noise) produced by the Drilling Machines.

   Give any relevant additional comments

   .....

   .....

(Signature) .....

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1. **Details of the respondent**

   Name of respondent: Wachira Waiburuyu Village: Kabete

   Phone No. 0720397905 ID No. 28736449 Location Nairobi

2. **Do you support the proposed project?** YES ☐ /NO ☑ **(tick one)**

   Do you have any reasons for your answer above? Please state

   loss of jobs that are done manually will be automated. Meaning operations will be interrupted.

3. **Please state any positive/negative environmental and social impacts caused by the proposed project.**

   (a) Positive Impacts

   ⇒ Making work easier by machines and not manually.

   (b) Negative impacts

   ⇒ Loss of job opportunities to the manual and technical workers.

   What would you propose as measures to mitigate the above negative impacts?

   Create an automated facility that will also create job opportunity to manual and technical workers

   Give any relevant additional comments

   Consider Our Voices.

(Signature) ----------

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1. **Details of the respondent**

   Name of respondent: Margaret Mwashumba Village: .....

   Phone No. 0757101516 ID No. 10042377 Location Police lines

2. **Do you support the proposed project?** YES ☑ /NO ☐ **(tick one)**

   Do you have any reasons for your answer above? Please state

   Sufficient and accessible flow of water.

3. **Please state any positive/negative environmental and social impacts caused by the proposed project.**

   (a) Positive Impacts

   - Adequate flow and ease.
   - Job creation for the youth.

   (b) Negative impacts

   - Noise pollution because of drilling.

   What would you propose as measures to mitigate the above negative impacts?

   - Should take the shortest time for completion.

   Give any relevant additional comments

   .....

   .....

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1. **Details of the respondent**

   Name of respondent: JOHN MWINGE Village: GIGIRI

   Phone No. 0729887841 ID No. 27826851 Location .....

2. **Do you support the proposed project? YES☑/NO ☐ (tick one)**

   Do you have any reasons for your answer above? Please state

   Easy access to meter boxes

   E.....

3. **Please state any positive/negative environmental and social impacts caused by theproposed project.**

   (a) Positive Impacts

   Easy access to meter reading

   .....

   (b) Negative impacts

   Air pollution

   .....

   What would you propose as measures to mitigate the above negative impacts?

   Sprinkle water before drilling.

   .....

   Give any relevant additional comments

   Create jobs.

   .....

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1. **Details of the respondent**

   Name of respondent: Benson Wambua Village: .....

   Phone No. 0723057352 ID No. ..... Location .....

2. **Do you support the proposed project?** YES☑/NO ☐ **(tick one)**

   Do you have any reasons for your answer above? Please state

   .....

   .....

3. **Please state any positive/negative environmental and social impacts caused by theproposed project.**

   (a) Positive Impacts

   Reduced water revenue

   .....

   (b) Negative impacts

   Open trenches

   .....

   What would you propose as measures to mitigate the above negative impacts?

   Cover open trenches after project

   .....

   Give any relevant additional comments

   .....

   .....

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(Signature)

Appendix 4: Bill of quantities



Copy of 27. Revised BoQs_23112023.xlsx

Appendix 5: NEMA practising license for the lead expert

EAE 2306 0024

FORM 7 (r.15(2))

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

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

License No : NEMA/EIA/ERPL/20304

Application Reference No: NEMA/EIA/EL/26959

M/S **Vitalis Kibiwott Too**
(individual or firm) of address
P.O. Box 990 - 00200 Nairobi

is licensed to practice in the capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert General**

registration number **1871**

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

Issued Date: 1/9/2024 Expiry Date: 12/31/2024

Signature.....

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001 : 2015 Certified