REPUBLIC OF KENYA

ATHI WATER WORKS DEVELOPMENT AGENCY

WATER AND SANITATION SERVICE IMPROVEMENT PROJECT – ADDITIONAL FINANCING (WASSIP-AF)

DEVELOPMENT OF AN INTEGRATED WATER AND IRRIGATION MASTERPLAN FOR MURANG'A COUNTY

Contract No. AWSB/WaSSIP-AF/Comp 1/CS/51/2016

STRATEGIC ENVIRONMENT AND SOCIAL ASSESSMENT (SESA) FOR AN INTEGRATED WATER AND IRRIGATION MASTERPLAN FOR MURANG'A COUNTY

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ATHI WATER WORKS DEVELOPMENT AGENCY (AWWDA)

CONSULTANT:

MIBP
CONSULTING ENGINEERS

DOCUMENT TITLE:	**STRATEGIC ENVIRONMENT AND SOCIAL ASSESSMENT (SESA) FOR AN INTEGRATED WATER AND IRRIGATION MASTERPLAN FOR MURANG'A COUNTY**

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02	21st May 2021	Final Strategic Environment and Social Assessment (SESA) for An Integrated Water and Irrigation Masterplan for Murang'a County	G.L Sakwa	E.I Muriithi	R.S. Rupra

CERTIFICATION

MANGAT I.B. PATEL (MIBP) LIMITED

Signed: Date: 20/05/2021

GODWIN LIDAHULI SAKWA
LEAD EXPERT NEMA REG NO. 2492

PROPONENT

Signed: .....Date: .....

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CHIEF EXECUTIVE OFFICER
ATHI WATER WORKS DEVELOPMENT AGENCY

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FINAL STRATEGIC ENVIRONMENT AND SOCIAL ASSESSMENT (SESA)

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LIST OF ABBREVIATIONS& ACRONYMS

AEZ	Agro Ecological Zones
AWWDA	Athi Water Works Development Agency
EMCA	Environment Management and Cordination Act
ESIAs	Environment and Social Impact Assessment
CECM	County Executive Committee member
CoK	Constitution of Kenya
CITES	Convention on International Trade on Endanged Species
CIDPs	County Intergrated Development Plans
CFA	Catchment Forest Associations
EFR	Environment Flow Releases
FAO	Food and Agricultural Organisation
KWS	Kenya Wildlife Services
KFS	Kenya Forest Services
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
MEA	Multi Lateral Agencies
MUWASCO	Murang'a Water and Sanitation Company
MUSWASCO	Murang'a South Water and Sanitation Company
MDGs	Mellinium Development Goals
MDA	Ministries Departments and Agencies
NEP	National Environment Policy
NEAP	National Environment Action Plan
NIB	National Irrigation Board
NEMA	National Environment Management Authority
NLC	National Lands Commission
IRTI	Upper Respiratiory Track Infection
RAPs	Ressettlement Action
SEA	Strategic Environement Assessment
SESA	Strategic Environment and Social Assessment
SDGs	Sustainable Development Goals
SoK	Surveys of Kenya
RGS	River Gauging Station
TARDA	Tana River Development Agency
WASSI -AF	Water and Sanitation Services Improvement Project – Additional Financing
WSP	Water Services Provider
WRA	Water Resources Agency
WRUAs	Water Resources Users Associations

EXECUTIVE SUMMARY

E. EXECUTIVE SUMMARY

E.1 Introduction

The Government of Kenya (GoK) and Athi Water Works Development Agency (AWWDA) in association with the International Development Association (IDA) under the Water and Sanitation Service Improvement Project-Additional Financing (WaSSIP-AF), is undertaking the Development of an Integrated Water and Irrigation Master Plan for Murang'a County.

The goal of the assignment is to develop a robust, flexible Water Source(s) Development Strategy that ensures security of Water Supply to Murang'a County and meets the expected growth in both Domestic and Irrigation Water Demands within the County over the Medium Term (Year 2045). In view of the increasing pressure on existing Water Sources, it is important that the Masterplan prepares an Investment Schedule for both short term and medium - term needs, required to address the Water Supply Deficit as well as the growing Irrigation Requirement.

The Contract for Consultancy Services for carrying out the "Development of the Integrated Water and Irrigation Master Plan for Murang'a County" was signed on 20th December 2017 between Athi Water Works Development Agency (AWWDA) and the Consultant, Mangat, I.B. Patel (MIBP) Ltd. with Effective Date of Commencement of Services being 15th January 2018.

This report presents Strategic Environment and Social Impact Assessment (SESA) for likely impacts and mitigation measures for Development Strategies 1-5 discussed in the Integrated Water and Irrigation Master Plan for Murang'a County. The design of the SESA Study has been informed by the National Guidelines issued by NEMA in 2011. Additionally, the SESA Scoping Report was approved by NEMA on the 29th March 2021 (Copy Attached as Appendix 1).

E.2 Water Resources Development Strategies

The *Overall Water Resources Development Strategy Report* prepared as a separate report under this consultancy presents tasks for development of strategies for Water Supply and Water Resources development as summarized below.

(i) Development of Strategies for phased Water Sources Development in 5year stages
(ii) Development of Strategies for Bulk Water Supply to Target Areas and conveyance of Irrigation Water from selected sources to identified Irrigation Schemes
(iii) Economic and Financial Analysis of Development Strategies for Integrated Water Services Development
(iv) Sensitivity and Risk Analysis
(v) Multi-Criteria Analysis and Logical Framework for Integrated Water Services Development.

Under the study, 10Nr. potential areas were identified as suitable Irrigable Areas within Murang'a County, for consideration in formulation of development strategies for meeting potable Water and Irrigation demands within the Study Area up to the ultimate planning

horizon (Year 2045). The identified areas are within the 1.5 km buffer distance on major riverbanks (Mathioya, Sabasaba, Maragua and Thika Catchment) as detailed in chapter 2 of this Report.

Therefore, 5Nr. Strategies have been formulated for Water Resource Development for Murang'a County, to bridge the current deficit in Water Supply and meet the projected future demands for Potable Water and Irrigation Requirements up to the Ultimate planning horizon (Year 2045).

The proposed Strategies are as follows: -

(i) Strategy S1; Development of Irati 3 Dam and Mitubiri Wellfield
(ii) Strategy S2; Development of Kayahwe 4 Dam and Mitubiri Wellfield
(iii) Strategy S3; Development of Thika 3A Dam and Mitubiri Wellfield
(iv) Strategy S4; Development of Thika 3A Dam
(v) Strategy S5; Development of Maragua B Dam and Mitubiri Wellfield

A Multi-Criteria Analysis was carried out on formulated Strategies for Development of sources to meet Water and Irrigation Demands for Murang'a County up to the ultimate (Year 2045) planning horizon as summarized below.

(i) Ranking 1: Strategy S3 – Construction of Thika 3A Dam and Development of Mitubiri Wellfield
(ii) Ranking 2: Strategy S4 – Construction of Thika 3A Dam
(iii) Ranking 3: Strategy S5 – Construction of Maragua B Dam and Development of Mitubiri Wellfield
(iv) Ranking 4: Strategy S2 – Construction of Kayahwe 4 Dam and Development of Mitubiri Wellfield
(v) Ranking 5: Strategy S1 – Construction of Irati 3 Dam and Development of Mitubiri Wellfield.

E.3 The Approach and Scope of SESA

Specific Objective of the SESA

The goal of the Project is to develop a robust, flexible Water Source(s) Development Strategy that ensures security of Water Supply to Murang'a County, that meets the expected growth in both Domestic and Irrigation Water Demands within the County over the Medium Term (Year 2045) in line with aspirations of the Economic Pillar to Vision 2030.

This goal defines the specific objective of the SESA which are to identify the potentially significant environmental and social issues relating to the Master Plan that will need to be addressed as summarized below.

i) To identify linkages between environmental protection and economic growth in areas to be influenced by the strategies for Water Resource Development for Murang'a County.
ii) To assess likely significant effects of development of the strategies on the natural and human environment in the areas influenced by the strategies.
iii) To formulate a set of mitigation measures required to address these concerns

iv) To recommend mechanisms for reducing environmental and social costs associated with achievement of the economic goals of strategies including measures that will enable future adjustments to maintain and promote sustainable and equitable growth in response to anticipated development of water resources strategies presented in the Master Plan.

Screening Stage

The screening process was undertaken to determine the potential impacts of the Water and Irrigation Master Plan for Murang'a Town on the Environment. The process of Environment and Social screening of potential Impacts likely to be triggered by the plan involved review and applicability of the assessment as detailed under in the SEA Guidelines of 2011 sub section (3.1) on Screening.

The SEA Guidelines 2011 and World Bank Safeguard Policies requires analysis of environment and social Impacts based on observed triggers, a decision is therefore required to be made on the scale of Impact Assessment required depending on the category of the Project A, B or C. The Environment and Social Risk assessment involved use of Environmental and Social Screening matrix developed for the Projects under this consultancy. Findings of screening exercise are presented in **Sub-section 8.1** on **Page 8.1** of this Report.

Scoping Stage

The scoping stage was essential in determining; **(i)** the geographical area of influence, **(ii)** nature of stakeholder to be included in the assessment and **(iii)** significance of impacts likely to be triggered by the proposed water development strategies.

The strategies for Water Resource Development for Murang'a County have been developed within Thika, Sabasaba, Maragua and Mathioya River Catchment. Therefore, the catchment was the focus of the scoping study which covered impacts related; physical, biological, socio economic and cultural environment.

The scoping process involved identification of significant environmental and social issues through preliminary field assessment, interviews and discussions with stakeholders Through the scoping assessment the following activities were undertaken:

(i) Field visit to the proposed dam Sites, intake sites, water treatment sites and irrigation fields
(ii) Literature review of technical reports and baseline data which included the following Reports among others.
(iii) Initial and broad assessment of the Project
(iv) Determination of geographical coverage
(v) Identification of relevant Stakeholders (interested and affected parties)
(vi) Significant impacts (areas of study) and the levels of detail required.

The scoping procedures and methods adopted in this assessment was through the use of matrices overlays (Leopold Matrix), filed observation and case comparisons to establish cause-effect links between different specific plans or programmes or to identify the environmental implications of more general policies or strategies. Further, scoping meetings with stakeholders resulted in a revision of the scope or focus of the SESA and

improvements. Findings of scoping exercise are presented in **subsection 8.2** on **Page 8.3** of this Report.

Baseline Data Collection

In order to understand the existing baseline environmental and social conditions in the area, a variety of data collection methods were undertaken mapping of sensitive receptors. The physical evaluation of the Project area was carried out with specific focus on the environmental and social issues related to 5Nr. Strategies formulated for Water Resource Development for Murang'a County. Baseline data was collected as per the National Guidelines for SEA in Kenya (NEMA, 2011).

(i) Physical environment - including climate, air quality, water resources and water quality, noise, topography, soils, geology, hydrology including risks of natural disasters.
(ii) Biological conditions - biodiversity, ecology and nature conservation in which issues of endangered species, protected ecosystems, habitat, species of commercial importance, invasive species and their impacts are assessed.
(iii) Social-economic conditions and human health – including archaeology and cultural heritage landscape and facial aspects, recreational, social-economic aspects, land use, transportation, infrastructure, agricultural development, tourism, and human health.

Detailed methodology on data collection and field surveys for the above narrated environmental variables is presented in **sub sections 1.5** on **Page 2-19.**

Impact Identification

The environment and social impact identification and analysis was done using the Leopold matrix, this method is an environment impact assessment method pioneered in 1971 by an Environment Researcher Called Leopold. The matrix is a grid that is used to identify the interaction between project activities, which are displayed along one axis, and environmental characteristics, which are displayed along the other axis. This information is provided in **sub section 1.6** on **Page 2-20.**

E.4 Stakeholder Consultation in the SESA

The purpose of Stakeholder meetings at Scoping was to sensitize stakeholders regarding the Scoping Process and get their concurrence on core issues identified for investigation in the detailed SESA. Essentially, it is comments from the Stakeholders at this stage which informed the Terms of Reference for the Detailed SESA Study.

Modalities for engagement: Upon stratification, all stake-holders categories were approached and arrangements for engagement made. Engagements took any participatory methods such as Key Informant Interviews, Focus Group Discussions and Formal Meetings as the need arose.

The approach of stakeholder identification and consultation in the SESA applied three core criteria as follows:

(i) Stakeholders with fundamental right holder to strategic resources in the Masterplan area.

(ii) Stakeholders with legal mandate within target jurisdiction to safeguard resources. Stakeholders identified under this category include those in National Government, County Government and State Corporations whose mandates confer jurisdiction over areas targeted Master plan area.
(iii) Stakeholders of high importance with high influence on the project
(iv) Stakeholders of High importance with low influence on the project
(v) Stakeholders of less importance with low influence on the project

Table E.1 below presents an overview of stakeholder consultations held with Key Informants in Murang'a, the outcome of such consultations is highlighted in sections below.

Table E.1: Stakeholders Consulted during SESA and Masterplan Preparation

Mode of Engagement	Target Group	Stakeholder Met	Number of Meetings
Formal meeting	Proponent	Athi Water Works Development Agency	Several
	Line Ministries	GoK Ministries (Ministry of Water and Sanitation)	Several
	County Commissioners	Kigumo, Kangema, Maragua etc.)	1
	Governor	Murang'a County	2 (County showed up in 1 meeting)
	Are MPS	Maragua and Mathioya	1
Key Informant Interviews	County Government officials	County Chief Officer Water and Irrigation	3
		County Chief Officer Lands Physical Planning	1
	Water Service Providers	Gatanga Community Water Scheme	5
		MUSWASCO	3
		MUWASCO	3
		Kahuti Water and Sanitation Company	3
		Gatamathi Water and Sanitation Company	3
	Regional Development Authorities	Water Resources Authority (WRA) (Nairobi office)	1
		Kenya Wildlife Services	1
		Kenya Forest Services	1
		NEMA	
		TARDA	1
	Research Institutions	Research mandate	1
	Plantations	Del monte, Kakuzi	1

From **Table E.2 on Page E-6**, core issues have been identified and analysed further in sections below towards informing the scope for further investigations during the detailed SESA stage as summarized below.

Table E.2: Stakeholder Stakeholder Consultations Outcome

Stakeholder	Comment Made	Engagement Concern
Athi Water Works Development Agency Ministry of Water and Sanitation	• Master Plan Inception and Progress • Ok with dam selection sites • Insisted to also look at small dams • Proposed cascading dams • Proposed HEP production on Maragua B dam	Dam Location and the need to limit displacement impacts
Kenya Wildlife Services	• Proper documentation of wildlife and flora listed under the IUCN red list protected under CITES • Undertake further engagement during actual implementation of the strategies	Ensures projects within the forest like the inlet works do not interfere with wildlife corridors. No works should interfere with flora and fauna listed under IUCN red list as provided by CITEs
Kenya Forest Services	Obtain consent to work in the protected forest reserves	Obtain consent to work in the protected forest reserves, moratorium on gazette forests still in force
Water Resources Authority (WRA) (Nairobi office)	Ok with the project objective and availed the data required	Streamflow Data Collection, ensure downstream environment reserve is maintained
All WSPs	• Promised to share any relevant information required for the study • Urged AWWDA to also look in the rehabilitation of the existing systems • On the irrigation schemes and areas being chosen, conflicts with local community members might be triggered if consultations not done adequately. • Possibility of dedication some dams for domestic water supply only • Athi Water Services Board should focus more on helping the Water Service Providers to deal with non-revenue water resulting from dilapidated transmission and distribution mains.	Continuous consultations required throughout preparation and implementation of the Plan
Murang'a County Chief Officer Water and Irrigation	Small capacity dams be given priority due to cost and time of completion. Additional locations that would be studied for dam construction include Maishathe along Mathioya River. Further consultations with the relevant stakeholders would be needed in future so as to ensure that no one is left out by the process.	The Masterplan has provided staged implementation of the preferred strategies. This will address the challenge of funding.

E.5 Key Environment and Social Impacts and Mitigation Measures

The SESA assessment identified significant environment and social areas of interest related to implementation of the Water Resources Development Strategies are presented in **Table E.3** below.

Table E.3: Environment and Social Impacts

Impact	Applicable Dam	Severity Ranking	Mitigation
Impacts on terrestrial and aquatic flora	All Dams sites	Score 52 (Medium)	✓ At the time of ESIA, a Biomass Survey will be undertaken to determine the quantity of woodlots likely to be destroyed, the report will propose appropriate offsets through re afforestation programs to be initiated within the Project. ✓ Encourage upstream community driven catchment conservation and management programs, such programs should be initiated through the Project in liaison with the Kenya Forest Services and local Forest Catchment Associations.
Downstream Environmental Flows.	Irati 3 Dam	Score 85 (High)	✓ Maintain at least steady base environment flow of the stream to sustain ecological and social requirements downstream based on the ecological flow values calculated. ✓ Irati River at RGS 4BE08 is fully exploited with only 2,590m3/day Q_{95} available, therefore, there will be a demand for full downstream Reserve Flows required until development of future storage options. ✓ Ensure compliance with water resource regulation at all times, this will be achieved through weirs and offtakes that will be able to provide variable yields depending on the volume of flow ✓ Provide mandatory buffer area for conservation of the river line and dam ecosystem through the review of riparian land ownership,
	Maragua B dam, Irati 3 Dam and Kayahwe 4 Dam	Score 52 (Medium)	
Impacts on terrestrial and aquatic fauna	All Dams sites	Score 52 (Medium)	✓ A detailed analysis of the Biodiversity Survey within the ecosystem and specifically the specific project location to be undertaken during ESIA. ✓ The project design at the abstraction weirs should take into consideration free movement of fish species and other aquatic organisms. ✓ To protect the proposed dams, intensive catchment management strategies will be developed among them, practicing re-afforestation, soil erosion control, land use control and settlement and urban development planning among other initiatives.
Sedimentation and Siltation Impacts	All Dams sites	Score 52 (Medium)	✓ A water pan (silt trap) may be established downstream of the dam which will act as a soil trap to hold the excessive silt during construction. ✓ The steep slopes surrounding the dam construction should be stabilized, compacted and strengthen to reduce on erosion and potential landslides as a result of deep cutting,

Impact	Applicable Dam	Severity Ranking	Mitigation
			drainage channels should be installed only when necessary, ✓ Encourage re-afforestation and improved farming systems upstream of the dam.
Water Quality Impacts	All Dams sites	Score 52 (Medium)	✓ Define a buffer zone for reservoir protection against siltation, waste deposit, pesticide use. ✓ Encourage re-afforestation and improved farming systems upstream of the dams ✓ Identification of point sources of water pollution from upstream farms for the purpose of management. ✓ Institute a water quality monitoring system and maintaining appropriate records on water quality, ✓ Best management practices will be utilized during site clearing and construction to minimize erosion and sedimentation
Dam Safety Impacts	All Dams sites	Score 75 (Medium to High)	✓ Review the dam design and dam construction by independent panel of experts ✓ Prepare and implement relevant plans (plan for construction supervision and quality assurance, an instrumentation plan, an operation and maintenance plan), ✓ Ensure frequent maintenance of the dam structures ✓ Ensure soil structure around the sites (Intake, dam and Water treatment sites) is protected
Land Acquisition, Displacement and other Social Impacts	All Dams sites	Score 65 (Medium to High)	✓ Land acquisition and displacement impacts will be mitigated through preparation of a detailed Resettlement Action Plan (RAP) ✓ Provision of alternative routes and water points to community members to compensate the submerged water points and routes. ✓ Appropriate compensation of all loses including loss of livelihood suffered by PAPs. ✓ Development of a labor management plan, Children Protection Strategy, and HIV / Aids control and management strategy at Project construction period.

E.6 SESA finding and Recommendations

Findings of the SESA

The strategies for Water Resource Development for Murang'a County have been developed within Thika, Sabasaba, Maragua and Mathioya River Catchment. Therefore, the catchment was the focus of the SESA study which covered impacts related physical, biological, socio economic and cultural environment as detailed in **section 8.3** on **Page 8.6** of this report. The SESA Assessment identified likely environment and social risks, applicable policy, legal and institutional provisions as summarized in **Table E.4** on **Page E-9.**

Table E.4: Environment and Social Impacts Linked to Applicable Policy, Legal and Institutional Provisions

Impact	Applicable Policy and Laws	Institutions Involved
Impacts on terrestrial and aquatic flora	(i) EMCA 1999, Cap 387 including below listed regulations ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. ✓ The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160. (ii) Forest Conservation and Management Act 2016 World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources ✓ Operational Policy 4.04 – Natural Habitats	• Kenya Forest Services • Forest Conservation Associations (CFA) • Athi Water Works Development Agency • National Environment Management Authority (NEMA)
Downstream Environmental Flows.	(iii) EMCA 1999, Cap 387 including below listed regulations ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. ✓ The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160. (i) Water Act 2016 World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ Operational Policy 4.04 – Natural Habitats	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, Kahuti) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA)
Impacts on terrestrial and aquatic fauna (fish and avian)	(i) EMCA 1999, Cap 387 including regulations below ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. ✓ The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160. (ii) Water Act 2016 (iii) Fisheries development and Management Act 2016	• Kenya Wildlife Services (KWS) • Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Athi Water Works Development Agency • National Environment Management Authority (NEMA

Impact	Applicable Policy and Laws	Institutions Involved
	World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources ✓ Operational Policy 4.04 – Natural Habitats	
Sedimentation and Siltation Impacts within river channels	(i) EMCA 1999, Cap 387 including below listed regulations ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, MUSWASCO, Kahuti among others) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA
Water Quality Impacts	(i) EMCA 1999, Cap 387 including regulations below (ii) Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009 (iii) The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120. World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources	• Water Resources Authority (WRA) • Water Resources Users Associations (WRA) • Water Services Providers (MUWASCO, Kahuti among others) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA
Dam Safety Impacts	(i) EMCA 1999, Cap 387 including regulations below ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009 ✓ The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120. World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ Operational Policy OP 4.37 on Dam Safety	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, MUSWASCO Kahuti among others) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA
Land Acquisition, Displacement and other Social Impacts	Land Act 2016 World Bank Policies ✓ World Bank OP 4.12 on Involuntary Resettlement	• Water Services Providers (MUWASCO, MUSWASC, Kahuti among others) • Athi Water Works Development Agency • National Environment Management Authority (NEMA • National Lands Commission • Surveys of Kenya (SoK)

From the assessment above, it can be observed that identified environment and social impacts likely to be triggered by the proposed strategies require a coordinated approach among the relevant national or county agencies and line ministries. Therefore, an appropriate steering committee will be established by AWWDA to spearhead implementation of the provisions of the Masterplan.

SESA Recommendations

To support timely and effective implementation of environmental and social mitigation for risk identified under this SESA, the Project will ensure adequate budget is provided to carry out site specific Environment and Social Impact Assessment (ESIA) and later implement the ESMPs developed for the Sub Projects under the Master Plan.

The SESA assessment also recommends training and capacity building of environment and social safeguards personnel within implementation agencies coordinated by AWWDA to allow adequate implementation of SESA recommendations. This SESA report provides an estimate of Ksh. 10 Million to be allowed in the Master Plan for training and capacity building of staff and personnel in the agencies identified above.

The actual cost of environment and social safeguards management for each sub-Project under the Master Plan will be determined during the detailed ESIAs prepared by independent consultants. However, a provisional budget of Ksh 50million should be provided for hiring of consultancy firms required for preparation of specific Environment and Social Impact Assessment (ESIA) and Resettlement Action Plans (RAPs)

The SESA therefore recommended that these projects be subjected to Environmental and Social Impact Assessments (ESIA) in order to:

(i) Identify all potentially project-specific significant adverse environmental and social impacts of the project and recommend measures for mitigation.
(ii) Gather baseline data to inform the assessment of impacts and to monitor changes to the environment as a result of each of the projects as well as evaluate the success of the mitigation measures implemented; and
(iii) Recommend measures to be used to avoid or reduce the anticipated negative impacts and enhance the positive impacts.

For each project the ESIA should be carried out in line with Kenyan regulations (EMCA 2009 amended in 2015) as well as international best practice as defined by the World Bank Social Safeguards Policies specifically the OP 4.01 on Environment Assessment.

It is also recommended that any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations (Land Act 2012) and World Bank Social Safeguards Policies specifically the OP 4.12 on Involuntary Resettlement.

MAIN REPORT

1.0 BACKGROUND INFORMATION

1.1 General Information

The Government of Kenya (GoK) and Athi Water Works Development Agency (AWWDA) in association with the International Development Association (IDA) under the Water and Sanitation Service Improvement Project-Additional Financing (WaSSIP-AF), is undertaking the Development of an Integrated Water and Irrigation Master Plan for Murang'a County.

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1.2 Water Resources Development Strategies

The Overall Water Resources Development Strategy Report presents the output of the following tasks aimed at development of strategies for Water Supply and Water Resources Assessment.

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(v) Multi-Criteria Analysis and Logical Framework for Integrated Water Services Development.

Under the current study, 10Nr. potential areas were identified as suitable Irrigable Areas within Murang'a County, for consideration in formulation of development strategies for meeting potable Water and Irrigation demands within the Study Area up to the ultimate planning horizon (Year 2045). The identified areas are within the 1.5 km buffer distance on major riverbanks (Mathioya, Sabasaba, Maragua and Thika Catchment) as detailed in chapter 2 of this Report.

Therefore, 5Nr. Strategies have been formulated for Water Resource Development for Murang'a County, to bridge the current deficit in Water Supply and meet the projected future demands for Potable Water and Irrigation Requirements up to the Ultimate planning horizon (Year 2045).

The proposed Strategies are as follows: -

(i) Strategy S1; Development of Irati 3 Dam and Mitubiri Wellfield
(ii) Strategy S2; Development of Kayahwe 4 Dam and Mitubiri Wellfield
(iii) Strategy S3; Development of Thika 3A Dam and Mitubiri Wellfield
(iv) Strategy S4; Development of Thika 3A Dam
(v) Strategy S5; Development of Maragua B Dam and Mitubiri Wellfield

A Multi-Criteria Analysis was carried out on formulated Strategies for Development of sources to meet Water and Irrigation Demands for Muranga County up to the ultimate (Year 2045) planning horizon. **Table 1.1** on **Page 1-15** below gives a summary breakdown of the ranking of strategies, based on results of the Multi-Criteria Analysis with respective project components are provided in **Table 2-33** on **Page 2-53**

Table 1.1: A Summary Breakdown of the Ranking of Strategies

Ranking	Strategy
1	Strategy S3 – Construction of Thika 3A Dam and Development of Mitubiri Wellfield
2	Strategy S4 – Construction of Thika 3A Dam
3	Strategy S5 – Construction of Maragua B Dam and Development of Mitubiri Wellfield
4	Strategy S2 – Construction of Kayahwe 4 Dam and Development of Mitubiri Wellfield
5	Strategy S1 – Construction of Irati 3 Dam and Development of Mitubiri Wellfield

Therefore, the Social Pillar of Kenya Vision 2030 demands development in a clean secure environment for all citizens as essentially guaranteed by the National Constitution 2010 and the Environmental Management and Coordination Act (EMCA) and its 2015 revision- the Environmental Management and Coordination (Amendment) Act, the World Bank Operational Policy (OP 4.01) on Environment Assessment.

Towards ensuring compliance to both the World Bank Safeguard Polices, National Constitution and reigning environmental legislation, the Master Plan for Development of the Integrated Water and Irrigation Water Sources for Murang'a Town been subjected to a Strategic Environmental Assessment (SEA) Study conducted as per Legal Notice 101 of June 2003 and the Guidelines for Strategic Environmental Assessment issued by NEMA in 2014.

1.3 Approach and Scope of SEA

The SESA was prepared in accordance with the provisions of the National Guidelines for SEA (2011) as detailed in sub chapters below.

1.3.1 Screening Stage

The screening process was undertaken to determine the potential impacts of the Water and Irrigation Master Plan for Murang'a Town on the Environment. The process of Environment and Social screening of potential Impacts likely to be triggered by the plan involved review and applicability of the assessment as detailed under in the SESA Guidelines of 2011 sub section (3.1) on Screening. The guideline lists scenarios under which a program requires to be subjected to SESA for instance as listed below among others.

(i) The Plan is likely to result in significant environmental effects, taking into account the magnitude, duration and spatial extent of effect
(ii) The cumulative nature of the effects (i.e., the additive and synergistic effects) are likely to be significant.
(iii) Social and/or ecological systems have low resilience and high vulnerability to disturbance or impact (e.g., poor communities, sensitive ecosystems).
(iv) The Plan is likely to result in major changes in actions, behaviors or decisions by individuals, businesses, NGOs or government, that could lead to the stimulation of development of infrastructure or other changes in urban or rural land.

The SEA Guidelines 2011 and World Bank Safeguard Policies requires analysis of environment and social Impacts based on observed triggers, a decision is therefore required to be made on the scale of Impact Assessment required depending on the category of the Project A, B or C. The Environment and Social Risk assessment involved use of Environmental and Social Screening matrix developed for the Projects under this consultancy. Findings of screening exercise are presented in **Subsection 8.1 on Page 8-1** of this Report.

1.3.2 Scoping Stage

The strategies for Water Resource Development for Murang'a County have been developed within Thika, Sabasaba, Maragua and Mathioya River Catchment. Therefore, the catchment was the focus of the scoping study which covered impacts related physical, biological, socio economic and cultural environment

The scoping process involved identification of significant environmental and social issues through preliminary field assessment, interviews and discussions with stakeholders Through the scoping assessment the following activities were undertaken:

(i) Field visit to the proposed dam Sites, intake sites, water treatment sites and irrigation fields
(ii) Literature review of technical reports and baseline data which included the following Reports among others.

- ✓ Water Overall Water Resources Development Strategy Report (MIBP May 2019)
- ✓ Environment Flows in Water Resources Policies, Plans and Projects. (Rafik Haji and Richard Davis 2009)
- ✓ Aberdare Forest Reserve Management Plan (Kenya Forest Service 2010-2019)
- ✓ Kenya National Wetlands Conservation and Management Policy (2008)
- ✓ County Integrated Development Plan for Murang'a County (2013-2017)

(iii) Initial and broad assessment of the Project
(iv) Determination of geographical coverage
(v) Identification of relevant Stakeholders (interested and affected parties),
(vi) Significant impacts (areas of study) and the levels of detail required.

The scoping procedures and methods adopted in this assessment was through the use of matrices overlays (Leopold Matrix), filed observation and case comparisons to establish cause-effect links between different specific plans or programmes or to identify the environmental implications of more general policies or strategies. Further, scoping meetings with stakeholders resulted in a revision of the scope or focus of the SESA and improvements. Findings of scoping exercise are presented in **Subsection 8.2** on **Page 8-2** of this Report.

Additionally, the SESA Scoping Report prepared and approved by NEMA on the 29th March 2021 (Copy Attached as **Appendix 1**).

1.4 Detailed SESA Study

1.4.1 Objectives of SESA Study

The objective of Strategic Environmental Assessment is to systematically integrate environmental considerations into policy, planning and decision-making processes, such that environmental information derived from the examination of proposed policies, plans, programs or projects are used to support decision making by:

i) To guide policy, programme and plan proposals to ensure they are compatible with Sustainable environmental planning and management.
ii) To ensure the full consideration of alternative policy options including the do-nothing option, at an early time when an agency has greater flexibility.
iii) To enable consistency to be developed across different policy sectors especially where trade-offs need to be made as between the objectives of the policy sectors.
iv) To evaluate regional environmental impacts of multi-sectoral developments in a region over a specified time.
v) To guide investment programmes involving multiple sub-projects or sector policies.
vi) To ensure that the environmental impacts of policies that do not have an overt environmental dimension are assessed.
vii) To identify environmental impacts and opportunities of mitigation measures into programme designs during the formulation stage of programmes, and in the process enhance environmental management plans.
viii) To ensure the cumulative, indirect or secondary impacts of diverse multiple activities are considered, including their unintended consequences.
ix) To obviate the needless reassessment of issues and impacts at project level where such issues could have been more effectively dealt with at a strategic level and offer time and cost savings.
x) To provide information to decision makers by evaluating alternative options that meet proposal objectives based on the best practicable environmental options.
xi) To ensure environmental principles such as sustainability, polluter pays, and the precautionary principle are integrated into the development, appraisal, and selection of policy options.
xii) To give proper place to environmental considerations in decision making as concerns economic and social concerns, in view of the fact that in some contexts they may be traded off against each other.
xiii) To provide an early opportunity to check whether or not a proposal complies with national and international environmental policy and consequent legislative obligations.
xiv) To contribute to the establishment of context that is more appropriate to nest future development proposals.
xv) To provide a publicly available and accountable decision-making framework.

1.4.2 Specific Objective of the SESA

The goal of the Project is to develop a robust, flexible Water Source(s) Development Strategy that ensures security of Water Supply to Murang'a County that meets the expected growth in both Domestic and Irrigation Water Demands within the County over the Medium Term (Year 2045) in line with aspirations of the Economic Pillar to Vision 2030. This goal defines the specific objective of the SESA which are to.

i) To identify linkages between environmental protection and economic growth in areas to be influenced by the strategies for Water Resource Development for Murang'a County.
ii) To assess likely significant effects of development of the strategies on the natural and human environment in the areas influenced by the strategies.
iii) To formulate a set of mitigation measures required to address these concerns
iv) To recommend mechanisms for reducing environmental and social costs associated with achievement of the economic goals of strategies including measures that will enable future adjustments to maintain and promote sustainable and equitable growth in response to anticipated development of water resources strategies presented in the Master Plan.

1.5 Baseline Data Collection

In order to understand the existing baseline environmental and social conditions in the area, a variety of data collection methods were undertaken mapping of sensitive receptors.

1.5.1 Field Assessment

The physical evaluation of the Project area was carried out with specific focus on the environmental and social issues related to 5Nr. Strategies formulated for Water Resource Development for Murang'a County. Baseline data was collected as per the National Guidelines for SEA in Kenya (NEMA, 2011),

- Physical environment - including climate, air quality, water resources and water quality, noise, topography, soils, geology, hydrology including risks of natural disasters.
- Biological conditions - biodiversity, ecology and nature conservation in which issues of endangered species, protected ecosystems, habitat, species of commercial importance, invasive species and their impacts are assessed.
- Social-economic conditions and human health – including archaeology and cultural heritage landscape and facial aspects, recreational, social-economic aspects, land use, transportation, infrastructure, agricultural development, tourism, and human health.

Detailed methodology on data collection and field surveys for the above narrated environmental variables is presented in sub sections below.

1.5.2 Data Collection and Site Surveys

Data collection and site surveys started involved visiting stakeholder institutions and making consultations with key community members in all the target locations in the Project area.

The main objective of this activity was to carry out on-site field assessments of the expected effects of the planned developments on the physical, biological and socio-economic environment. During these surveys, interviews, observations and the administration of screening checklists was carried out with key informants who included County Government and National Government staff, local leaders and community representatives. Details of each survey are explained in subsequent sections.

1.5.3 Flora and Fauna Surveys

The assessment of flora and fauna focused on the proposed dam's sites, water treatment sites and irrigation field and their immediate surroundings. These were assessed by means of walks, interviews, and secondary data collection. Walks were undertaken at sites where various construction works have been proposed Project sites. Interviews were conducted with both locals and key informants. Secondary data was collected through the use of appropriate maps and relevant literature. Other useful information collected included GPS locations, digital still camera records, and data sheets.

1.5.4 Socio-Economic Baseline

The socio-economic baseline was established principally from secondary data, consultations conducted for SESA, and observations on-site and areas through which the pipelines pass.

1.5.5 Secondary and Primary Data

Secondary socio-economic data was obtained from books, reports, journals and other sources such as the CIDP for County Government of Murang'a County, Kenya National Bureau of Statistics Reports, Feasibility study report among others. Primary data was collected from key informants and consultations which included public barazas.

1.6 Environment and Social Impacts Ranking

1.6.1 Impact Identification

The environment and social impact identification and analysis was done using the Leopold matrix, this method is an environment impact assessment method pioneered in 1971 by an Environment Researcher Called Leopold. The matrix is a grid that is used to identify the interaction between project activities, which are displayed along one axis, and environmental characteristics, which are displayed along the other axis.

1.6.1.1 Impact Rating Variables

The impact rating evaluation adopted is summarized three key areas related to the extent of the impact, timing of occurrence of the impact, intensity of the impact and probability of the impact as explained in **Table 1.2** below.

Table 1.1: Impact Rating Variables

Impact Rating	Explanation
Extent	An area of influence covered by the impact, if the action produces a much-localized effect within the space, it is considered that the impact is **low (1).** If, however, the effect does not support a precise location within the project environment, having a pervasive influence beyond the project footprint, the impact will be at location **level (3)** or could be **Beyond County (5)**
Timing:	Refers to the moment of occurrence, the time lag between the onset of action and effect on the appearance of the corresponding factor. We consider five categories according to this time period is zero, up to 1 year (short term), or more than two years, which are called respectively medium term (3), long-term (4), and permanent (5).
Intensity	Refers to the degree of impact on the factor, in the specific area in which it operates, ranked from low (1) to high (5).
Probability	Refers to the likelihood of the impact occurring during the project implementation, this is also ranked as Probable (1) to highly probable.

1.6.1.2 Impact Severity

The impact severity was determined based the capacity of the receptor to sustain shocks triggered by the impact. In this regard the impact severity could be termed as negligible, low, medium or high as summarized in **Table 1.3** below.

Table 1-2: Impact Severity

Sensitivity	Definition (considers duration of the impact, spatial extent, reversibility, and ability of comply with legislation)	Colour Connotation
High	Vulnerable receptor (human or ecological) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.	
Medium	Vulnerable receptor (human or ecological) with limited capacity to absorb proposed changes or limited opportunities for mitigation.	
Low	Vulnerable receptor (human or ecological) with some capacity to absorb proposed changes or moderate opportunities for mitigation	
Negligible	Vulnerable receptor (human or ecological) with good capacity to absorb proposed changes or and good opportunities for mitigation	

As explained by Leopold (1971), for effective impact identification, the environment characteristics are assigned weights used to indicate the severity of environment impacts detailed in **Table 1.4** on **Page 1-9**.

Table 1.3: Impact Rating Criteria for Environment and Social Risks

Extent		Duration		Intensity		Probability		Weighting Factor (WF)		Severity Rating (SR)		Mitigation efficiency	
Foot print	1	Short term	1	Low	1	Probable	1	Low	1	Low	0-19	High	0,2
Site (1km radius)	2	Short to medium	2			Possible	2	Low to Medium	2	Low to Medium	20-39	Medium to High	0,4
Location	3	Medium term	3	Medium	3	Likely	3	medium	3	medium	40-59	medium	0,6
Sub County	4	Long term	4			Highly likely	4	Medium to high	4	Medium to high	60-79	Low to medium	0,8
Beyond County	5	Permanent	5	High	5	High	5	High	5	High	80-100	low	1,0

1.6.1.3 Approach to mitigation and management

The SESA includes a description of the measures envisaged to prevent, reduce and where possible offset any significant adverse impacts on the environment. The identification of such measures is an iterative process which needs to be undertaken in parallel with the design to aid the incorporation of measures into the design during project development. Early adoption of appropriate mitigation will help reduce significant environmental impacts to a practicable minimum.

2.0 WATER RESOURCES DEVELOPMENT STRATEGIES

2.1 Key Objectives of the Water Resources Development Strategy

The strategy to be adopted as the most viable for development of water resources for Murang'a County should ensure that:

- Potable water and Irrigation Water Demands for the entire Murang'a County are fully met, up to the Year 2045 Planning Horizon,
- Where existing sources are inadequate (deficit in water balance), development of new water sources is considered,
- All potable water supplies are developed to a common standard for potable water supply.
- Development of new Water Sources and proposed facilities increase the reliability and security of Water Supply, both potable water and Irrigation water requirements, for Murang'a County through: -
    - Optimal use of existing facilities.
    - Increase of Surface Water Storage Sources,
    - Diversification of sources (surface water, groundwater, rainfall roof harvesting, etc.) where appropriate,
    - Development of local or combined systems for selected target areas and promoting the use of local water resources to provide potable water and to meet irrigation needs for the people near the source.

2.2 Water Resources Development Principles

To meet the aforementioned broad strategic objectives, the following key principles have been considered in preparing the long-term Water Resource Development Strategies for Murang'a County:

1. The water sources development strategy should meet the growing demand for Potable Water and Irrigation Requirements up to year 2045, through a staged investment process.
2. The Water Sources Development Strategy should make optimal use of the existing facilities (reservoirs, transmission lines, water treatment works, etc.).
3. The strategy should propose diversification of water sources and development of reliable schemes, providing more safety and operational flexibility:
    - Promote the steady development of boreholes to tap groundwater in zones of relatively high groundwater potential.
    - Promote alternative water sources such as rainwater roof harvesting.
4. Small water production schemes for larger Towns should be limited to maximize on economies of scale, avoid complexification of the Water Supply Systems, to reduce costs and optimize the operation.
5. En-route demands along the Transmission Mains where local sources are not available should be met via offtakes from the Transmission Mains, keeping to a minimum number of tapings on the main Transmission Pipelines.

6. Efforts should be put in place by WSPs to minimize the physical water losses along the systems (intakes, transmission pipes, treatment works, distribution schemes, etc.)
7. Priority to be given to Strategies with less social and environmental impacts.
8. Minimize the cost of new water sources facilities through:
    i) limiting the length of water distribution,
    ii) limiting or avoiding pumping requirements and maximize gravity transmission,
    iii) optimizing dam reservoir size and dam location,
    iv) best use of existing water system infrastructure through rehabilitation / upgrading, interconnection and expansion.
9. Consistent phasing of investments: any new step in the development of new sources should be consistent with the previous ones and with the next planned steps.

2.3 Formulation of Development Strategies for New Water Sources to Serve Murang'a County

2.3.1 Introduction

From the review of existing developed Water Sources within Murang'a County and overall Water Demand Assessment and Preliminary Water Balance carried out for the Study Area as detailed in the preceding Chapter 3 and 4, it concluded that the existing developed water sources do not meet the present water demand of the Study Areas. It is therefore necessary to expand the water sources where applicable and/ or develop new sources to meet the present and projected future demand for potable water and irrigation requirements.

Table 2.1 below shows a preliminary Water Balance for the study area, depicting the deficit of the existing sources in meeting the current demands.

Table 2.1: Water Balance Assessment

Year	Combined Water Demand		Current Water Supply		Surplus/Deficit Water Demand	
	(m^3/day)	Mm^3/Year	(m^3/day)	Mm^3/Year	(m^3/day)	Mm^3/Year
2018	171,419	62.6	84,908	31	**-86,511**	**-31.6**
2045	192,910	70.4	84,908	31	**-108,002**	**-39.4**

Detailed hydrological review and catchment yield assessment as well as groundwater potential assessment carried out for the entire Study Area identified various potential water sources, which if developed, are capable of meeting the current and the projected future water demands up to the ultimate planning horizon. Details of the Hydrological Analysis have been described in the preceding section.

Further analysis has been carried out on the 8Nr. selected possible dam sites, mainly considering optimum net yields and gravity command areas with respect to the study area.

Based on the foregoing criteria, the following 5Nr. Potential dam sites were found to have combined characteristics of largest gravity command areas and relatively high yields:-

- Maragua 4 Dam Site
- Maragua B Dam Site
- Kayahwe 4 Dam Site
- Irati 3 Dam Site
- Thika 3A Dam Site

Under the Master Plan for Developing of New Water Sources for Nairobi and Satellite Towns (2014), Maragua 4 Dam was identified and proposed as a possible source for Water Supply to Nairobi.

The proposed Maragua 4 Dam, which is currently in advanced planning stages, is proposed to supply 120,000m^3/day of water to Nairobi, with an additional allocation of 20,000m^3/day of raw water to Murang'a County. For purposes of the Study, 5% of the allocated 20,000m^3/day has been assumed to be consumed under local uses within the Treatment Works Site. 19,000m^3/day has been assumed to be available for distribution to consumers within Murang'a County.

In addition to the identified surface water sources, groundwater resource development has been proposed within the high groundwater potential area around Mitubiri.

The above potential dams and the Mitubiri wellfield form the basis upon which Water Resources Development Strategies for Murang'a County have been formulated, which will largely be considered as augmentation to the existing sources. Except where the existing system will require to be disused or phased out, one key assumption has been made in formulation of the Water Resources Development Strategies that the existing water supply systems within the County will continue operating at their optimum design capacities up to the ultimate planning horizon. These will therefore require rehabilitation measures to revert to their original design capacities.

It is recommended that detailed condition survey be carried out and rehabilitation measures identified as quick intervention measures on all existing infrastructure to revert to their optimum design capacities.

5Nr. Strategies have been formulated for Water Resource Development for Murang'a County, to bridge the current deficit in Water Supply and meet the projected future demands for Potable Water and Irrigation Requirements up to the Ultimate planning horizon (Year 2045).

The proposed Strategies are as follows:

- Strategy S1; Development of Irati 3 Dam and Mitubiri Wellfield
- Strategy S2; Development of Kayahwe 4 Dam and Mitubiri Wellfiled
- Strategy S3; Development of Thika 3A Dam and Mitubiri Wellfield
- Strategy S4; Development of Thika 3A Dam
- Strategy S5; Development of Maragua B Dam and Mitubiri Wellfield.

The above listed Strategies are discussed in subsequent sections.

2.4 Strategy S1; Development of Irati 3 Dam and Mitubiri Wellfield

The proposed Water Resources Development under Strategy S1 to meet the ultimate water and irrigation demands for Murang'a County entail:

- Continued abstraction of optimum yield from Existing 17Nr. Run-of-River Intakes; cumulative treated water supply capacity 75,370m³/day
- Continued abstraction from Existing developed Ground Water sources; cumulative optimum capacity 5,568m³/day
- Proposed Maragua 4 Dam, which is being developed under a separate programme by AWWDA for Water Supply for Nairobi and Satellite Towns; treated water supply allocated for Murang'a County 19,000m³/day
- Construction of Irati 3 Dam; Safe yield of 64,900m³/day
- Development of Mitubiri Wellfield; 10,000m³/day.

To ensure effective utilization of the existing water sources and infrastructure, it is necessary that they be rehabilitated to continue serving at their optimum design capacities up to the ultimate planning horizon. Detailed condition surveys have to be carried out to identify rehabilitation measures required to revert these existing systems to their optimum design capacities.

To improve the reliability of water supply from the existing run-of-the-river intakes, it is recommended to increase the height of the existing weirs or develop small dams (height<15m) to enhance storage, and improve reliability of the sources during extreme drought periods.

Under Strategy **S1**, it is proposed that the existing sources be augumented by construction of the proposed Irati 3 Dam and development of the Mitubiri Wellfield, which will bridge the deficit in supply and continue meeting the projected demands for potable water and irrigation for the entire Murang'a County upto the Year 2045 planning horizon.

Under Strategy S1, priority has been given to potable water demand, with the surplus water allocated to irrigation demand, in line with guidelines stipulated in the MWI Design Practice Manual (2005).

a) Supply for Potable Water

The principle source considered in formulation of Strategy S1 of water supply to Murang'a County is Irati 3 Dam. To ensure equitable and economic distribution of potable water to the study area, the study area has been divided into two (2) Supply Zones (Zone 1 and Zone 2) based on on the potential gravity command area of Irati 3 Dam. Zone 1 comprises of all areas within the study area that cannot be supplied by gravity from the proposed Irati 3 Dam while Zone 2 covers the gravity command area for the proposed Irati 3 Dam. The two supply Zones are described hereunder and shown in **Figure 2.1** on **Page 2-7**.

i) Zone 1, Strategy S1

Zone 1 covers the area upstream of the proposed Irati 3 Dam. This Zone is proposed to be served from the existing 13Nr. run-of-the-river intakes and existing developed groundwater sources, total combined treated water capacity 67,904m³/day and the allocation for Murang'a County from the proposed Maragua 4 Dam, treated water supply capacity 19,000m³/day.

The total available water resource for Zone 1 from the above listed existing sources and the proposed Maragua 4 Dam is 86,904m^3/day, against a projected ultimate potable water demand of 65,596m^3/day, resulting in a surplus of 21,308m^3/day.

ii) Zone 2, Strategy S1

Zone 2 covers the area downstream of the proposed Irati 3 Dam, which can be supplied by gravity from the Dam. This Zone is proposed to be served from the existing 4Nr. run-of-river intakes treated capacity (25,650m^3/day) and existing developed groundwater sources (3,062m^3/day), total combined capacity 28,712m^3/day, with additional augmented supply from the proposed Irati 3 Dam, safe yield 64,900m^3/day and the proposed Mitubiri Wellfield, capacity 10,000m^3/day.

The total available water resource for Zone 2 from the existing sources, the proposed Irati 3 Dam and the proposed Mitubiri Wellfield is 103,612m^3/day, against a projected ultimate potable water demand of 46,099m^3/day, resulting in a surplus of 57,513m^3/day.

A summary Water Balance for the potable water demand against available resource for supply Zones 1 and 2 under Strategy S1 is given in **Table 2.2** below.

Table 2.2: Summary Water Balance for Potable Water Demand under Strategy S1 (Year 2042)

Zone 1, Strategy S1	
Projected Water Demand (Year 2045)	65,596 m^3/day
Existing available sources (13Nr. Surface water and developed Groundwater Sources)	67,904 m^3/day
Proposed Maragua 4 Dam (Treated Water allocation for Murang'a County)	19,000 m^3/day
Total available resource	**86,904 m^3/day**
Surplus (available for Irrigation)	21,308 m^3/day
Zone 2, Strategy S1	
Projected Water Demand (Year 2045)	46,099 m^3/day
Existing available sources (4Nr. Surface water and Groundwater Sources)	28,712 m^3/day
Proposed Irati 3 Dam	64,900 m^3/day
Proposed Mitubiri Wellfields (10Nr. Boreholes)	10,000 m^3/day
Total available Resource	**103,612 m^3/day**
Surplus (available for Irrigation)	57,513 m^3/day
Overall Potable Water Balance (Year 2045)	
Projected potable water demand (year 2045)	111,695 m^3/day
Existing available sources	96,616 m^3/day
Proposed New Sources	93,900 m^3/day
Total available Resource	**190,516 m^3/day**
Total Surplus for Zone 1 and Zone 2 (available for irrigation)	73,253 m^3/day

b) Supply of Irrigation Water

Irrigation Water Demand for consideration under Strategy S1 was estimated based on pre-identified irrigation schemes that were Technically and Economically viable to be supplied from the proposed principle source, Irati 3 Dam.

Under Strategy **S1**, 2Nr. Irrigation Schemes namely Saba Saba Irrigation Scheme denoted as Area 5 as shown in **Figure 2.2** and Gatanga Irigation Scheme denoted as Areas 9&10 as shown in **Figure 2.3** were identified as potential schemes for development, to be irrigated from the identified Principle Source under the Strategy (Irati 3 Dam). These Irrigation Schemes are described hereunder.

i) <u>Saba Saba Irrigation Scheme (Area 5)</u>

The proposed Saba Saba Irrigation Scheme is located 1.5Km to the North of Maragua Town in 4BF catchment, partially within Kigumo, Kandara and Maragua Constituencies as shown in **Figure 2.2 on Page 2-8**. The Scheme as envisaged, will be supplied by gravity from the proposed Irati 3 Dam. It encompasses both existing Karathe – Thaara Irrigation Scheme (30 ha) and future schemes (70 ha) as planned by the Murang'a County Government.

The scheme basic information is shown on **Table 2.3** below.

Table 2.3: Basic Information – Saba Saba Irrigation Scheme

Water source:	Irati-3 Dam Irrigation outlet at: +1,695 masl
Gross Irrigation Area:	3,040 ha
GIWR (annual)	3.9 MCM
GIWR (Peak in September)	0.6 MCM
GIWR* (Peak abstraction)	**20,779 m^3/day**
Conveyance pipe	600mm diameter steel pipe
Irrigation Methods	Sprinkler and Drip

**GWIR- Gross Water Irrigation Requirements*

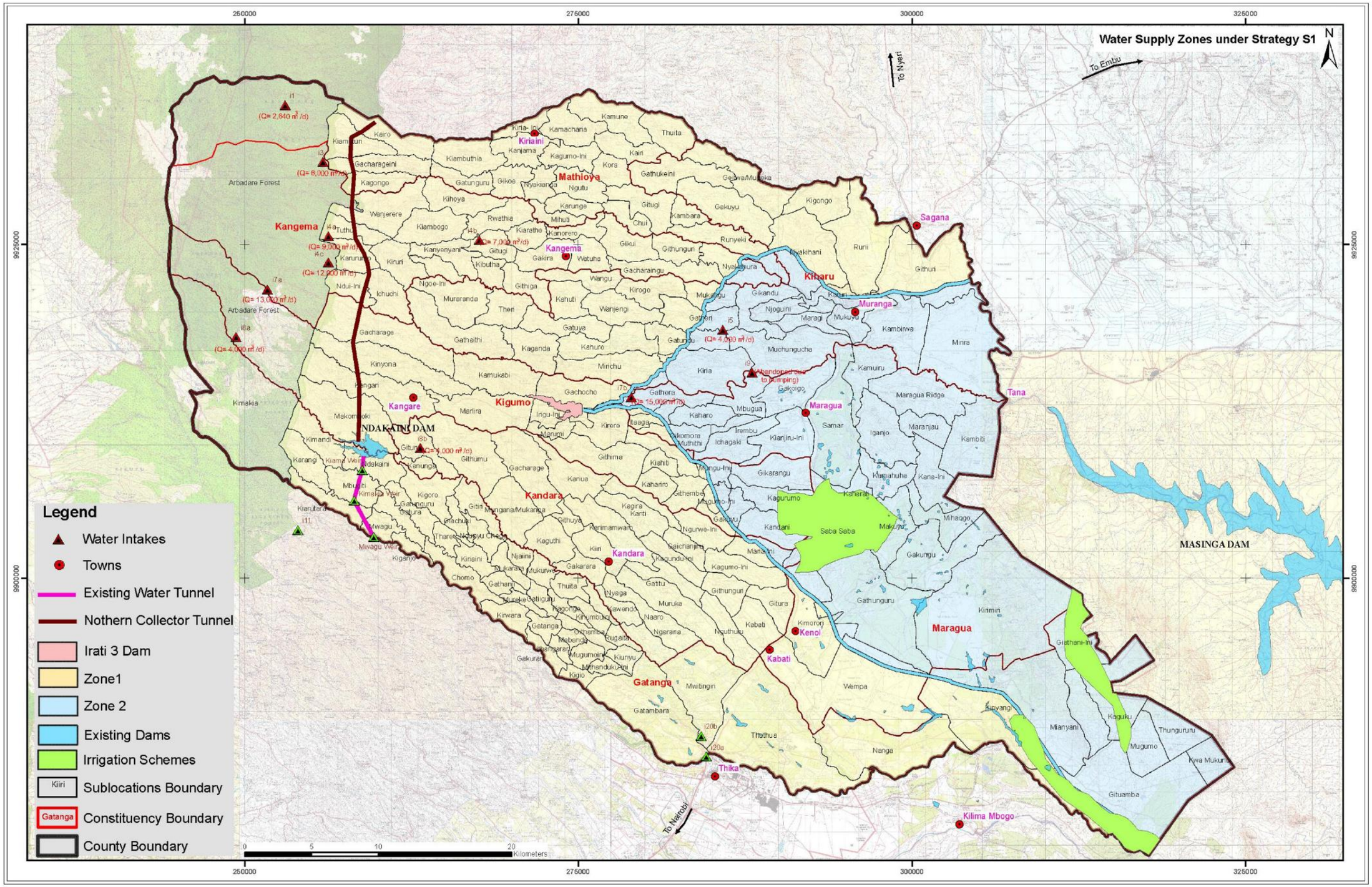

Figure 2.1: Water Supply Zones under Strategy S1

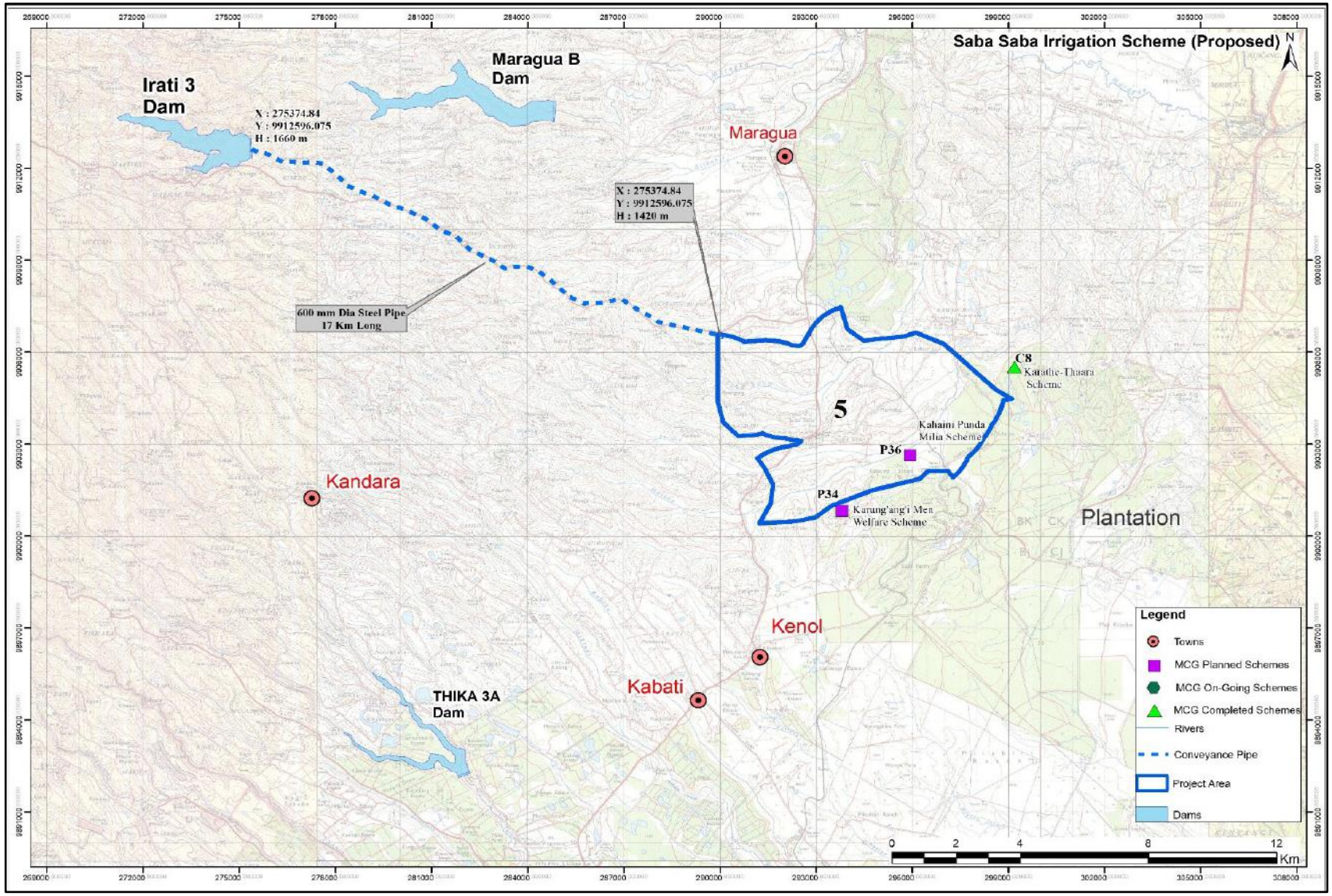

Figure 2.2: Location of proposed Saba Saba Irrigation Scheme

The Cropping Pattern adopted in estimation of Irrigation Water Demand for the proposed Saba Saba Irrigation Scheme is shown on **Table 2.4** below.

Table 2.4: Cropping Pattern adopted for Saba saba Irrigation Scheme

Crop	Irrigated Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maize-1	10%			Maize									
Maize-2	10%									Maize			
Pulses-1	15%				Pulses								
Pulses-2	15%								Pulses				
Vegetables-1	10%				Vegetables								
Vegetables-2	10%								Vegetables				
Vegetables-3	10%	Vegetables											
Fruit trees	20%	Fruits											
% Scheme area occupied	100%	40%	30%	40%	55%	55%	55%	45%	45%	55%	55%	45%	30%

ii) <u>Gatanga Irrigation Scheme (Area 9&10)</u>

The proposed Gatanga Irrigation Scheme is to be situated in the South East of Murang'a County in 4BG catchment, within Gatanga Constituency. **Figure 2.3** on **Page 2-10** shows the location of the proposed Gatanga Scheme. The proposed Gatanga Irrigation Scheme will be supplied by gravity flow from the proposed Mitubiri Wellfield.

The proposed project location for the Gatanga Irrigation scheme has no existing, on-going or future schemes planned by Murang'a County Government.

The scheme basic information is shown on **Table 2.5** below.

Table 2.5: Basic Information – Gatanga Irrigation Scheme (Area 9 & 10)

Water source:	Groundwater well Irrigation outlet at: + 1,493 masl
Gross Irrigation Area:	Area 9: 550 ha Area 10: 550 ha Total: 1,100 ha
GIWR (annual)	1. 0 MCM
GIWR (Peak in September)	0. 2 MCM
GIWR (Peak abstraction)	**6, 684 m^3/day**
Conveyance pipe	400/200mm diameter steel pipe
Irrigation Methods	Drip

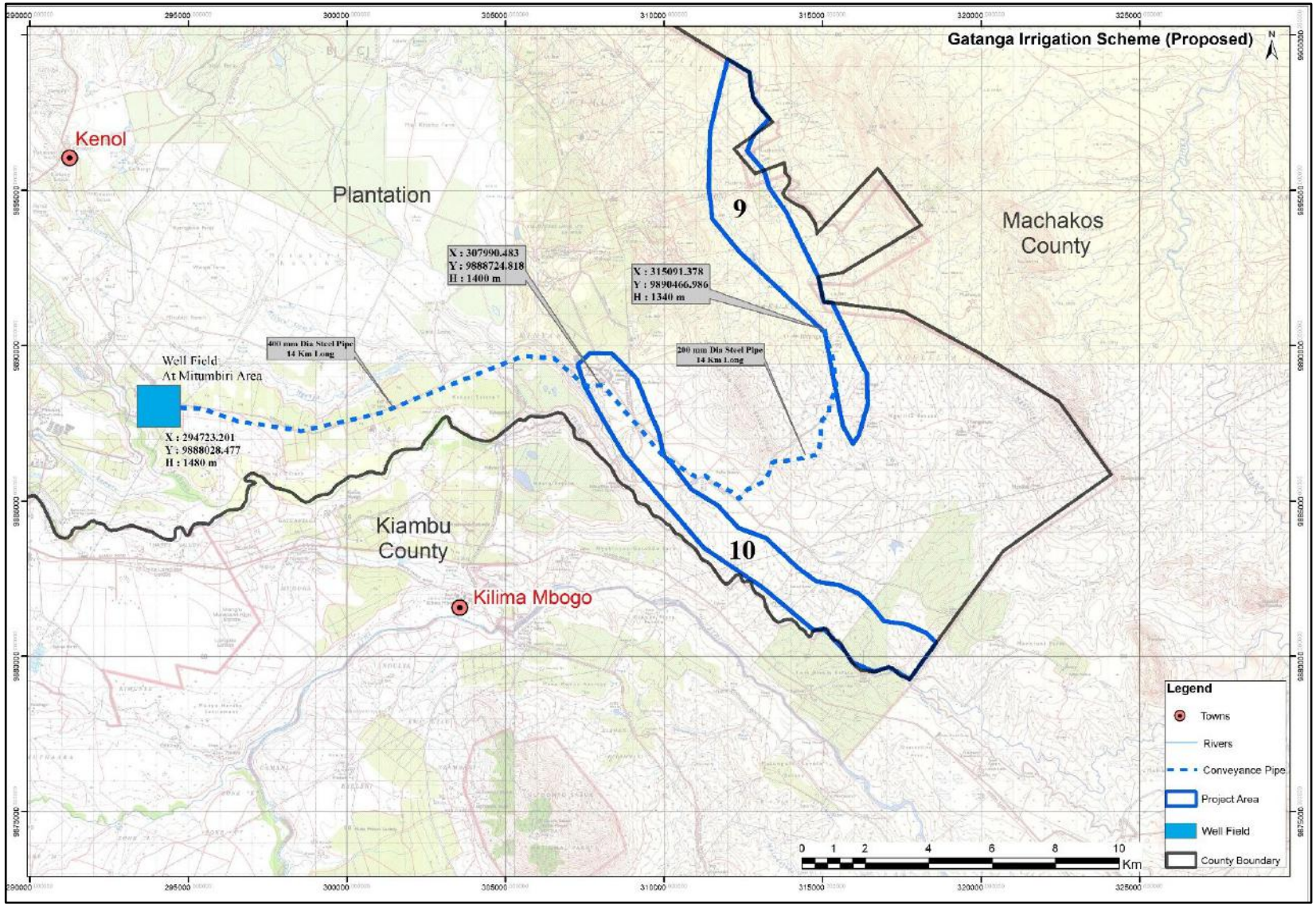

Figure 2.3: Location of proposed Gatanga Irrigation Scheme

The Cropping Pattern adopted in estimation of Irrigation Water Demand for the proposed Gatanga Irrigation Scheme is shown on **Table 2.6** below.

Table 2.6: Cropping Pattern adopted for Gatanga Irrigation Scheme

Crop	Irrigated Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maize-1	5%			Maize									
Maize-2	5%									Maize			
Pulses-1	15%				Pulses								
Pulses-2	15%								Pulses				
Vegetables-1	15%				Vegetables								
Vegetables-2	15%								Vegetables				
Vegetables-3	15%	Vegetables											
Fruit trees	15%	Fruits											
% Scheme area occupied	100%	35%	30%	35%	50%	50%	50%	35%	45%	50%	50%	35%	20%

c) Strategy S1 Project Components

The envisaged Project components for the proposed Water Resource Development for Murang'a County to meet Potable Water and Irrigation Demands under Strategy S1 are given in **Table 2.7** below.

Table 2.7: Strategy S1 Project Components

No.	Item	Year	Components
1	New Treatment Works (6Nr.) on Thika River Intake, Kimakia River Intake, Githika River Intake, Chathanda River Intake and Maragua River Intake, to treat currently supplied raw water	**2022**	• Construction of new Treatment Works Capacity 4,000m^3/day on Thika Intake to treat raw water currently served to Gatanga Area. • Construction of new Treatment Works Capacity 1,500m^3/day on Kimakia Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 1,000m^3/day on Kiama Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 2,500m^3/day on Githika Intake to treat raw water currently served Makomboki Sub-Location • Construction of new Treatment Works Capacity 3,500m^3/day on Chathanda Intake to treat raw water currently served to Kangari Urban Centre. • Construction of new Treatment Works Capacity 4,000m^3/day on Maragua Intake to treat raw water currently served to Maragua Ridge and Kambiti Areas.

No.	Item	Year	Components
2	New Treatment Works for raw water allocation to Murang'a County from the proposed Maragua 4 Dam	**2022**	• Construction of 1 No. Treatment Works Capacity 20,000m^3/day each from the proposed Maragau 4 Dam, • 500mm dia. Raw Water Gravity main, length 1.5km • 500mm dia. Treated Water Gravity mains, length 7km • 2Nr. Storage Tanks Capacity 1,500m^3 each
3	Construction of New Irati 3 Dam	**2027**	• New 49m high Irati 3 Dam (on Irati River), Volume 25Mm^3, Safe Yield 64,900m^3/day
4	Ground Water Resource Development	**2022**	• Development of Mitubiri well field capacity 10,000m^3/day, comprising of 10Nr. boreholes and accessories, high level storage tank and manifold.
5	Irrigation Strategies	**2027**	• 600mm dia. Steel Transmission Main, length 17Km from the proposed Irati 3 Dam to the propose Mathioya Irrigation Scheme (Area 1) • 400mm dia. Steel Transmission Main, length 14Km from the proposed Mitubiri Wellfield to Area 10 of the proposed Gatanga Irrigation Scheme • 200mm dia. Steel Transmission Main, length 14Km from Area 10 to Area 9 of the proposed Gatanga Irrigation Scheme • Sedimentation Tank/ Detention Tank at terminal point of transmission main from the proposed Irati 3 Dam

A Summary Water Balance of the proposed Strategy S1 for Water Supply and Irrigation Requirements for Murang'a County is given in **Table 2.8** below and shown graphically on **Figure 2.4** on **Page 2-13**.

Table 2.8: Summary Water Balance of Proposed Strategy S1

	Planning Horizon (Year)						
	2018	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Potable Water Demand	88,883	92,217	94,933	99,264	103,477	108,168	111,695
Irrigation Water Demand	27,463	27,463	27,463	27,463	27,463	27,463	27,463
Total Water Demand	**116,346**	**119,680**	**122,396**	**126,727**	**130,940**	**135,631**	**139,158**
Capacity of existing Developed Sources (2018)	**96,616**	**96,616**	**96,616**	**96,616**	**96,616**	**96,616**	**96,616**
Deficit/ Surplus in supply based on existing sources	**-19,730**	**-23,064**	**-25,780**	**-30,111**	**-34,324**	**-39,015**	**-42,542**
Proposed measures under Strategy S1							
Proposed Treated Water supply from Proposed Maragua 4 Dam (T. Works capacity 19,000m^3/day)	-	19,000	19,000	19,000	19,000	19,000	19,000
Proposed Supply from the Construction of Irati 3 Dam (T. Works capacity 4,000m^3/day)	-	-	64,900	64,900	64,900	64,900	64,900

	Planning Horizon (Year)						
	2018	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Development of Mitubiri Well Field			10,000	10,000	10,000	10,000	10,000
Total Supply after Implementation of Strategy S1	**96,616**	**115,616**	**190,516**	**190,516**	**190,516**	**190,516**	**190,516**
Deficit/ Surplus in supply under Strategy S1	**-19,730**	**-4,064**	**68,120**	**63,789**	**59,576**	**54,885**	**51,358**

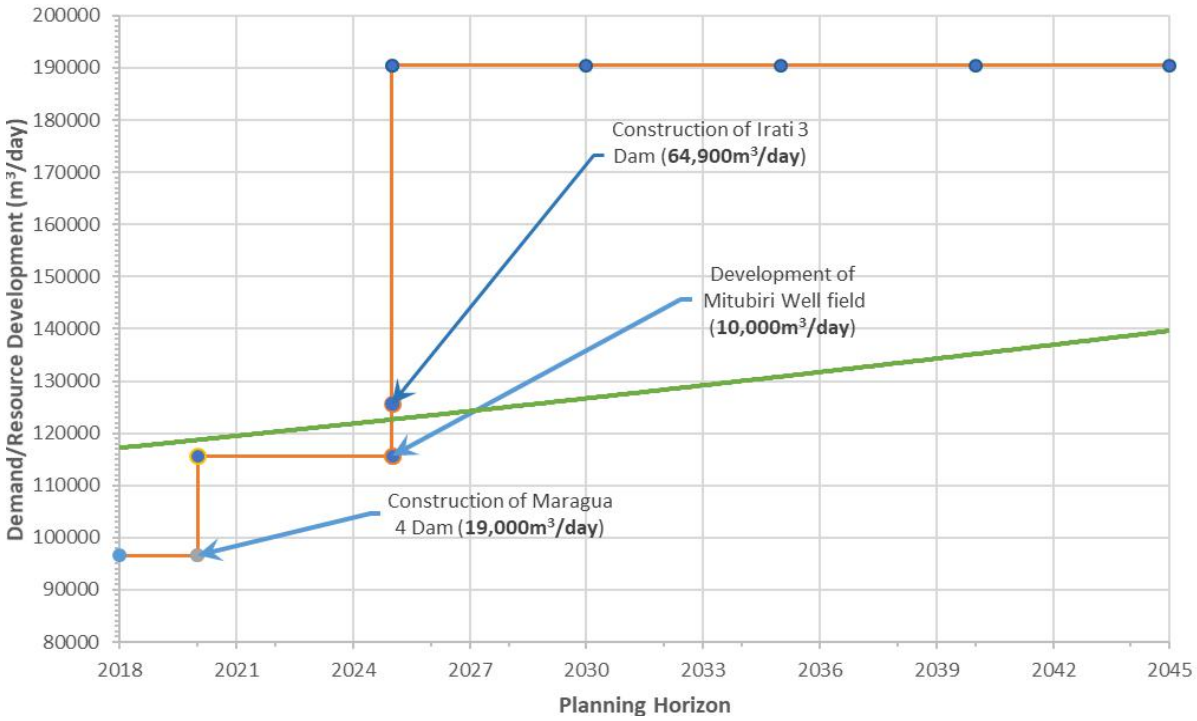

Figure 2.4: Development Phases under Strategy S1

Figure 2.5 on **Page 2-14** shows a schematic diagram of the proposed Project Components for Strategy S1.

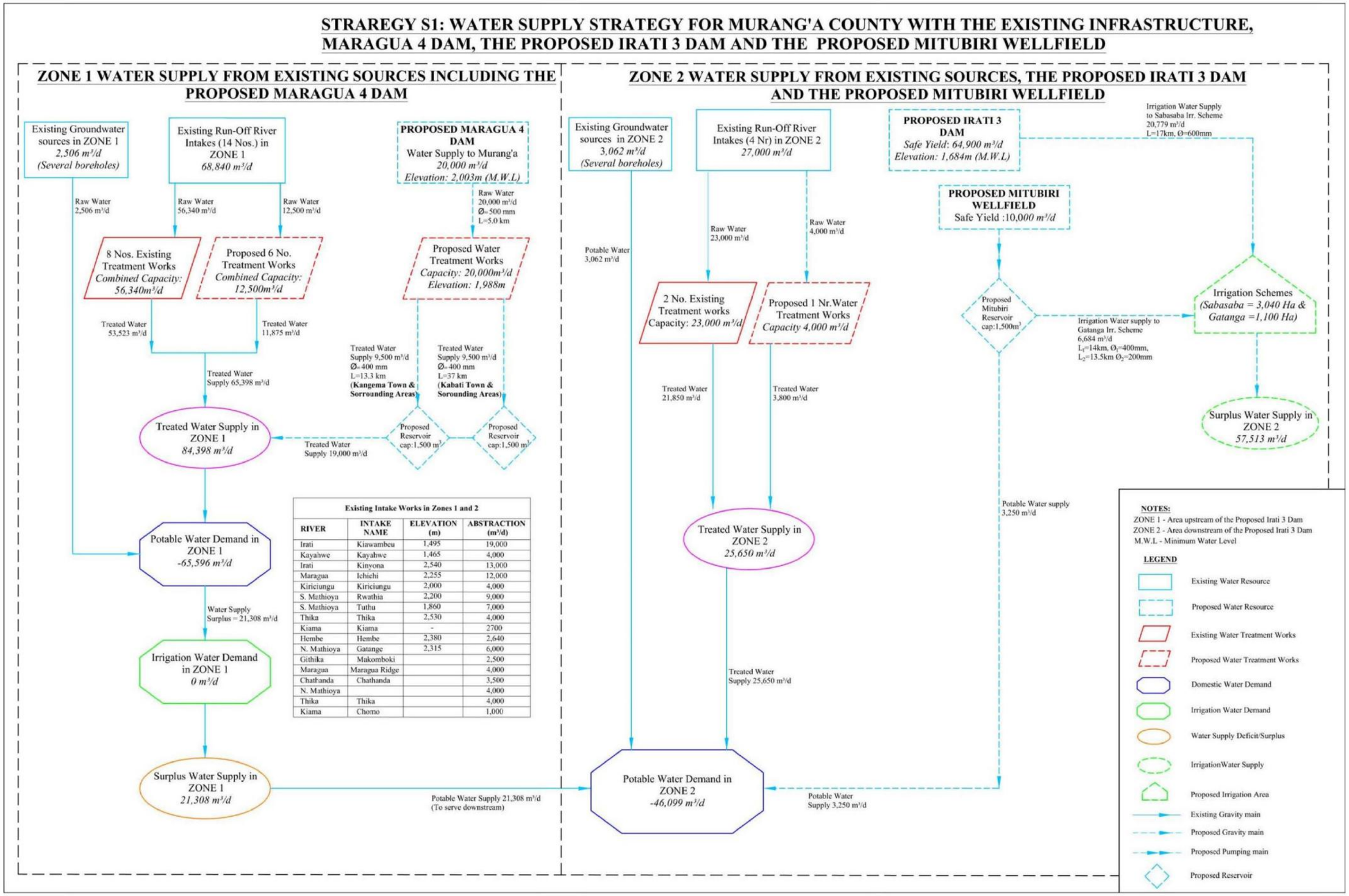

Figure 2.5: Schematic Diagram of Proposed Project Components under Strategy S1

2.5 Strategy S2; Development of Kayahwe 4 Dam and Mitubiri Wellfield

The proposed Water Resources Development under Strategy S2 to meet the ultimate water and irrigation demands for Murang'a County entail:

- Continued abstraction of optimum yield from existing 17Nr Run-of-River Intakes; cumulative treated water supply capacity 91,048m³/day
- Continued abstraction from existing developed Ground Water sources; cumulative optimum capacity 5,568m³/day
- Proposed Maragua 4 Dam, which is being developed under a separate programme by AWWDA for Water Supply for Nairobi and Satellite Towns; treated water supply allocated for Murang'a County 19,000m³/day
- Construction of Kayahwe 4 Dam; Safe yield of 60,100m³/day
- Development of Mitubiri Wellfield; 10,000m³/day

To ensure effective utilization of the existing water sources and infrastructure, it is necessary that they be rehabilitated to continue serving at their optimum design capacities up to the ultimate planning horizon. Detailed condition surveys have to be carried out to identify rehabilitation measures required to revert these existing systems to their optimum design capacities.

To improve the reliability of water supply from the existing run-of-the-river intakes, it is recommended to increase the height of the existing weirs or develop small dams (height<15m) to enhance storage and improve reliability of the sources during extreme drought periods.

Under Strategy **S2**, it is proposed that the existing sources be augumented by construction of the proposed Kayahwe 4 Dam and development of the Mitubiri Wellfield, which will bridge the deficit in supply and continue meeting the projected demands for potable water and irrigation for the entire Murang'a County upto the Year 2042 planning horizon.

Under Strategy S2, priority has been given to potable water demand, with the surplus water allocated to irrigation demand, in line with guidelines stipulated in the MWI Design Practice Manual (2005).

a) Supply of Potable Water

The principle source considered in formulation of Strategy S2 of water supply to Murang'a County is the Kayahwe 4 Dam. The study area has been divided into two (2) Supply Zones (Zone 1 and Zone 2). Zone 1 **excludes** all areas that are to be supplied from the Kayahwe 4 Dam while Zone 2 covers the area proposed to be supplied from the Kayahwe 4 Dam. The two supply Zones proposed under Strategy S2 are shown in **Figure 2.6** on **Page 2-16** and described thereafter.

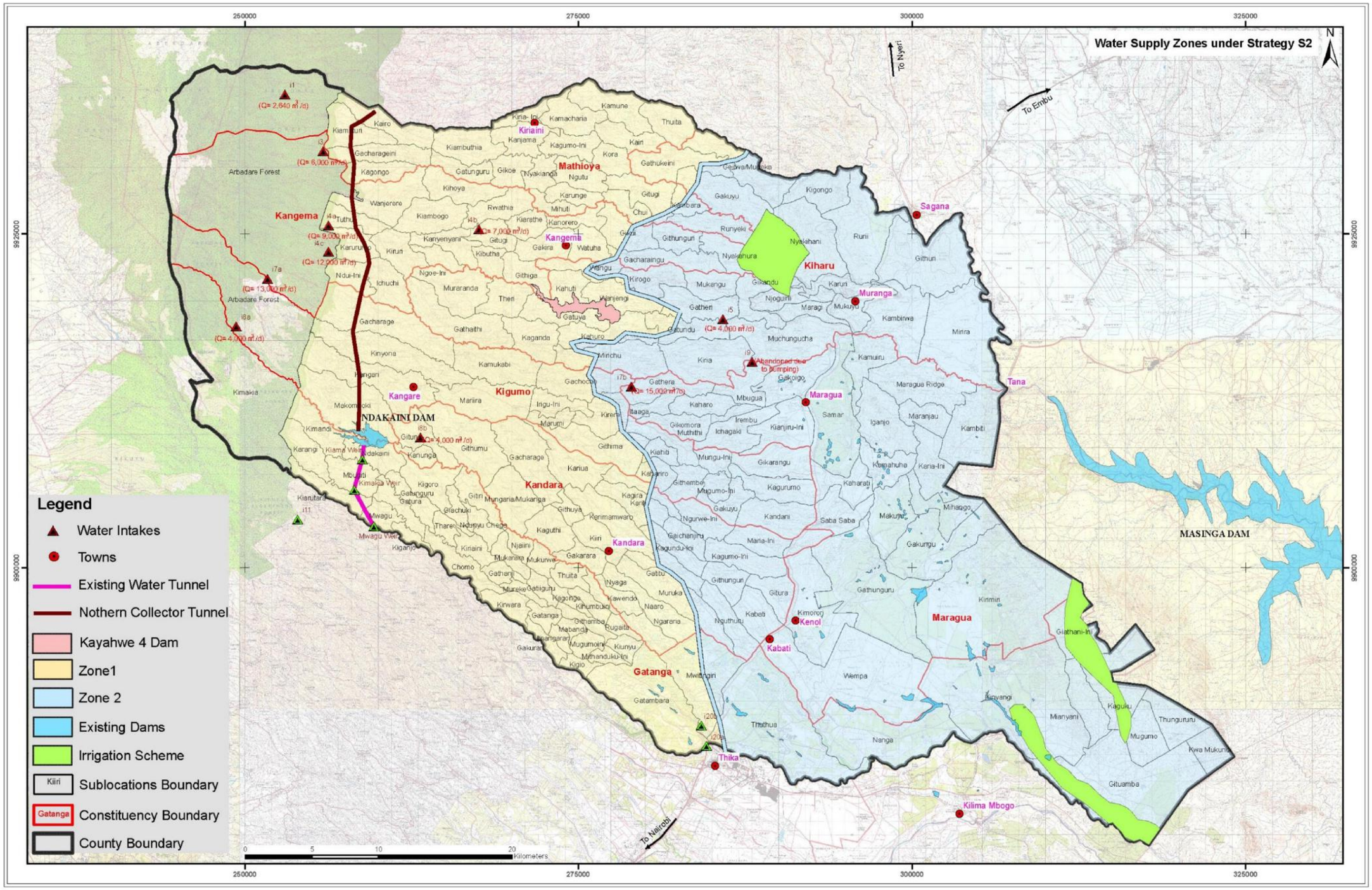

Figure 2.6: Water Supply Zones under Strategy S2

i) Zone 1, Strategy S2

This zone is proposed to be served from the existing 14Nr. run-of-river intakes (69,198m^3/day) and existing developed groundwater sources (5,123m^3/day), total combined treated water capacity 74,321m^3/day and the allocation for Murang'a County from the proposed Maragua 4 Dam, treated water supply capacity 19,000m^3/day.

The total available water resource for Zone 1 from the above listed existing sources and the proposed Maragua 4 Dam is 93,321m^3/day, against a projected ultimate potable water demand of 92,708m^3/day, resulting to a surplus of 613m^3/day.

ii) Zone 2, Strategy S2

This zone is proposed to be served from the existing 3Nr. run-of-river intakes (21,850m^3/day) and existing developed groundwater sources (445m^3/day), total combined capacity 22,295m^3/day, with additional augmented supply from the proposed Kayahwe 4 Dam, safe yield 60,100m^3/day and the proposed Mitubiri Wellfield, capacity 10,000m^3/day.

The total available water resource in Zone 2 from the existing sources, the proposed Kayahwe 4 Dam and the proposed Mitubiri wellfield is 92,395m^3/day, against a projected ultimate potable water demand of 18,987m^3/day, resulting in a surplus of 73,408m^3/day, to be allocated to irrigation demand.

A summary Water Balance for the potable water demand against available resource for supply Zones 1 and 2 under Strategy S2 is given in **Table 2.9** below.

Table 2.9: Summary Water Balance for Potable Water Demand under Strategy S2 (Year 2042)

Zone 1, Strategy S2	
Projected Water Demand (Year 2045)	92,708 m^3/day
Existing available sources (14Nr. Surface water and developed Groundwater Sources)	74,321 m^3/day
Proposed Maragua 4 Dam (Treated Water Supply allocation for Murang'a County)	19,000 m^3/day
Total available resource	**93,321 m^3/day**
Surplus in Zone 1 (available for Irrigation)	613 m^3/day
Zone 2, Strategy S2	
Projected Water Demand (Year 2045)	18,987 m^3/day
Existing available sources (3Nr. Surface water and developed Groundwater Sources)	22,295 m^3/day
Proposed Kayahwe 4 Dam	60,100 m^3/day
Proposed Mitubiri Wellfield	10,000 m^3/day
Total available resource	**92,395 m^3/day**
Surplus in Zone 2 (available for Irrigation)	73,408 m^3/day
Overall Potable Water Balance (Year 2045), Strategy S2	
Projected potable water demand (year 2045)	111,695 m^3/day
Existing available sources	96,616 m^3/day
Proposed New Sources	89,100 m^3/day
Total available Resource	**185,716 m^3/day**
Total Surplus for Zone 1 and Zone 2 (available for irrigation)	74,021 m^3/day

b) Supply of Irrigation Water

Irrigation Water Demand for consideration under Strategy S2 was estimated based on pre-identified irrigation schemes that were Technically and Economically viable to be supplied from the proposed principle source, Kayahwe 4 Dam.

Under Strategy **S2**, 2Nr. Irrigation Schemes namely Mathioya Irrigation Scheme denoted as Area 1 as shown in **Figure 7.7** and Gatanga Irigation Scheme denoted as Areas 9 &10 as shown in **Figure 7.3** were identified as potential schemes for development under the Strategy.These are described hereunder.

i) <u>Mathioya Irrigation Scheme (Area 1)</u>

The proposed Mathioya Irrigation Scheme (Area 1) is located 7km East of Kangema town, in 4BA catchment. The Scheme as envisaged in Strategy S2, will be supplied by gravity from the proposed Kayahwe 4 Dam. It encompasses existing and planned Irrigation Schemes within the proposed scheme area under the Murang'a County Government namely; Gacharaigu (50 ha), Mukurwe-Mweru (300 ha) and Nyanjigi (200ha). The location of the proposed Mathioya Irrigation Scheme is shown in **Figure 2.7** on **Page 2-19**.

The scheme basic information is shown on **Table 2.10** below.

Table 2.10: Basic Information – Mathioya Irrigation Scheme

Water source:	Kayahwe Dam Irrigation outlet at: +1,625 masl
Gross Irrigation Area:	1,570 ha
GIWR (annual)	2.0 MCM
GIWR (Peak in September)	0.3 MCM
GIWR* (Peak abstraction)	**10,731 m^3/day**
Conveyance pipe	400mm diameter steel pipe
Irrigation Method	Sprinkler and Drip

**GWIR- Gross Water Irrigation Requirements*

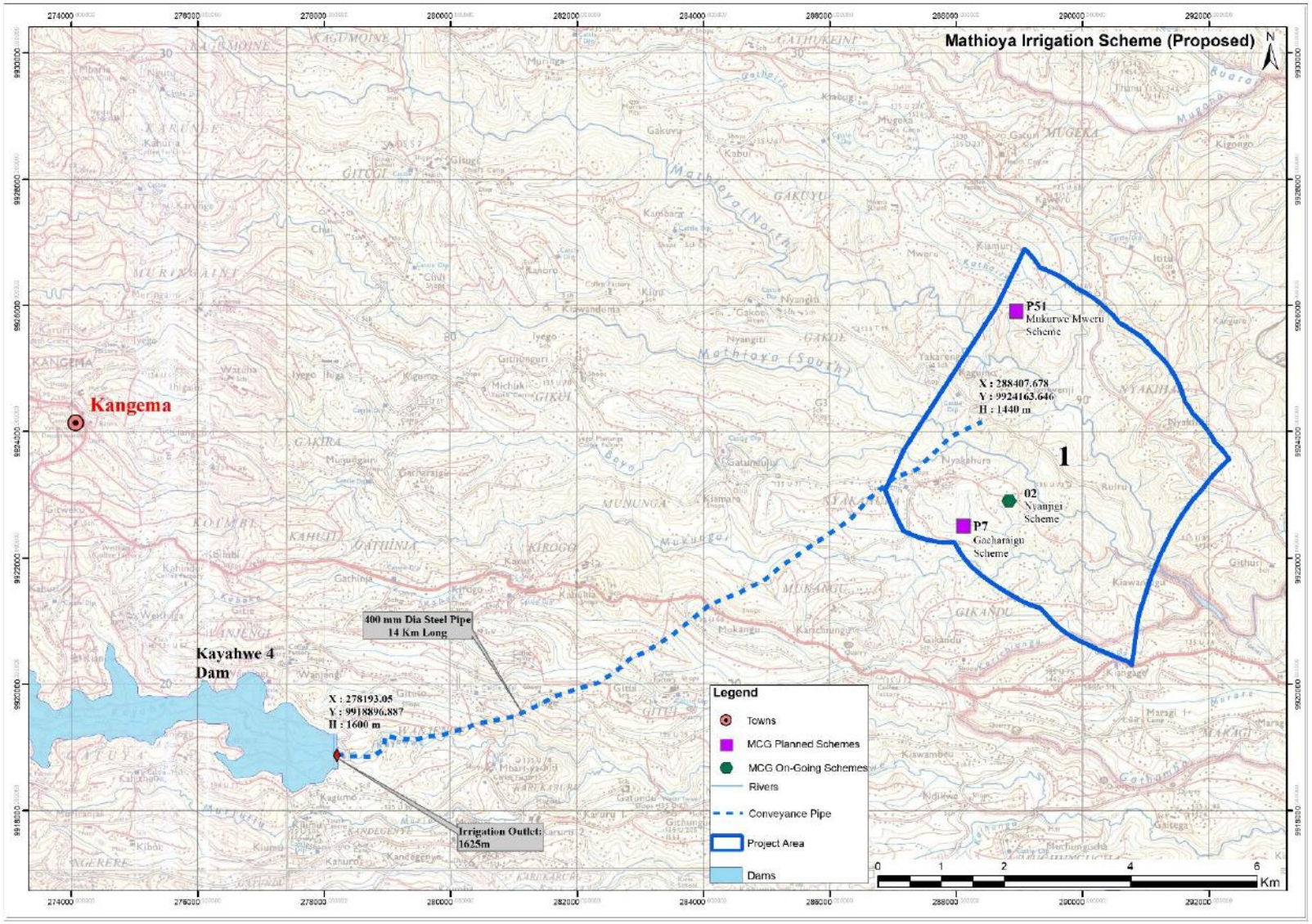

Figure 2.7: Location of Proposed Mathioya Irrigation Scheme

The Cropping Pattern adopted in estimation of Irrigation Water Demand for the proposed Mathioya Irrigation Scheme is shown on **Table 2.11** below.

Table 2.11: Cropping Pattern adopted for Mathioya Irrigation Sceme

Crop	Irrigated Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maize-1	10%			Maize									
Maize-2	10%									Maize			
Pulses-1	15%				Pulses								
Pulses-2	15%								Pulses				
Vegetables-1	10%				Vegetables								
Vegetables-2	10%								Vegetables				
Vegetables-3	10%	Vegetables											
Fruit trees	20%	Fruits											
% Scheme area occupied	100%	40%	30%	40%	55%	55%	55%	45%	45%	55%	55%	45%	30%

ii) <u>Gatanga Irrigation Scheme (Area 9&10)</u>

Location and details of the proposed Gatanga Irrigation Scheme are as described under the preceding Strategy S1. A recap of the basic information of the proposed Gatanga Irrigation Scheme is given in **Table 2.12** below.

Table 2.12: Basic Information – Gatanga Irrigation Scheme (Area 9 & 10)

Water source:	Groundwater well Irrigation outlet at: + 1,493 masl
Gross Irrigation Area:	Area 9: 550 ha Area 10: 550 ha Total: 1,100 ha
GIWR (annual)	1. 0 MCM
GIWR (Peak in September)	0. 2 MCM
GIWR* (Peak abstraction)	**6, 684 m^3/day**
Conveyance pipe	400/200mm diameter steel pipe
Irrigation Methods	Drip

**GWIR- Gross Water Irrigation Requirements*

Similar to Strategy S1, under Strategy S2, the proposed Gatanga Irrigation Scheme will be supplied by gravity from the proposed Mitubiri Wellfield.

c) Strategy S2 Project Components

The envisaged Project components for the proposed Water Resource Development for Murang'a County to meet Potable Water and Irrigation Demands under Strategy S2 are given in **Table 2.13** on **Page 2-21**.

Table 2.13: Strategy S2 Project Components

No.	Item	Year	Components
1	New Treatment Works (6Nr.) on Thika River Intake, Kimakia River Intake, Githika River Intake, Chathanda River Intake and Maragua River Intake, to treat currently supplied raw water	**2022**	• Construction of new Treatment Works Capacity 4,000m^3/day on Thika Intake to treat raw water currently served to Gatanga Area. • Construction of new Treatment Works Capacity 1,500m^3/day on Kimakia Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 1,000m^3/day on Kiama Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 2,500m^3/day on Githika Intake to treat raw water currently served Makomboki Sub-Location • Construction of new Treatment Works Capacity 3,500m^3/day on Chathanda Intake to treat raw water currently served to Kangari Urban Centre. • Construction of new Treatment Works Capacity 4,000m^3/day on Maragua Intake to treat raw water currently served to Maragua Ridge and Kambiti Areas.
2	New Treatment Works for raw water allocation to Murang'a County from the proposed Maragua 4 Dam	**2022**	• Construction of 1 No. Treatment Works Capacity 20,000m^3/day each from the proposed Maragau 4 Dam, • 500mm dia. Raw Water Gravity main, length 1.5km • 500mm dia. Treated Water Gravity mains, length 7km • 2Nr. Storage Tanks Capacity 1,500m^3 each
3	Construction of New Kayahwe 4 Dam	**2027**	• New 32m high Kayahwe 4 Dam (on Kayahwe River), Volume 30Mm^3, Safe Yield 60,100m^3/day • 350mm dia. Raw Water Gravity main, total length 5.5km • Construction of 1 No. Treatment Works Capacity 4,100m^3/day. • 250mm dia. Treated Water Pumping main, total length 19km • 2 No. Storage Tanks each capacity 1,000m^3 each
4	Ground Water	**2022**	• Development of Mitubiri well field capacity 10,000m^3/day, comprising of 10Nr. boreholes and accessories, high level storage tank and manifold.
5	Irrigation	**2022**	• 400mm dia. Steel Transmission Main, length 14Km from the proposed Kayahwe 4 Dam to the propose Mathioya Irrigation Scheme (Area 1) • 400mm dia. Steel Transmission Main, length 14Km from the proposed Mitubiri Wellfield to Area 10 of the proposed Gatanga Irrigation Scheme • 200mm dia. Steel Transmission Main, length 14Km from Area 10 to Area 9 of the proposed Gatanga Irrigation Scheme • Sedimentation Tank/ Detention Tank at terminal point of transmission main from the proposed Kayahwe 4 Dam, within the proposed Mathioya Irrigation Scheme.

A Summary Water Balance of the proposed Strategy S2 for Water Supply and Irrigation Requirements for Murang'a County is given in **Table 2.14** below and shown graphically on **Figure 2.8** on **Page 2-23**.

Table 2.14: Summary Water Balance of Proposed Strategies under Strategy S2

	Planning Horizon (Year)						
	2018	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Potable Water Demand	88,883	92,217	94,933	99,264	103,477	108,168	111,695
Irrigation Water Demand	17,415	17,415	17,415	17,415	17,415	17,415	17,415
Total Water Demand	106,298	109,632	112,348	116,679	120,892	125,583	129,110
Capacity of existing Developed Sources (2018)	96,616	96,616	96,616	96,616	96,616	96,616	96,616
Deficit/ Surplus in supply based on existing sources	-9,682	-13,016	-15,732	-20,063	-24,276	-28,967	-32,494
Proposed measures under Strategy S2							
Construction of 19,000m^3/day capacity Treatment Works for treated water supply allocated for Murang'a County from the proposed Maragua 4 Dam	-	19,000	19,000	19,000	19,000	19,000	19,000
Proposed Supply from Mitubiri Boreholes	-	-	10,000	10,000	10,000	10,000	10,000
Proposed Supply from Construction of Kayahwe 4 Dam, with 12,000m^3/day capacity Treatment Works for potable Water	-	-	60,100	60,100	60,100	60,100	60,100
Total Supply after Implementation of Strategy S2	96,616	115,616	185,716	185,716	185,716	185,716	185,716
Deficit/ Surplus in supply under Strategy S2	**-9,682**	**5,984**	**73,368**	**69,037**	**64,824**	**60,133**	**56,606**

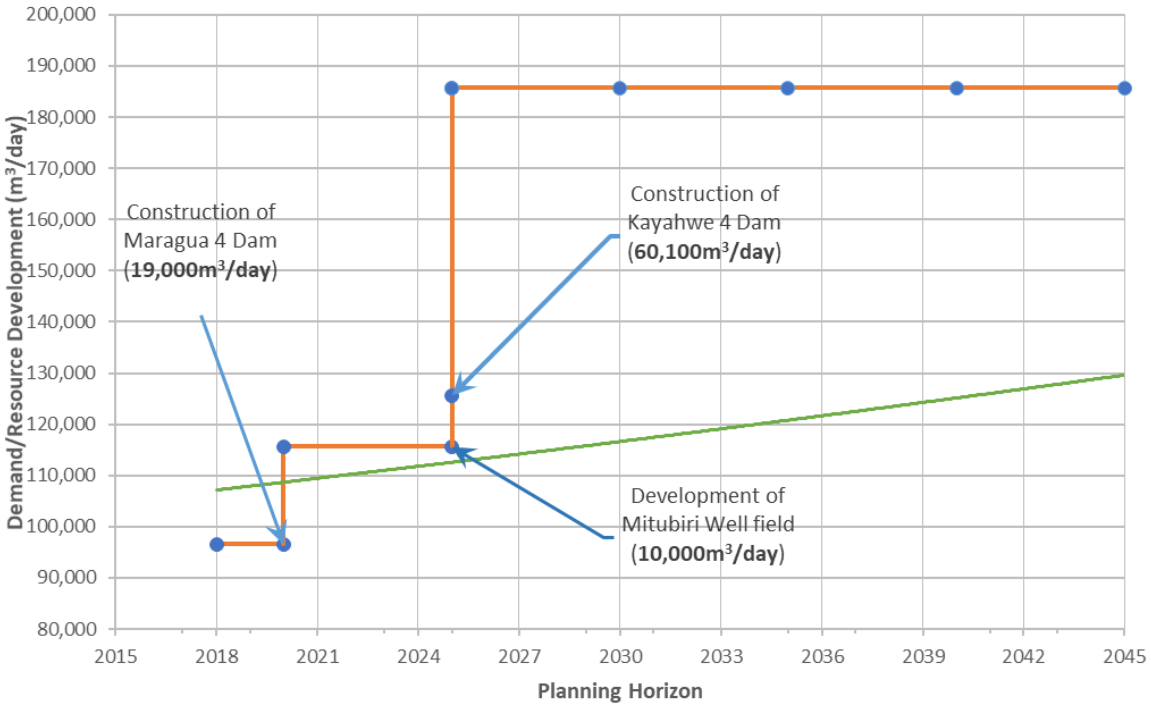

Figure 2.8: Development Phases under Strategy S2

Figure 2.9 on **Page 2-24** shows a schematic diagram of the proposed Project Components for Strategy S2.

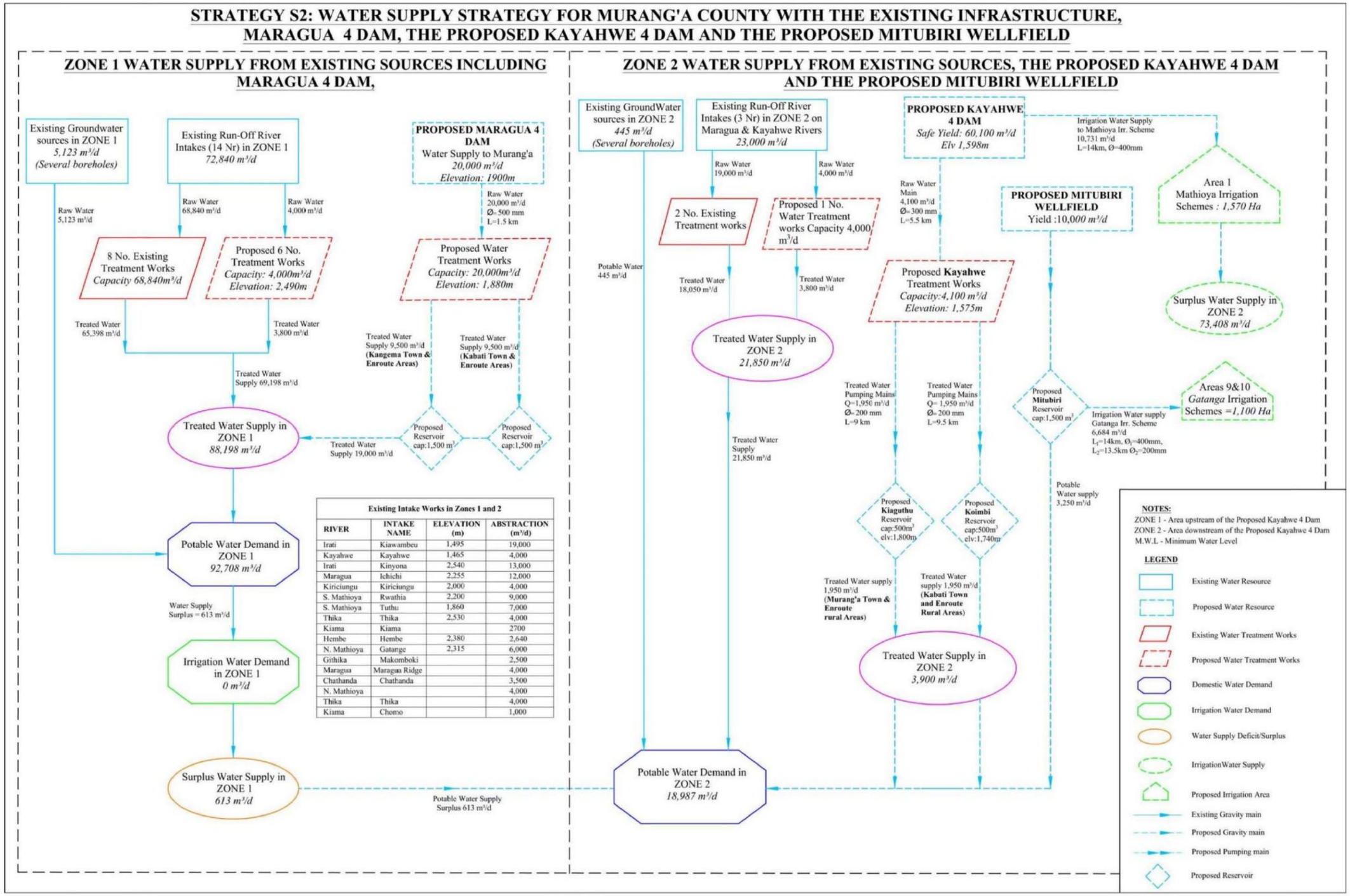

Figure 2.9: Schematic Diagram of Proposed Project Components under Strategy S2

2.6 Strategy S3; Development of Thika 3A Dam and Mitubiri Wellfield

The proposed Water Resources Development under Strategy S3 to meet the ultimate water and irrigation demands for Murang'a County entail:

- Continued abstraction of optimum yield from Existing 17Nr. Run-of-River Intakes; cumulative treated water supply capacity 91,048m³/day
- Continued abstraction from existing Ground Water Sources; cumulative optimum capacity 5,568m³/day
- Proposed Maragua 4 Dam, which is being developed under a separate programme by AWWDA for Water Supply for Nairobi and Satellite Towns; treated water supply allocated for Murang'a County 19,000m³/day
- Construction of Thika 3A Dam; Safe yield of 103,400m^3/day
- Development of Mitubiri Wellfield; 10,000m^3/day.

To ensure effective utilization of the existing water sources and infrastructure, it is necessary that they be rehabilitated to continue serving at their optimum design capacities up to the ultimate planning horizon. Detailed condition surveys have to be carried out to identify rehabilitation measures required to revert these existing systems to their optimum design capacities.

To improve the reliability of water supply from the existing run-of-the-river intakes, it is recommended to increase the height of the existing weirs or develop small dams (height<15m) to enhance storage and improve reliability of the sources during extreme drought periods.

Under Strategy **S3**, it is proposed that the existing sources be augumented by construction of the proposed Thika 3A Dam and development of the Mitubiri Wellfield, which will bridge the deficit in supply and continue meeting the projected demands for potable water and irrigation for the entire Murang'a County upto the Year 2045 planning horizon.

Under Strategy S3, priority has been given to potable water demand, with the surplus water allocated to irrigation demand, in line with guidelines stipulated in the MWI Design Practice Manual (2005).

a) Supply of Potable Water

The principle source considered in formulation of Strategy S3 of water supply to Murang'a County is the proposed Thika 3A Dam. To ensure equitable and economic distribution of potable water to the study area, the study area has been divided into two (2) Supply Zones (Zone 1 and Zone 2) based on the potential gravity command area of Thika 3A Dam as described hereunder and shown in **Figure 2.10** on **Page 2-27**.

i) Zone 1, Strategy S3

Zone 1 covers the area upstream of the proposed Thika 3A Dam. This Zone is proposed to be served from the existing 16Nr. run-of-river intakes (treated capacity 87,248m^3/day) and existing developed groundwater sources (835m^3/day), total combined treated water capacity 88,083m^3/day, and the allocation for Murang'a County from the proposed Maragua 4 Dam, treated water supply capacity 19,000m^3/day.

The total available water resource from the above listed existing sources and the proposed Maragua 4 Dam, for Zone 1, is 107,083m^3/day, against a projected ultimate potable water demand of 83,629m^3/day, resulting in a surplus of 23,454m^3/day.

ii) Zone 2, Strategy S3

Zone 2 covers the area downstream of the proposed Thika 3A Dam, which can be be supplied by gravity from the Dam. This zone is proposed to be supplied from existing 1Nr. run-of-river intakes (treated capacity 3,800m^3/day) and existing ground water sources capacity 4,733m^3/day, total combined treated water capacity 8,533m^3/day, from the proposed Dam which has a safe yield of 103,400m^3/day and from the proposed Mitubiri Wellfield, capacity 10,000m^3/day.

The total available water resource for Zone 2 is 121,933m^3/day, from the above mentioned sources, against a projected ultimate potable water demand of 28,066m^3/day, resulting in a surplus of 93,867 m^3/day.

A summary Water Balance for the potable water demand against available resource for the entire study area (Zone 1 and Zone 2) under Strategy S3 is given in **Table 2.15** below.

Table 2.15: Summary Water Balance for Potable Water Demand under Strategy S3

Zone 1, Strategy S3	
Projected Water Demand (Year 2045)	83,629 m^3/day
Existing available sources (16Nr. Surface water and developed Groundwater Sources)	88,083 m^3/day
Proposed Maragua 4 Dam (Treated Water Supply allocation for Murang'a County)	19,000 m^3/day
Total available resource	**107,083 m^3/day**
Surplus in Zone 1 (available for Irrigation)	23,454 m^3/day
Zone 2, Strategy S3	
Projected Water Demand (Year 2045)	28,066 m^3/day
Existing available sources (1Nr. Surface water and developed Groundwater Sources)	8,533 m^3/day
Proposed Mitubiri Wellfield	10,000 m^3/day
Proposed Thika 3A Dam	103,400 m^3/day
Total available resource	**121,933 m^3/day**
Surplus in Zone 2 (available for Irrigation)	93,867m^3/day
Overall Potable Water Balance (Year 2045), Strategy S3	
Projected potable water demand (year 2045)	111,695 m^3/day
Existing available sources	96,616 m^3/day
Proposed New Sources	132,400 m^3/day
Total available Resource	**229,016 m^3/day**
Total Surplus for Zone 1 and Zone 2 (available for irrigation)	117,321 m^3/day

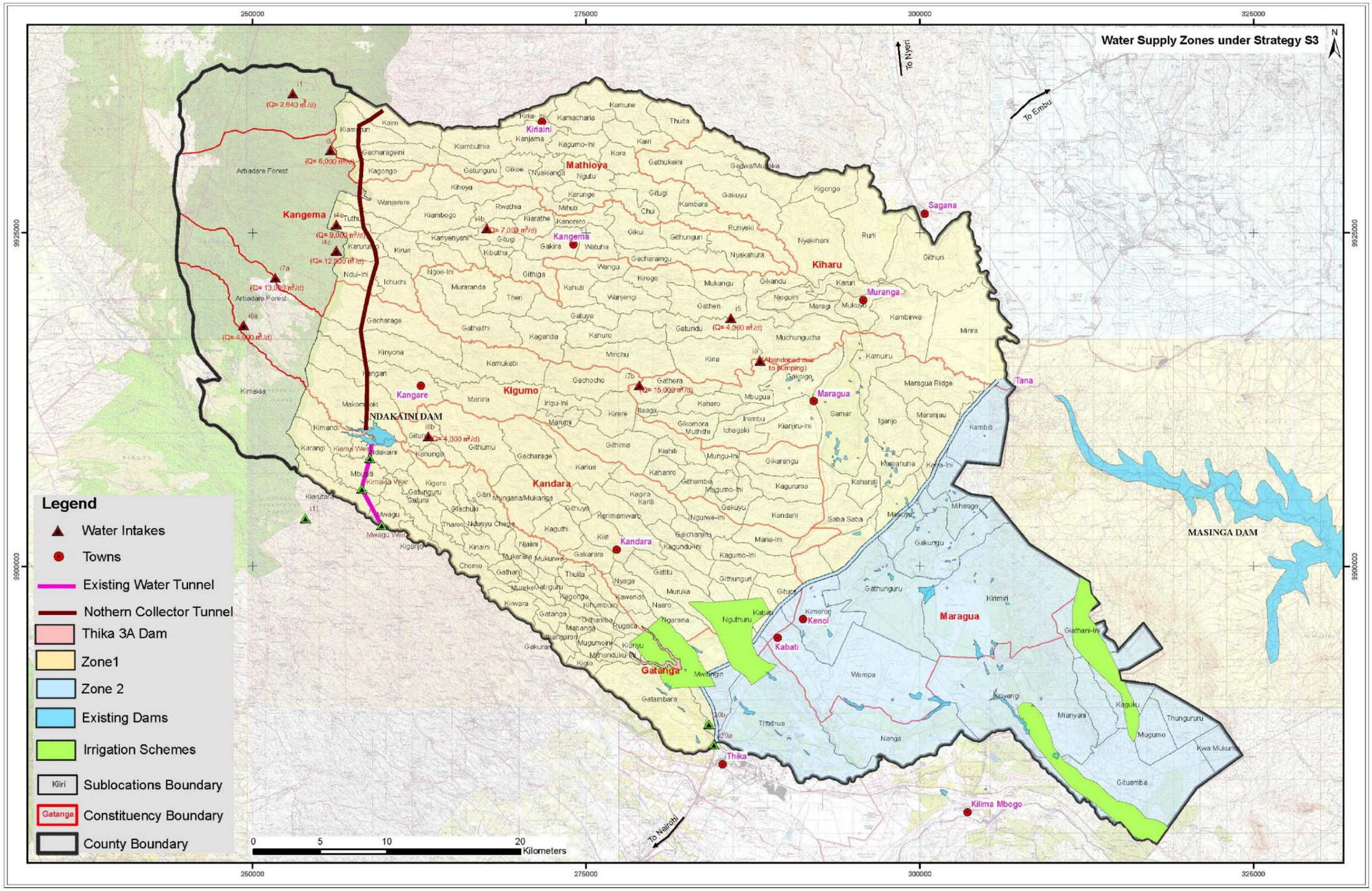

Figure 2.10: Water Supply Zones under Strategy S3

b) Supply of Irrigation Water

Irrigation Water Demand for consideration under Strategy S3 was estimated based on pre-identified irrigation schemes that were deemed to be technically and Economically viable to be supplied from the surplus in water resource after meeting the Potable Water Demand. The principle Sources identified as suitable for meeting irrigation water demand under this Strategy are the proposed Thika 3A Dam and the proposed Mitubiri Wellfield.
Under Strategy S3, 3Nr. Irrigation Schemes namely Makindi Irrigation Scheme, Thika 3A Irrigation Scheme and Gatanga Irrigation Scheme have been identified as potential schemes for development under the Strategy S3. These are described hereunder.

i) <u>Makindi Irrigation Scheme (Area 6)</u>

The proposed Makindi Irrigation Scheme (Area 6) is located 2Km to the East of Kabati Urban Center in 4CC catchment, in Kandara Constituency as shown in **Figure 2.11** on **Page 2-29.** The Scheme as envisaged, will be supplied by pumping from the proposed Thika 3A Dam.

The scheme basic information for the proposed Makindi Irrigation Scheme is shown on **Table 2.16** below.

Table 2.16: Basic Information – Makindi Irrigation Scheme (Area 6)

Water source:	Thika 3A Dam Pumping to scheme head at: +1,695 masl
Gross Irrigation Area:	Area 6: 1,600 ha
GIWR (annual)	1.4 MCM
GIWR (Peak in February)	0.3 MCM
GIWR* (Peak abstraction)	**8,599 m^3/day**
Conveyance pipe	400mm diameter steel pipe
Irrigation Methods	Sprinkler /Drip

**GWIR- Gross Water Irrigation Requirements*

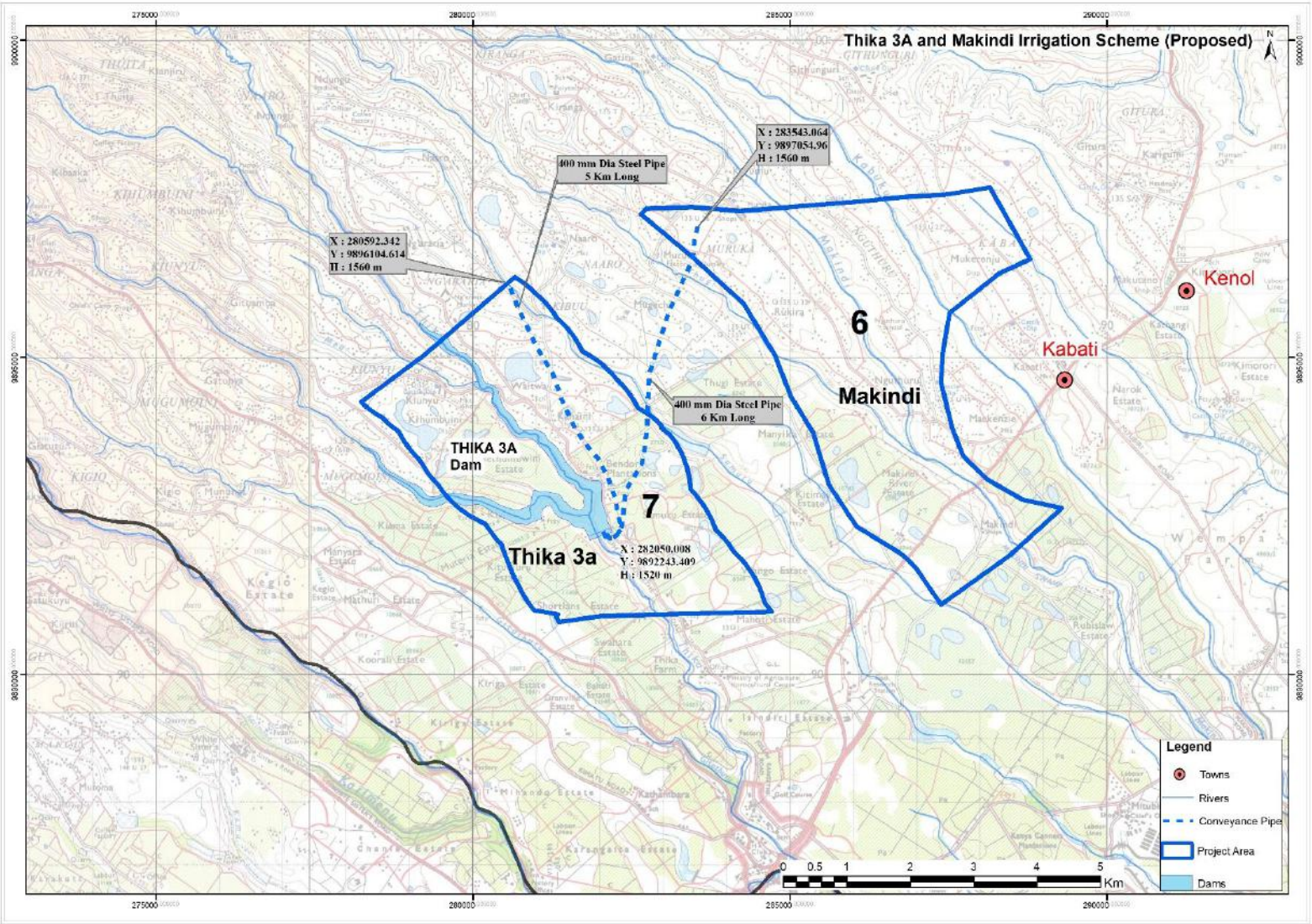

Figure 2.11: Location of proposed Makindi and Thika 3A Irrigation Schemes (Areas 6 & 7)

The Cropping Pattern adopted in estimation of Irrigation Water Demand for the proposed Makindi Irrigation Scheme is shown on **Table 2.17** below.

Table 2.17: Cropping Pattern Adopted for the Proposed Makindi Irrigation Scheme

Crop	Irrigated Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maize-1	5%			Maize									
Maize-2	5%									Maize			
Pulses-1	10%				Pulses								
Pulses-2	10%								Pulses				
Vegetables-1	20%				Vegetables								
Vegetables-2	20%								Vegetables				
Vegetables-3	20%	Vegetables											
Fruit trees	10%	Fruits											
% Scheme area occupied	100%	35%	30%	35%	45%	45%	45%	25%	40%	45%	45%	25%	15%

ii) Thika 3A Irrigation Scheme (Area 7)

The proposed Thika 3A Irrigation Scheme is located 5Km to the North East of Thika Town, adjacent to the proposed Thika 3A Dam Site, in 4CC and 4CB catchments. The Scheme lies within Kandara and Gatanga constituencies. **Figure 2.11** on **Page 2-29** shows the location of the proposed Thika 3A Irrigation Scheme (Area 7) and the proposed Makindi Irrigation Scheme (Area 6). The Scheme as envisaged, will be supplied by pumping from the proposed Thika 3A Dam.

The scheme basic information for the proposed Thika 3A Irrigation Scheme is shown on **Table 2.18** below.

Table 2.18: Basic Information – Thika 3A Irrigation Scheme (Area 7)

Water source:	Thika 3A Dam Irrigation outlet at: +1,524 masl
Pump station	2No. Irrigation Pumps 75kW electric motor c/w accessories
Gross Irrigation Area:	Area 7: 1,360 ha
GIWR (annual)	1.2 MCM
GIWR (Peak in February)	0.2 MCM
GIWR* (Peak abstraction)	**7,309 m^3/day**
Conveyance pipe	400mm diameter steel pipe
Irrigation Methods	Sprinkler and Drip

**GWIR- Gross Water Irrigation Requirements*

The Cropping Pattern adopted in estimation of Irrigation Water Demand for the proposed Thika 3A Irrigation Scheme is shown on **Table 2.19** below.

Table 2.19: Cropping Pattern Adopted for the Proposed Thika 3A Irrigation Scheme

Crop	Irrigated Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maize-1	5%			Maize									
Maize-2	5%									Maize			
Pulses-1	10%				Pulses								
Pulses-2	10%								Pulses				
Vegetables-1	20%				Vegetables								
Vegetables-2	20%								Vegetables				
Vegetables-3	20%	Vegetables											
Fruit trees	10%	Fruits											
% Scheme area occupied	100%	35%	30%	35%	45%	45%	45%	25%	40%	45%	45%	25%	15%

iii) Gatanga Irrigation Scheme (Area 9&10)

Location and details of the proposed Gatanga Irrigation Scheme are as described under the preceding Strategy S1. A recap of the basic information of the proposed Gatanga Irrigation Scheme is given in **Table 2.20** below.

Table 2.20: Basic Information – Gatanga Irrigation Scheme (Area 9 & 10)

Water source:	Groundwater well Irrigation outlet at: + 1,493 masl
Gross Irrigation Area:	Area 9: 550 ha Area 10: 550 ha Total: 1,100 ha
GIWR (annual)	1. 0 MCM
GIWR (Peak in September)	0. 2 MCM
GIWR* (Peak abstraction)	**6, 684 m3/day**
Conveyance pipe	400/200mm diameter steel pipe
Irrigation Methods	Drip

**GWIR- Gross Water Irrigation Requirements*

Similar to Strategy S1 and S2, under Strategy S3, the proposed Gatanga Irrigation Scheme will be supplied by gravity from the proposed Mitubiri Wellfield.

c) Strategy S3 Project Components

The envisaged Project components for the proposed Water Resource Development for Murang'a County to meet Potable Water and Irrigation Demands under Strategy S3 are given in **Table 2.21** on **Page 2-32**.

Table 2.21: Strategy S3 Project Components

No.	Item	Year	Components
1	New Treatment Works (6Nr.) on Thika River Intake, Kimakia River Intake, Githika River Intake, Chathanda River Intake and Maragua River Intake, to treat currently supplied raw water	**2022**	• Construction of new Treatment Works Capacity 4,000m^3/day on Thika Intake to treat raw water currently served to Gatanga Area. • Construction of new Treatment Works Capacity 1,500m^3/day on Kimakia Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 1,000m^3/day on Kiama Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 2,500m^3/day on Githika Intake to treat raw water currently served Makomboki Sub-Location • Construction of new Treatment Works Capacity 3,500m^3/day on Chathanda Intake to treat raw water currently served to Kangari Urban Centre. • Construction of new Treatment Works Capacity 4,000m^3/day on Maragua Intake to treat raw water currently served to Maragua Ridge and Kambiti Areas.
2	New Treatment Works for raw water allocation to Murang'a County from the proposed Maragua 4 Dam	**2022**	• Construction of 1 No. Treatment Works Capacity 20,000m^3/day each from the proposed Maragau 4 Dam, • 500mm dia. Raw Water Gravity main, length 1.5km • 500mm dia. Treated Water Gravity mains, length 7km • 2Nr. Storage Tanks Capacity 1,500m3 each
3	Ground Water	**2022**	• Development of Mitubiri well field capacity 10,000m^3/day, comprising of 10Nr. boreholes and accessories, high level storage tank and manifold.
4	Construction of New Thika 3A Dam	2027	• New 27m high Thika 3A Dam (on Thika River), Volume 10Mm^3, Safe Yield 103,400m^3/day
5	Irrigation	**2027**	• Construction of Raw Water Pumping Station downstream of the proposed Dam • 400mm dia. Steel Rising Mains, total length 11Km from the proposed Thika 3A Dam to the propose Makindi and Thika 3A Irrigation Schemes (Areas 6 & 7) • 400mm dia. Steel Transmission Main, length 14Km from the proposed Mitubiri Wellfield to Area 10 of the proposed Gatanga Irrigation Scheme • 200mm dia. Steel Transmission Main, length 14Km from Area 10 to Area 9 of the proposed Gatanga Irrigation Scheme • Construction of 2Nr. Sedimentation Tanks/ Detention Tanks at terminal point of rising mains from the proposed Thika 3A Dam, within the proposed Makindi and Thika 3A Irrigation Schemes.

A Summary Water Balance of the proposed Strategy S3 for Water Supply and Irrigation Requirements for Murang'a County is given in **Table 2.22** and shown graphically on **Figure 2.12** on **Page 2-34.**

Table 2.22: Summary Water Balance of Proposed Strategy S3

	Planning Horizon (Year)						
	2018	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Potable Water Demand	88,883	92,217	94,933	99,264	103,477	108,168	111,695
Irrigation Water Demand	15,908	15,908	15,908	15,908	15,908	15,908	15,908
Total Water Demand	104,791	108,125	110,841	115,172	119,385	124,076	127,603
Capacity of existing Developed Sources (2018)	96,616	96,616	96,616	96,616	96,616	96,616	96,616
Deficit/ Surplus in supply based on existing sources	-8,175	-11,509	-14,225	-18,556	-22,769	-27,460	-30,987
Proposed measures under Strategy S3							
Construction of 19,000m^3/day capacity Treatment Works for treated water supply allocated for Murang'a County from the proposed Maragua 4 Dam	-	19,000	19,000	19,000	19,000	19,000	19,000
Proposed Supply from Mitubiri Boreholes	-	-	10,000	10,000	10,000	10,000	10,000
Proposed Supply from Construction of Thika 3A Dam, with 8,000m^3/day capacity Treatment Works for potable Water	-	-	103,400	103,400	103,400	103,400	103,400
Total Supply after Implementation of Strategy S3	96,616	115,616	229,016	229,016	229,016	229,016	229,016
Deficit/ Surplus in supply under Strategy S3	**-8,175**	**7,491**	**118,175**	**113,844**	**109,631**	**104,940**	**101,413**

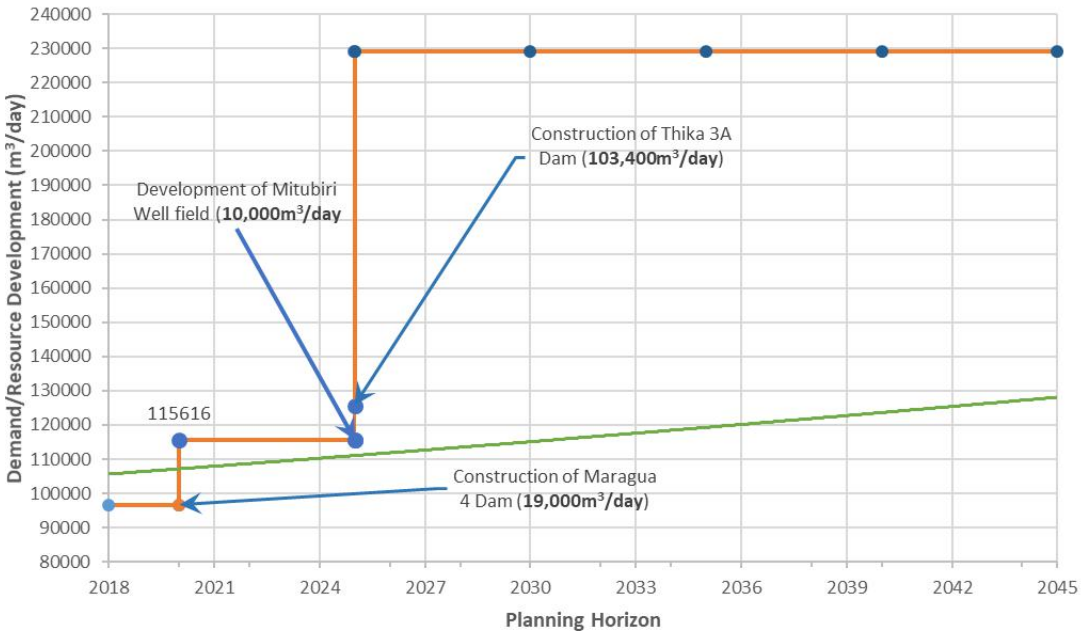

Figure 2.12: Development Phases under Strategy S3

Figure 2.13 on **Page 2-34** shows a schematic diagram of the proposed Project Components under Strategy S3.

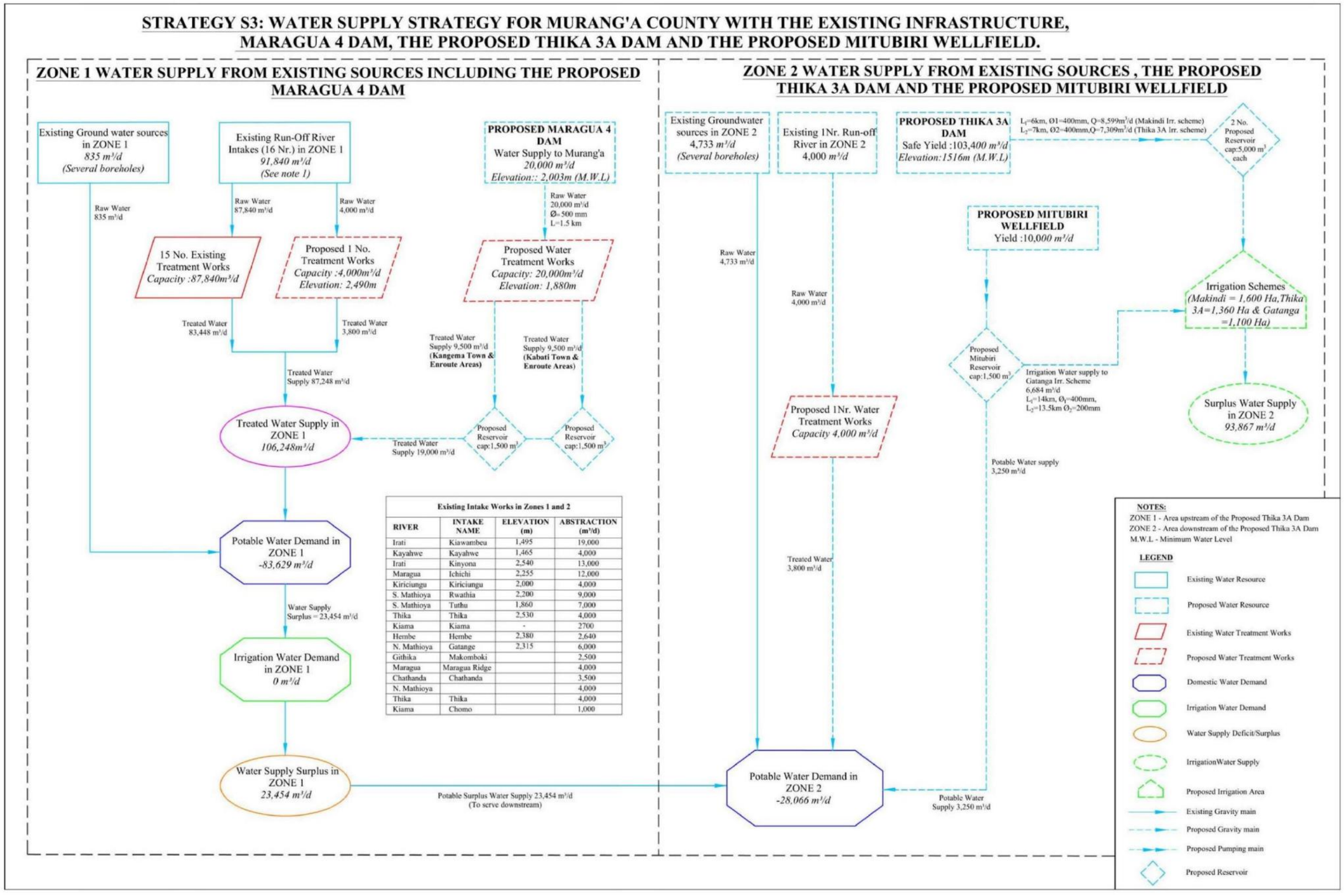

Figure 2.13: Schematic Diagram of Proposed Project Components under Strategy S3

2.7 Strategy S4; Development of Thika 3A Dam

Strategy S4 was largely developed from Strategy S3, by deleting the option for Development of the Mitubiri Wellfield. The proposed Water Resources Development under Strategy S4 to meet the ultimate potable water and irrigation demands for Murang'a County entail:

- Continued abstraction of optimum yield from Existing 17Nr. Run-of-River Intakes; cumulative treated water supply capacity 91,048m³/day
- Continued abstraction from existing Ground Water Sources; cumulative optimum capacity 5,568m³/day
- Proposed Maragua 4 Dam, which is being developed under a separate programme by AWWDA for Water Supply for Nairobi and Satellite Towns; treated water supply allocated for Murang'a County 19,000m³/day
- Construction of Thika 3A Dam; Safe yield of 103,400m^3/day.

To ensure effective utilization of the existing water sources and infrastructure, it is necessary that they be rehabilitated to continue serving at their optimum design capacities up to the ultimate planning horizon. Detailed condition surveys have to be carried out to identify rehabilitation measures required to revert these existing systems to their optimum design capacities.

To improve the reliability of water supply from the existing run-of-the-river intakes, it is recommended to increase the height of the existing weirs or develop small dams (height<15m) to enhance storage and improve reliability of the sources during extreme drought periods.

Under Strategy **S4**, it is proposed that the existing sources be augumented by construction of the proposed Thika 3A, which will bridge the deficit in supply and continue meeting the projected demands for potable water and irrigation for the entire Murang'a County upto the Year 2045 planning horizon.

Under Strategy S4, priority has been given to potable water demand, with the surplus water allocated to irrigation demand, in line with guidelines stipulated in the MWI Design Practice Manual (2005).

a) Supply of Potable Water

The principle source considered in formulation of Strategy S4 of water supply to Murang'a County is the proposed Thika 3A Dam. To ensure equitable and economic distribution of potable water to the study area, the study area has been divided into two (2) Supply Zones (Zone 1 and Zone 2) based on the potential gravity command area of Thika 3A Dam as described hereunder and shown in **Figure 2.10** on **Page 2-27**.

i) Zone 1, Strategy S4

Zone 1 covers the area upstream of the proposed Thika 3A Dam. This Zone is proposed to be served from the existing 16Nr. run-of-river intakes (treated capacity 87,248m^3/day) and existing developed groundwater sources (835m^3/day), total combined treated water capacity 88,083m^3/day, and the allocation for Murang'a County from the proposed Maragua 4 Dam, treated water supply capacity 19,000m^3/day.

The total available water resource from the above listed existing sources and the proposed Maragua 4 Dam, for Zone 1, is 107,083m^3/day, against a projected ultimate potable water demand of 83,629m^3/day, resulting in a surplus of 23,454m^3/day.

ii) Zone 2, Strategy S4

Zone 2 covers the area downstream of the proposed Thika 3A Dam, which can be be supplied by gravity from the Dam. This zone is proposed to be supplied from existing 1Nr. run-of-river intakes (treated capacity 3,800m^3/day) and existing ground water sources capacity 4,733m^3/day, total combined treated water capacity 8,533m^3/day, from the proposed Dam which has a safe yield of 103,400m^3/day.

The total available water resource for Zone 2 is 111,933m^3/day, from the above mentioned sources, against a projected ultimate potable water demand of 28,066m^3/day, resulting in a surplus of 83,867 m^3/day.

A summary Water Balance for the potable water demand against available resource for the entire study area under Strategy S4 is given in **Table 2.23** below.

Table 2.23: Summary Water Balance for Potable Water Demand under Strategy S4

Zone 1, Strategy S4	
Projected Water Demand (Year 2045)	83,629 m^3/day
Existing available sources (16Nr. Surface water and developed Groundwater Sources)	88,083 m^3/day
Proposed Maragua 4 Dam (Treated Water Supply allocation for Murang'a County)	19,000 m^3/day
Total available resource	**107,083 m^3/day**
Surplus in Zone 1 (available for Irrigation)	23,454 m^3/day
Zone 2, Strategy S4	
Projected Water Demand (Year 2045)	28,066 m^3/day
Existing available sources (1Nr. Surface water and developed Groundwater Sources)	8,533 m^3/day
Proposed Thika 3A Dam	103,400 m^3/day
Total available resource	**111,933 m^3/day**
Surplus in Zone 2 (available for Irrigation)	83,867m^3/day
Overall Potable Water Balance (Year 2045), Strategy S4	
Projected potable water demand (year 2045)	111,695 m^3/day
Existing available sources	96,616 m^3/day
Proposed New Sources	122,400 m^3/day
Total available Resource	**219,016 m^3/day**
Total Surplus for Zone 1 and Zone 2 (available for irrigation)	107,321 m^3/day

b) Supply of Irrigation Water

The 3Nr. Irrigation Schemes identified as potential schemes for irrigation under Strategy S3 have also been adopted under Strategy S4. Details of the proposed Schemes as described under Strategy S3 remain unchanged, except that under Strategy S4, the proposed Gatanga Irrigation Scheme will be supplied by gravity from the proposed Thika 3A Dam. A Location Plan of the proposed Gatanga Irrigation Scheme, including alignment of the proposed Transmission Main is shown in **Figure 2.14** on **Page 2-38**.

The Scheme Basic Information for the 3Nr. Irrigation Schemes is given in **Table 2.24** below.

Table 2.24: Basic information of Proposed Irrigation Schemes under Strategy S4

Proposed Makindi Irrigation Scheme (Area 6)	
Water source:	Thika 3A Dam Pumping to scheme head at: +1,695 masl
Gross Irrigation Area:	Area 6: 1,600 ha
GIWR (annual)	1.4 MCM
GIWR (Peak in February)	0.3 MCM
GIWR* (Peak abstraction)	**8,599 m^3/day**
Conveyance pipe	400mm diameter steel pipe
Irrigation Methods	Sprinkler /Drip
Proposed Thika 3A Irrigation Scheme (Area 7)	
Water source:	Thika 3A Dam Irrigation outlet at: +1,524 masl
Pump station	2No. Irrigation Pumps 75kW electric motor c/w accessories
Gross Irrigation Area:	Area 7: 1,360 ha
GIWR (annual)	1.2 MCM
GIWR (Peak in February)	0.2 MCM
GIWR* (Peak abstraction)	**7,309 m^3/day**
Proposed Gatanga Irrigation Scheme (Area 9 &10)	
Water source:	Thika 3A Dam Irrigation outlet at: +1,524 masl
Gross Irrigation Area:	Area 9: 550 ha Area 10: 550 ha Total: 1,100 ha
GIWR (annual)	1. 0 MCM
GIWR (Peak in September)	0. 2 MCM
GIWR* (Peak abstraction)	**6, 684 m3/day**
Conveyance pipe	400/200mm diameter steel pipe
Irrigation Methods	Drip

**GWIR- Gross Water Irrigation Requirements*

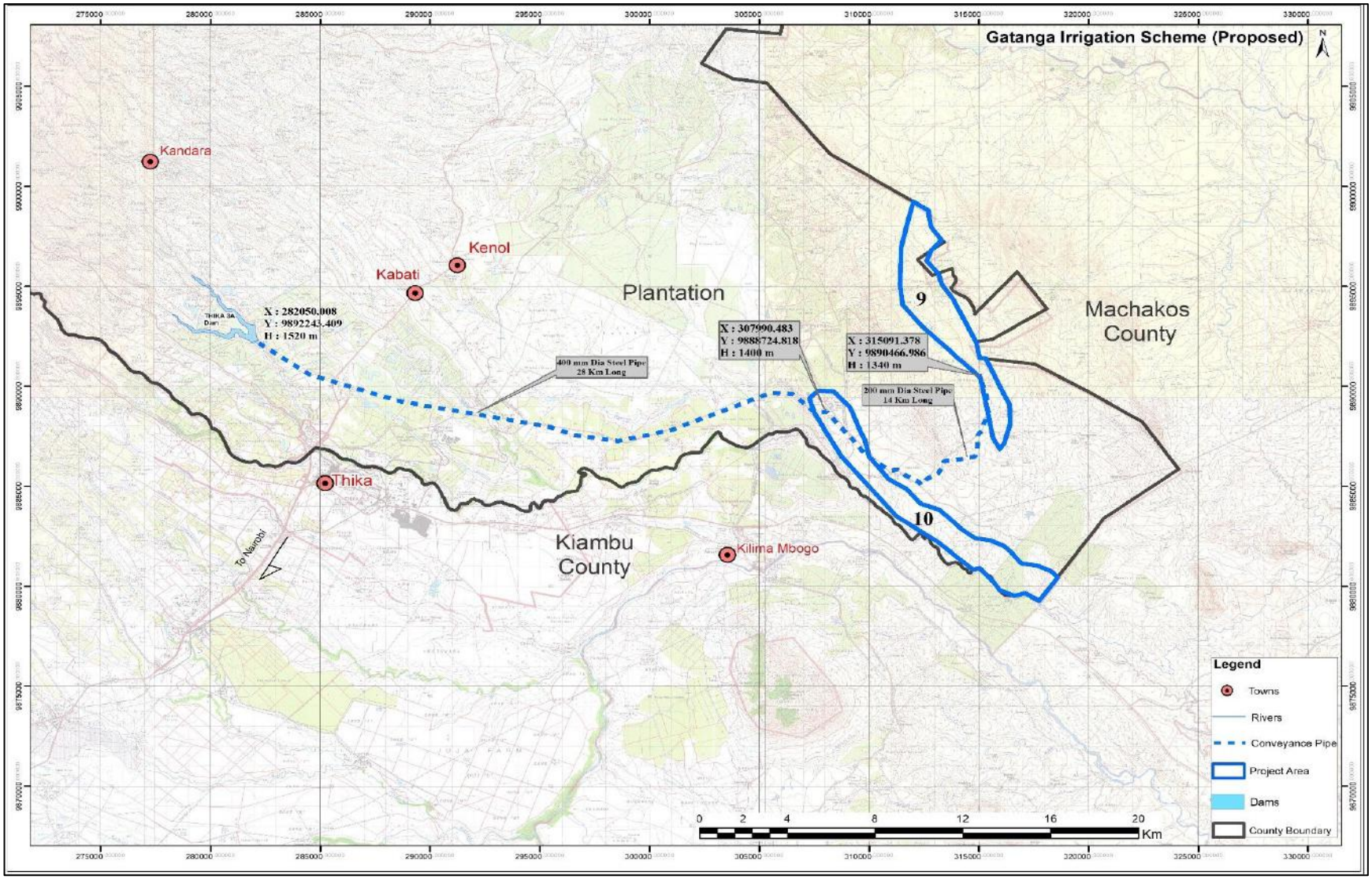

Figure 2.14: Location of Gatanga Irrigation Scheme (Areas 9 & 10)

c) Strategy S4 Project Components

The envisaged Project components for the proposed Water Resource Development for Murang'a County to meet Potable Water and Irrigation Demands under Strategy S4 are given in **Table 2.25** below.

Table 2.25: Strategy S4 Project Components

No.	Item	Year	Components
1	New Treatment Works (6Nr.) on Thika River Intake, Kimakia River Intake, Githika River Intake, Chathanda River Intake and Maragua River Intake, to treat currently supplied raw water	**2022**	• Construction of new Treatment Works Capacity 4,000m^3/day on Thika Intake to treat raw water currently served to Gatanga Area. • Construction of new Treatment Works Capacity 1,500m^3/day on Kimakia Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 1,000m^3/day on Kiama Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 2,500m^3/day on Githika Intake to treat raw water currently served Makomboki Sub-Location • Construction of new Treatment Works Capacity 3,500m^3/day on Chathanda Intake to treat raw water currently served to Kangari Urban Centre. • Construction of new Treatment Works Capacity 4,000m^3/day on Maragua Intake to treat raw water currently served to Maragua Ridge and Kambiti Areas.
2	New Treatment Works for raw water allocation to Murang'a County from the proposed Maragua 4 Dam	**2022**	• Construction of 1 No. Treatment Works Capacity 20,000m^3/day each from the proposed Maragau 4 Dam, • 500mm dia. Raw Water Gravity main, length 1.5km • 500mm dia. Treated Water Gravity mains, length 7km • 2Nr. Storage Tanks Capacity 1,500m^3 each
3	Construction of New Thika 3A Dam	2027	• New 27m high Thika 3A Dam (on Thika River), Volume 10Mm^3, Safe Yield 103,400m^3/day
4	Irrigation	**2027**	• Construction of Raw Water Pumping Station downstream of the proposed Dam • 400mm dia. Steel Rising Mains, total length 11Km from the proposed Thika 3A Dam to the propose Makindi and Thika 3A Irrigation Schemes (Areas 6 & 7) • 400/200mm dia. Steel Gravity Main, total length 42km from Proposed Dam to proposed Gatanga Irrigation Scheme (Areas 9 & 10). • Construction of 3Nr. Sedimentation Tanks/ Detention Tanks at terminal point of rising mains from the proposed Thika 3A Dam, within the proposed Makindi, Thika 3A and Gatanga Irrigation Schemes.

A Summary Water Balance of the proposed Strategy S4 for Water Supply and Irrigation Requirements for Murang'a County is given in **Table 2.26** on **Page 2-40** and shown graphically on **Figure 2.15.**

Table 2.26: Summary Water Balance of Proposed Strategy S4

	Planning Horizon (Year)						
	2018	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Potable Water Demand	88,883	92,217	94,933	99,264	103,477	108,168	111,695
Irrigation Water Demand	22,592	22,592	22,592	22,592	22,592	22,592	22,592
Total Water Demand	111,475	114,809	117,525	121,856	126,069	130,760	134,287
Capacity of existing Developed Sources (2018)	96,616	96,616	96,616	96,616	96,616	96,616	96,616
Deficit/ Surplus in supply based on existing sources	-14,859	-18,193	-20,909	-25,240	-29,453	-34,144	-37,671
Proposed measures under Strategy S4							
Construction of 19,000m^3/day capacity Treatment Works for treated water supply allocated for Murang'a County from the proposed Maragua 4 Dam	-	19,000	19,000	19,000	19,000	19,000	19,000
Proposed Supply from Construction of Thika 3A Dam, with 8,000m^3/day capacity Treatment Works for potable Water	-	-	103,400	103,400	103,400	103,400	103,400
Total Supply after Implementation of Strategy S4	96,616	115,616	219,016	219,016	219,016	219,016	219,016
Deficit/ Surplus in supply under Strategy S4	**-14,859**	**1,807**	**101,491**	**97,160**	**92,947**	**88,256**	**84,729**

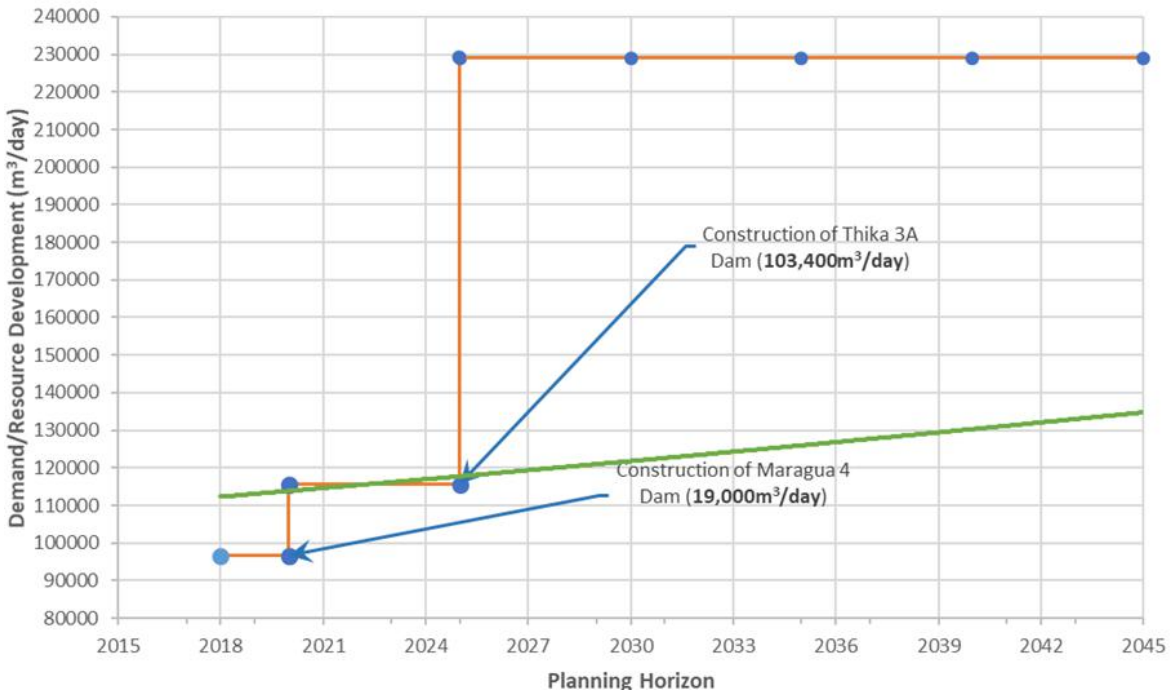

Figure 2.15: Development Phases under Strategy S4

Figure 2.16 on **Page 2-41** shows a schematic diagram of the proposed Project Components for Strategy S4.

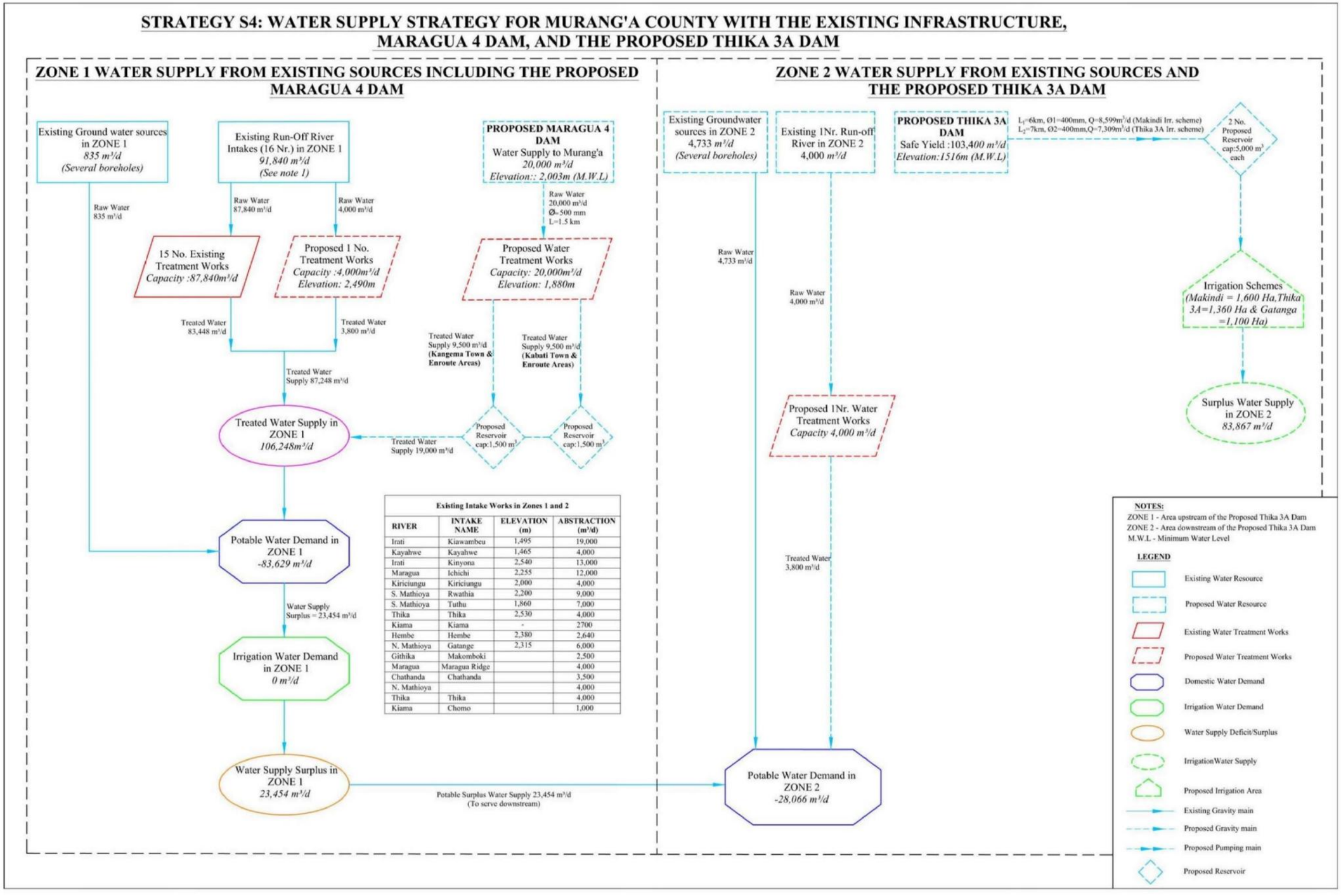

Figure 2.16: Schematic Diagram of Proposed Project Components under Strategy S4

2.8 Strategy S5; Development of Maragua B Dam and Mitubiri wellfield

In Strategy S5, the proposed Water Resources Development Strategies to meet the ultimate potable water and irrigation demands for Murang'a County entail:

- Continued abstraction of optimum yield from Existing 17Nr. Run-of-River Intakes; cumulative treated water supply capacity 91,048m³/day
- Continued abstraction from existing developed Ground Water sources; cumulative optimum capacity 5,568m³/day
- Proposed Maragua 4 Dam, which is being developed under a separate programme by AWWDA for Water Supply for Nairobi and Satellite Towns; treated water supply allocated for Murang'a County 19,000m³/day
- Construction of Maragua B Dam; Safe yield of 173,400m³/day
- Development of Mitubiri Wellfield; 10,000m³/day

To ensure effective utilization of the existing water sources and infrastructure, it is necessary that they be rehabilitated to continue serving at their optimum design capacities up to the ultimate planning horizon. Detailed condition surveys have to be carried out to identify rehabilitation measures required to revert these existing systems to their optimum design capacities.

To improve the reliability of water supply from the existing run-of-the-river intakes, it is recommended to increase the height of the existing weirs or develop small dams (height<15m) to enhance storage and improve reliability of the sources during extreme drought periods.

Under Strategy **S5**, it is proposed that the existing sources be augmented by construction of the proposed Maragua B Dam and development of the Mitubiri Wellfield, which will bridge the deficit in supply and continue meeting the projected demands for potable water and irrigation for the entire Murang'a County upto the Year 2045 planning horizon.

Under Strategy S5, priority has been given to potable water demand, with the surplus water allocated to irrigation demand, in line with guidelines stipulated in the MWI Design Practice Manual (2005).

a) Supply of Potable Water

The principle source considered in formulation of Strategy S5 of water supply to Murang'a County is Maragau B Dam. The study area has been divided into two (2) Supply Zones (Zone 1 and Zone 2). Zone 1 **excludes** all areas that are to be supplied from the Maragua B Dam while Zone 2 covers the area proposed to be supplied from the Maragua B Dam. The two supply Zones proposed under Strategy S5 are shown in **Figure 2.17** on **Page 2-43** and described thereafter.

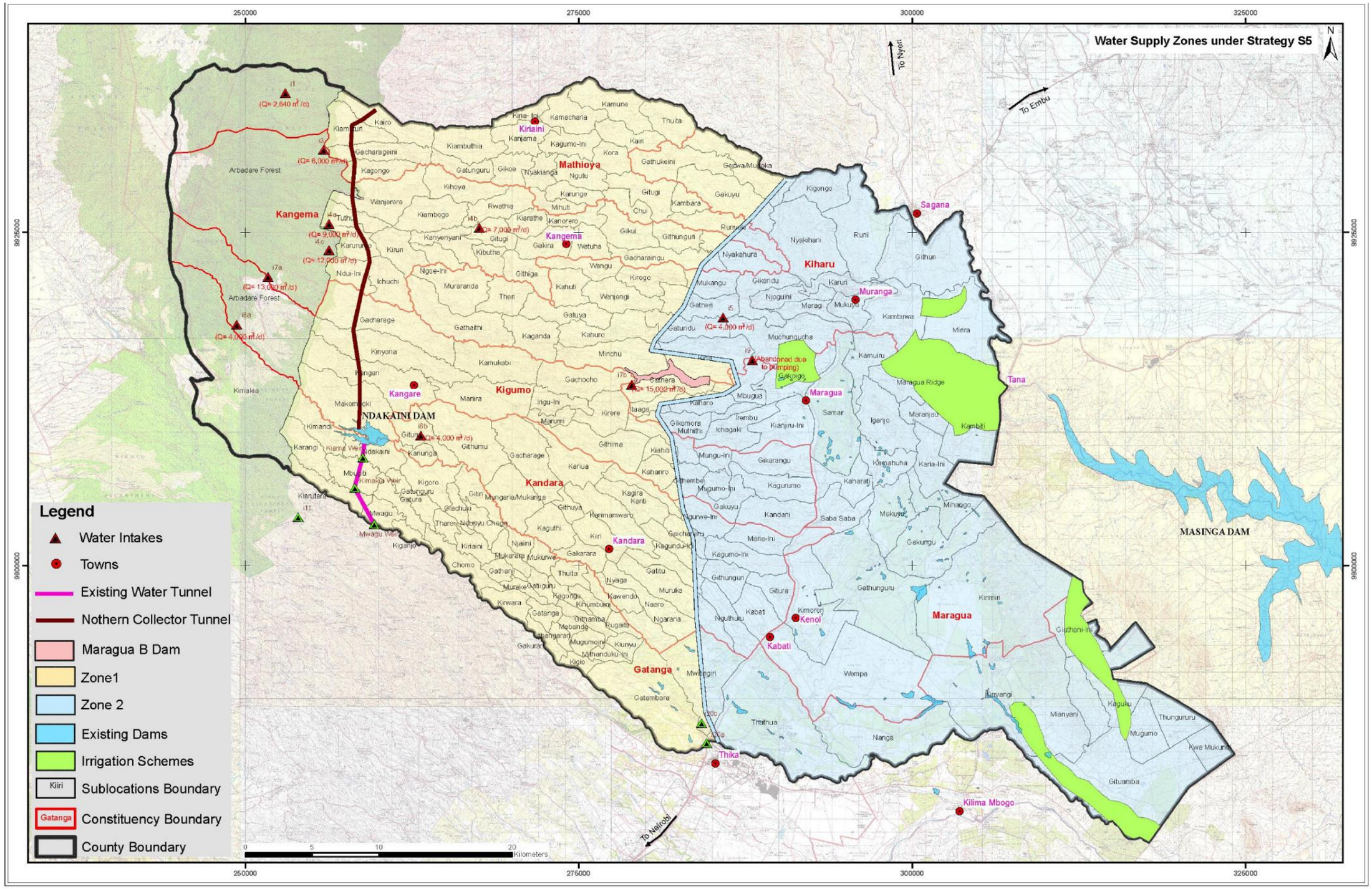

Figure 2.17: Water Supply Zones Under Strategy S5

i) Zone 1, Strategy S5

This Zone is proposed to be served from the existing 14Nr. run-of-river intakes (69,198m^3/day) and existing developed groundwater sources (5,178m^3/day), total combined treated water capacity 74,376m^3/day and the allocation for Murang'a County from the proposed Maragua 4 Dam, treated water supply capacity 19,000m^3/day.

The total available water resource for Zone 1 from the above listed existing sources and the proposed Maragua 4 Dam is 93,376m^3/day, against a projected ultimate potable water demand of 93,219m^3/day, resulting in a surplus of 157m^3/day.

ii) Zone 2, Strategy S5

This Zone is proposed to be served from existing 2Nr. run-of-river intakes (18,050m^3/day) and existing developed ground water sources (390m^3/day), total combined capacity 18,440m^3/day, with additional augmented supply from the proposed Maragau B Dam, safe yield 173,400m^3/day and the proposed Mitubiri Wellfield, capacity 10,000m^3/day.

The total available water resource for Zone 2 from the existing sources, the proposed Maragau B Dam and the proposed Mitubiri Wellfield is 201,840m^3/day, against a projected ultimate potable water demand of 29,551m^3/day, resulting in a surplus of 172,289m^3/day.

A summary Water Balance for the potable water demand against available resource for supply Zones 1 and 2 under Strategy S5 is given in **Table 2.27** below.

Table 2.27: Summary Water Balance for Potable Water Demand under Strategy S5 (Year 2045)

Zone 1, Strategy S5	
Projected Potable Water Demand (Year 2045)	93,219 m^3/day
Existing available sources (14Nr. Surface water and developed Groundwater Sources)	74,376 m^3/day
Proposed Maragua 4 Dam (Treated Water Supply allocation for Murang'a County)	19,000 m^3/day
Total available resource	**93,376 m^3/day**
Surplus	157 m^3/day
Zone 2, Strategy S5	
Projected Water Demand (Year 2045)	18,476 m^3/day
Existing available sources (3Nr. Surface water and developed Groundwater Sources)	22,240 m^3/day
Proposed Maragua B Dam	173,400m^3/day
Proposed Mitubiri Wellfields (10Nr. Boreholes)	10,000 m^3/day
Total available Resource	**205,640m^3/day**
Surplus (available for Irrigation)	187,164 m^3/day
Overall Potable Water Balance (Year 2045)	
Projected potable water demand (year 2045)	111,695 m^3/day
Existing available sources	96,616 m^3/day
Proposed New Sources	202,400m^3/day
Total available Resource	**299,016m^3/day**
Total Surplus (available for irrigation)	187,321 m^3/day

b) Supply of Irrigation Water

Irrigation Water Demand for consideration under Strategy S5 was estimated based on pre-identified irrigation schemes that were Technically and Economically viable to be supplied from the proposed principle source Maragua B.

Under Strategy **S5**, 2Nr. Irrigation Scheme namely Maragua Irrigation Scheme denoted as Areas 2, 3 & 4 as shown in **Figure 2.18** and Gatanga Irrigation Scheme denoted as Areas 9 &10 as shown in **Figure 2.3** were identified as potential schemes for development under the Strategy S5. These are described hereunder.

i) Maragua Irrigation Scheme (Area 2, 3 & 4)

The proposed Maragua Irrigation scheme is located on three clusters in 4BD catchment as follows:

- Area 2: Comprises of 320 ha, located 5 km to the East of Murang'a town;
- Area 3: Comprises of 720 ha, located in Upper Maragua, 1 km to the North of Maragua town;
- Area 4: Comprises of 3,120 ha, located in Lower Maragua, 5 km to the East of Maragua town.

Figure 2.18 on **Page 2-45** shows the location of the proposed Maragua Irrigation Scheme. The Scheme will be supplied by gravity from the proposed Maragua B Dam.

The proposed Maragua Irrigation Scheme encompasses the existing Gikundu irrigation scheme (60ha) in lower Maragua and 9,810 ha of other planned schemes within upper Maragua, under the Murang'a County Government.

The scheme basic information are shown on **Table 2.28** below.

Table 2.28: Basic information of Proposed Maragua Irrigation Scheme

Water source:	Maragua-B Dam Irrigation outlet at: +1,422 masl
Gross Irrigation Area:	Area 2: 320 ha Area 3: 720 ha Area 4: 3,120 ha Total: 4,160 ha
GIWR (annual)	5.4 MCM
GIWR (Peak in September)	0.9 MCM
GIWR* (Peak abstraction)	**28,434 m^3/day**
Conveyance pipe	600mm diameter steel pipe
Irrigation Methods	Sprinkler and Drip

**GWIR- Gross Water Irrigation Requirements*

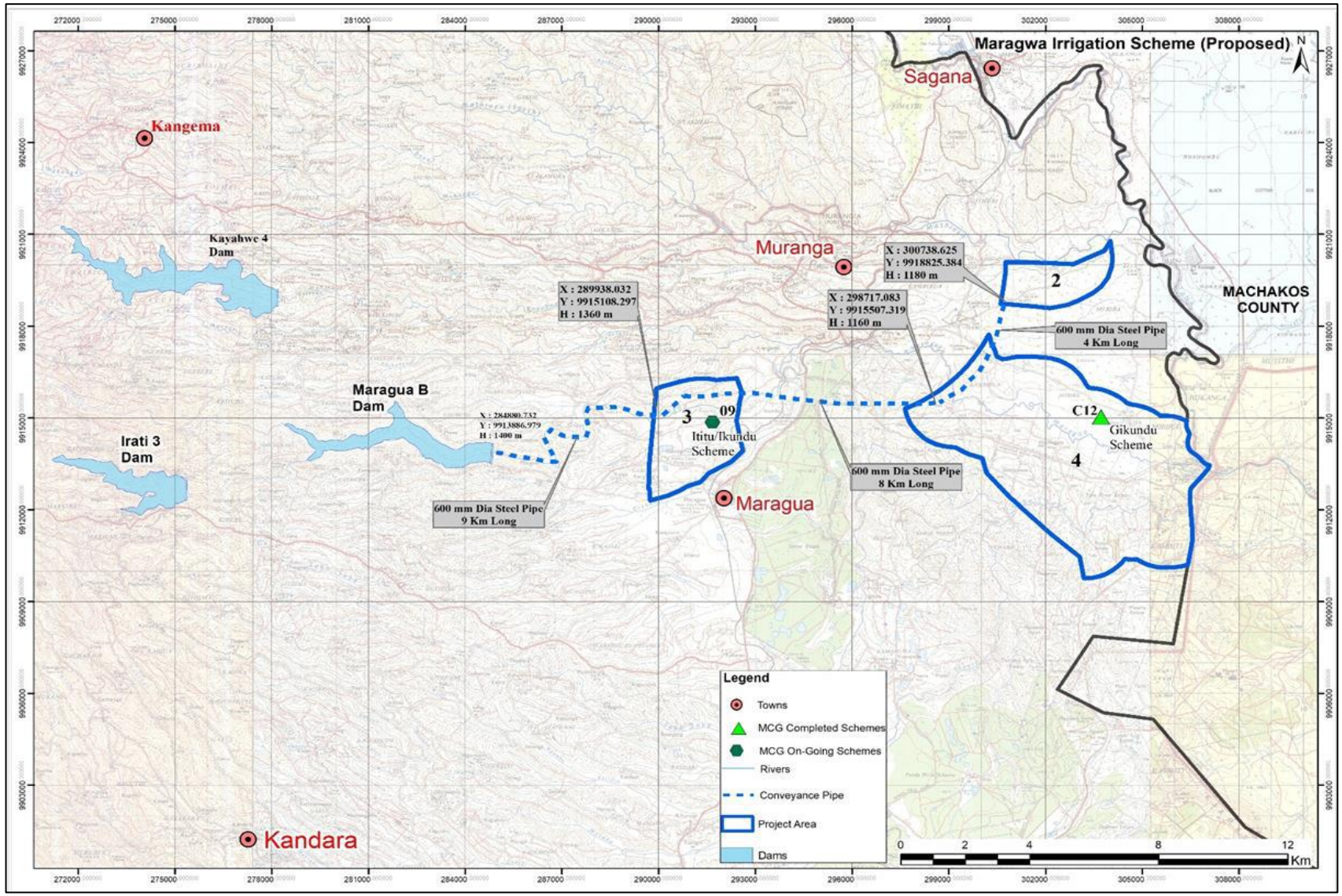

Figure 2.18: Location of proposed Maragua Irrigation Scheme (Areas 2, 3 & 4)

The Cropping Pattern adopted in estimation of Irrigation Water Demand for the proposed Maragua Irrigation Scheme is shown on **Table 2.29** below.

Table 2.29: Cropping Pattern adopted for Maragua Irrigation Scheme

Crop	Irrigated Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maize-1	10%			Maize									
Maize-2	10%									Maize			
Pulses-1	15%				Pulses								
Pulses-2	15%								Pulses				
Vegetables-1	10%				Vegetables								
Vegetables-2	10%								Vegetables				
Vegetables-3	10%	Vegetables											
Fruit trees	20%	Fruits											
% Scheme area occupied	100%	40%	30%	40%	55%	55%	55%	45%	45%	55%	55%	45%	30%

ii) Gatanga Irrigation Scheme (Area 9 & 10)

Location and details of the proposed Gatanga Irrigation Scheme are as described under the preceding Strategy S5. A recap of the basic information of the proposed Gatanga Irrigation Scheme is given in **Table 2.30** below.

Table 2.30: Basic Information – Gatanga Irrigation Scheme (Area 9 & 10)

Water source:	Groundwater well Irrigation outlet at: + 1,493 masl
Gross Irrigation Area:	Area 9: 550 ha Area 10: 550 ha Total: 1,100 ha
GIWR (annual)	1. 0 MCM
GIWR (Peak in September)	0. 2 MCM
GIWR (Peak abstraction)	**6, 684 m3/day**
Conveyance pipe	400/200mm diameter steel pipe
Irrigation Methods	Drip

Similar to Strategy S1, S2 and S3, under Strategy S5, the proposed Gatanga Irrigation Scheme will be supplied by gravity from the proposed Mitubiri Wellfield.

d) Strategy S5 Project Components

The envisaged Project components for the proposed Water Resource Development for Murang'a County to meet Potable Water and Irrigation Demands under Strategy S5 are given in **Table 2.31** on **Page 2-48.**

Table 2.31: Strategy S5 Project Components

No.	Item	Year	Components
1	New Treatment Works (6Nr.) on Thika River Intake, Kimakia River Intake, Githika River Intake, Chathanda River Intake and Maragua River Intake, to treat currently supplied raw water	**2022**	• Construction of new Treatment Works Capacity 4,000m^3/day on Thika Intake to treat raw water currently serving Gatanga Area. • Construction of new Treatment Works Capacity 1,500m^3/day on Kimakia Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 1,000m^3/day on Kiama Intake to treat raw water currently served to Lower Gatanga Area. • Construction of new Treatment Works Capacity 2,500m^3/day on Githika Intake to treat raw water currently served Makomboki Sub-Location • Construction of new Treatment Works Capacity 3,500m^3/day on Chathanda Intake to treat raw water currently served to Kangari Urban Centre. • Construction of new Treatment Works Capacity 4,000m^3/day on Maragua Intake to treat raw water currently served to Maragua Ridge and Kambiti Areas.
2	New Treatment Works for raw water allocation to Murang'a County from the proposed Maragua 4 Dam	**2022**	• Construction of 1 No. Treatment Works Capacity 20,000m^3/day each from the proposed Maragau 4 Dam, • 500mm dia. Raw Water Gravity main, length 1.5km • 500mm dia. Treated Water Gravity mains, length 7km • 2Nr. Storage Tanks Capacity 1,500m^3 each
3	Construction of New Maragua B Dam	**2027**	• New 55m high Maragua B Dam (on Maragua River), Volume 45Mm^3, Safe Yield 173,400m^3/day • Construction of Raw Water Gravity Main, Diameter 400mm, length approx. 5km. • Construction of new treatment works capacity 6,700m^3/day • Construction of Treated Water Pumping Main, Diameter 250mm, length approx. 14km. • Construction of 2Nr. Storage Reservoirs 1,500m^3 capacity each
4	Ground Water	**2022**	• Development of Mitubiri well field capacity 10,000m^3/day, comprising of 10Nr. boreholes and accessories, high level storage tank and manifold.
5	Irrigation	**2027**	• 600mm dia. Steel Transmission Main, length 20Km from the proposed Maragua B Dam to the propose Maragua Irrigation Scheme (Area 2,3&4) • 400mm dia. Steel Transmission Main, length 14Km from the proposed Mitubiri Wellfield to Area 10 of the proposed Gatanga Irrigation Scheme • 200mm dia. Steel Transmission Main, length 14Km from Area 10 to Area 9 of the proposed Gatanga Irrigation Scheme • Sedimentation Tank/ Detention Tank at terminal point of transmission main from the proposed Maragua B Dam

A Summary Water Balance of the proposed Strategy S5 for Water Supply and Irrigation Requirements for Murang'a County is given in **Table 2.32** below and shown graphically on **Figure 2.19** below.

Table 2.32: Summary Water Balance of Proposed Strategy S5

	Planning Horizon (Year)						
	2018	**2022**	**2027**	**2032**	**2037**	**2042**	**2045**
Potable Water Demand (m^3/day)	88,883	92,217	94,933	99,264	103,477	108,168	111,695
Irrigation Water Demand (m^3/day)	28,434	28,434	28,434	28,434	28,434	28,434	28,434
Total Water Demand (m^3/day)	117,317	120,651	123,367	127,698	131,911	136,602	140,129
Capacity of existing Developed Sources (2018) (m^3/day)	96,616	96,616	96,616	96,616	96,616	96,616	96,616
Deficit/ Surplus in supply based on existing sources (m^3/day)	-20,701	-24,035	-26,751	-31,082	-35,295	-39,986	-43,513
Proposed measures under Strategy S5							
Construction of 19,000m^3/day capacity T. Works for treated water supply allocated for Murang'a County from the proposed Maragua 4 Dam	-	19,000	19,000	19,000	19,000	19,000	19,000
Proposed Supply from Mitubiri Boreholes	-	-	10,000	10,000	10,000	10,000	10,000
Proposed Supply from Construction of Maragua B Dam, with 15,500m^3/day capacity T. Works for potable Water	-	-	174,400	174,400	174,400	174,400	174,400
Total Supply after Implementation of Strategy S5	96,616	115,616	300,016	300,016	300,016	300,016	300,016
Deficit/ Surplus in supply under Strategy S5	**-20,701**	**-5,035**	**176,649**	**172,318**	**168,105**	**163,414**	**159,887**

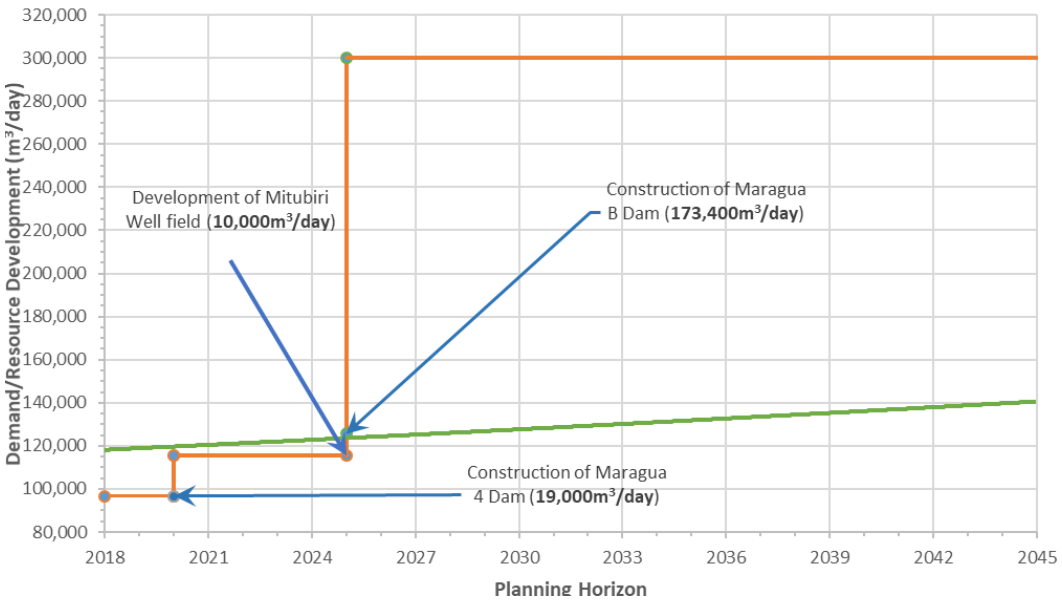

Figure 2.19: Development Phases under Strategy S5

Figure 2.20 on **Page 2-52** shows a schematic diagram of the proposed Project Components for Strategy S5.

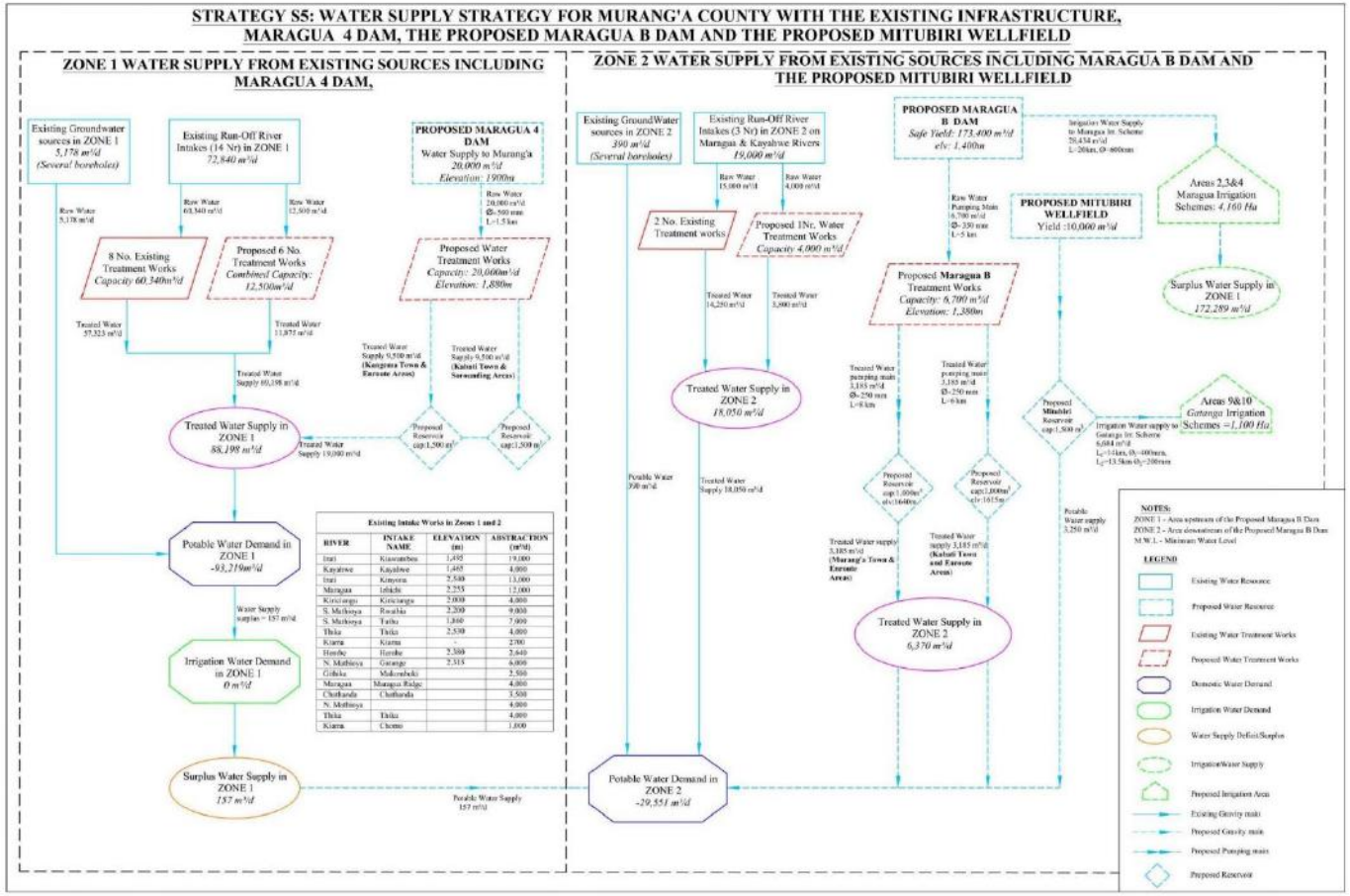

Figure 2.20: Schematic Diagram of Proposed Project Components under Strategy

2.9 Modified Strategies to Irrigate all Identified Areas

A Multi-Criteria Analysis was carried out on formulated Strategies for Development of sources to meet Water and Irrigation Demands for Muranga County up to the ultimate (Year 2045) planning horizon. **Table 2.33** below gives a summary breakdown of the ranking of strategies, based on results of the Multi-Criteria Analysis, with respective project components.

Table 2.33: Ranking of formulated Strategies for Water and Irrigation Development for Murang'a County

Ranking	Strategy	Components
1	Strategy S3 – Construction of Thika 3A Dam and Development of Mitubiri Wellfield	• New T. Works (6Nr.) on existing Thika River Intake, Kimakia River Intake, Kiama River Intake, Githika River Intake, and Maragua River Intake to treat currently supplied raw water • New Treatment Works and Transmission Mains for Raw Water allocated to Murang'a County from the proposed Maragua 4 Dam, Capacity 20,000m^3/day • Development of Mitubiri Wellfield, capacity 10,000m^3/day • Construction of new Thika 3A Dam, 27m high, safe yield 103,400m^3/day • Construction of Raw Water Pumping Station, Sedimentation Tank and Irrigation Water Transmission Mains, DN 400mm, 11km long to Makindi and Thika 3A Irrigation Schemes (Areas 6 and 7) • Construction of Sedimentation Tank and Irrigation Water Rising Mains, DN 400/200mm, 14km long, from Mitubiri Wellfield to Gatanga Irrigation Scheme (Areas 9 and 10)
2	Strategy S4 – Construction of Thika 3A Dam	• New T. Works (6Nr.) on existing Thika River Intake, Kimakia River Intake, Kiama River Intake, Githika River Intake, and Maragua River Intake to treat currently supplied raw water • New Treatment Works and Transmission Mains for Raw Water allocated to Murang'a County from the proposed Maragua 4 Dam, Capacity 20,000m^3/day • Construction of new Thika 3A Dam, 27m high, safe yield 103,400m^3/day • Construction of Raw Water Pumping Station, Sedimentation Tank and Irrigation Water Rising Mains, DN 400mm, 11km long to Makindi and Thika 3A Irrigation Schemes (Areas 6 and 7) • Construction of 2Nr. Sedimentation Tank and Irrigation Water Gravity Mains, DN 400/200mm, 42km long, from Thika 3A Dam to Gatanga Irrigation Scheme (Areas 9 and 10)
3	Strategy S5 – Construction of Maragua B Dam and Development of Mitubiri Wellfield	• New T. Works (6Nr.) on existing Thika River Intake, Kimakia River Intake, Kiama River Intake, Githika River Intake, and Maragua River Intake to treat currently supplied raw water • New Treatment Works and Transmission Mains for Raw Water allocated to Murang'a County

Ranking	Strategy	Components
		from the proposed Maragua 4 Dam, Capacity 20,000m^3/day • Development of Mitubiri Wellfield, capacity 10,000m^3/day • Construction of new Maragua B Dam, 55m high, safe yield 173,400m^3/day • Development of Irrigation Water Transmission Infrastructure from Maragua B Dam to proposed Maragua Irrigation Scheme (Areas 2,3&4) • Development of Irrigation Water Transmission Infrastructure from Mitubiri Wellfield to proposed Gatanga Irrigation Scheme (Areas 9&10).
4	Strategy S2 – Construction of Kayahwe 4 Dam and Development of Mitubiri Wellfield	• New T. Works (6Nr.) on existing Thika River Intake, Kimakia River Intake, Kiama River Intake, Githika River Intake, and Maragua River Intake to treat currently supplied raw water • New Treatment Works and Transmission Mains for Raw Water allocated to Murang'a County from the proposed Maragua 4 Dam, Capacity 20,000m^3/day • Development of Mitubiri Wellfield, capacity 10,000m^3/day • Construction of new Kayahwe 4 Dam, 32m high, safe yield 60,100m^3/day, Treatment Works (capacity 4,100m^3/day) and Transmission Mains • Development of Irrigation Water Transmission Infrastructure from Kayahwe 4 Dam to proposed Mathioya Irrigation Scheme (Area 1) • Development of Irrigation Water Transmission Infrastructure from Mitubiri Wellfield to proposed Gatanga Irrigation Scheme (Areas 9&10).
5	Strategy S1 – Construction of Irati 3 Dam and Development of Mitubiri Wellfield	• New T. Works (6Nr.) on existing Thika River Intake, Kimakia River Intake, Kiama River Intake, Githika River Intake, and Maragua River Intake to treat currently supplied raw water • New Treatment Works and Transmission Mains for Raw Water allocated to Murang'a County from the proposed Maragua 4 Dam, Capacity 20,000m^3/day • Development of Mitubiri Wellfield, capacity 10,000m^3/day • Construction of new Irati 3 Dam, 49m high, safe yield 64,900m^3/day. • Development of Irrigation Water Transmission Infrastructure from Kayahwe 4 Dam to proposed Mathioya Irrigation Scheme (Area 1) • Development of Irrigation Water Transmission Infrastructure from Mitubiri Wellfield to proposed Gatanga Irrigation Scheme (Areas 9&10).

Based on results of the Multi-Criteria Analysis as indicated in Table 3.1, Strategy S3, which entails construction of Thika 3A Dam and development of the Mitubiri Wellfield ranked as the best strategy for development to meet potable water and irrigation demands upto the ultimate planning horizon (Year 2045). Similarly, the second ranked strategy is Strategy S4, which entails Construction of Thika 3A Dam, excluding Mitubiri Wellfield.

The gravity command area for potable Water Supply under the proposed Thika 3A Dam as envisaged in Strategies S3 and S4 is 560km^2 (56,051 Ha) while the Irrigation coverage area is 40.6 km^2 (4,060Ha), out of which 29.6km^2 (2,960Ha) will require pumping.

The proposed Thika 3A Dam, which is located close to the boundary of Murang'a and Kiambu Counties has been identified under previous studies as a future source for water supply to the rapidly expanding Thika Municipality.

The third ranked strategy is Strategy S5 which entails Construction of Maragua B Dam and development of the Mitubiri Wellfield. The gravity command area for potable water supply under Maragua B Dam under Strategy S5 is 1,128km^2 (112,809Ha) while the total Irrigation area is 41.6km^2 (4,160Ha). The gravity command area for Strategy S5 is 101% larger than that of Strategy S3 for potable Water Supply and 41% larger for Irrigation coverage area.

The strategies were formulated on the basis of meeting potable water demands as the priority, considering that potable water demands take precedence over other competing needs. Under all strategies, only irrigation areas that can be supplied from the identified principle source were considered for the respective strategy. These are summarized in **Table 2.34** below.

Table 2.34: Summary of Irrigation Areas under various Strategies

S/No.	Strategy	Principle Source	Irrigation Areas	Scheme	Total Area (Ha)	Demand (m^3/day)
1	S1 (Construction of Irati 3 Dam and Development of Mitubiri Wellfield)	Irati 3 Dam	• Area 5 (3,040 Ha) • Area 9 (550Ha) • Area 10 (550Ha)	Saba Saba Gatanga Gatanga	4,140	27,463
2	S2 (Construction of Kayahwe 4 Dam and Development of Mitubiri Wellfield)	Kayahwe 4 Dam	• Area 1 (1,570 Ha) • Area 9 (550Ha) • Area 10 (550Ha)	Mathioya Gatanga Gatanga	2,670	17,415
3	S3 (Construction of Thika 3A Dam and Development of Mitubiri Wellfield)	Thika 3A Dam	• Area 6 (1,600 Ha) • Area 7 (1,360Ha) • Area 9 (550Ha) • Area 10 (550Ha)	Makindi Thika 3A Gatanga Gatanga	4,060	22,952
4	S4 (Construction of Thika 3A Dam, without Mitubiri Wellfield)	Thika 3A Dam	• Area 6 (1,600 Ha) • Area 7 (1,360Ha) • Area 9 (550Ha) • Area 10 (550Ha)	Makindi Thika 3A Gatanga Gatanga	4,060	22,952
5	S5 (Construction of Maragua B Dam, and Development of Mitubiri Wellfield)	Maragua B Dam	• Area 2 (320 Ha) • Area 3 (720Ha) • Area 4(3,120Ha) • Area 9 (550Ha) • Area 10 (550Ha)	Maragua Maragua Maragua Gatanga Gatanga	5,260	35,118

2.10 Modified Strategies to Irrigate 100% of the identified Irrigable Areas

The Key Objective of the Integrated Water and Irrigation Master Plan for Murang'a County is to formulate a coherent, viable Development Strategy that meets projected potable water and irrigation demands for the entire Murang'a County up to the ultimate (Year 2045) planning horizon.

Meeting the objective of the Master Plan Study will require that the adopted strategy satisfies both domestic water demand for the entire county and irrigation demands for all identified irrigable areas throughout the planning horizon. All the formulated strategies fall short of that.

In view of the foregoing, **Modified Strategies** have been developed for the first three ranked strategies, based on results of the Multi-Criteria Analysis, to incorporate additional sources, to ensure 100% coverage of the identified irrigable areas as follows:

(i) Modified Strategy S3 – Developed from original Strategy S3 (Thika 3A Dam with Mitubiri Wellfield
(ii) Modified Strategy S4 – Developed from original Strategy S4 (Thika 3A Dam excluding Mitubiri Wellfield
(iii) Modified Strategy S5 – Developed from original Strategy S5 (Maragua B Dam with Mitubiri Wellfield.

The modified Strategies are described in the following section.

2.10.1 Modified Strategy S3

The original Strategy S3 was formulated to meet projected potable water demands for the entire Study Area and irrigation demands for only 4Nr. Irrigable Areas name Area 6, Area 7, Area 9 and Area 10, total irrigation area considered is 4,060Ha., approx. 31.5% of the total 12,900Ha. of identified irrigable areas, out of which 2,960Ha. will require pumping. Additional Sources have been proposed to irrigate the remaining 68.5% of the irrigable area as well as elimination of pumping requirement, under the Modified Strategy S3 as shown in **Table 2.35** below.

Table 2.35: Proposed Sources to ensure 100% irrigation coverage under Modified Strategy S3

S/No.	Proposed Sources	Yield (m^3/day)	Target Irrigation Areas	Nature of Supply
Original Proposed Sources				
1	Thika 3A Dam	106,000	Area 6*[1] Area 7*[1]	Pumping (deleted) Pumping (deleted)
2	Mitubiri Wellfield	10,000	Area 9*[2] Area 10*[2]	Pumping (deleted) Pumping (deleted)
Additional Sources				
3	Irati 3 Dam	64,000	Area 1 Area 5 Area 9 Area 10	Gravity Gravity Gravity Gravity
4	Maragua B Dam	173,400	Area 2 Area 3 Area 4	Gravity Gravity Gravity

S/No.	Proposed Sources	Yield (m^3/day)	Target Irrigation Areas	Nature of Supply
5	Kiama Dam	26,000	Area 6 Area 7	Gravity Gravity

*[*1] Pumping requirement to Areas 6&7 eliminated by Introduction of Kiama Dam Under the Modified Strategy S3*

*[*2] Mitubiri Wellfield replaced by supply from proposed Irati 3 Dam, to eliminate pumping costs*

Under the Modified Strategy S3, Thika 3A Dam and Mitubiri Wellfield, which had been proposed under the original Strategy S3, have been replaced by Irati 3 Dam and Kiama Dam respectively, to eliminate pumping requirement, while meeting 100% of the potable water and irrigation demands. Areas originally proposed to be supplied with potable water from Thika 3A Dam will be supplied from the proposed Kiama Dam under the Modified Strategy S3.

Figure 2.21 below shows a graphical presentation of the Strategies under modified Strategy S3.

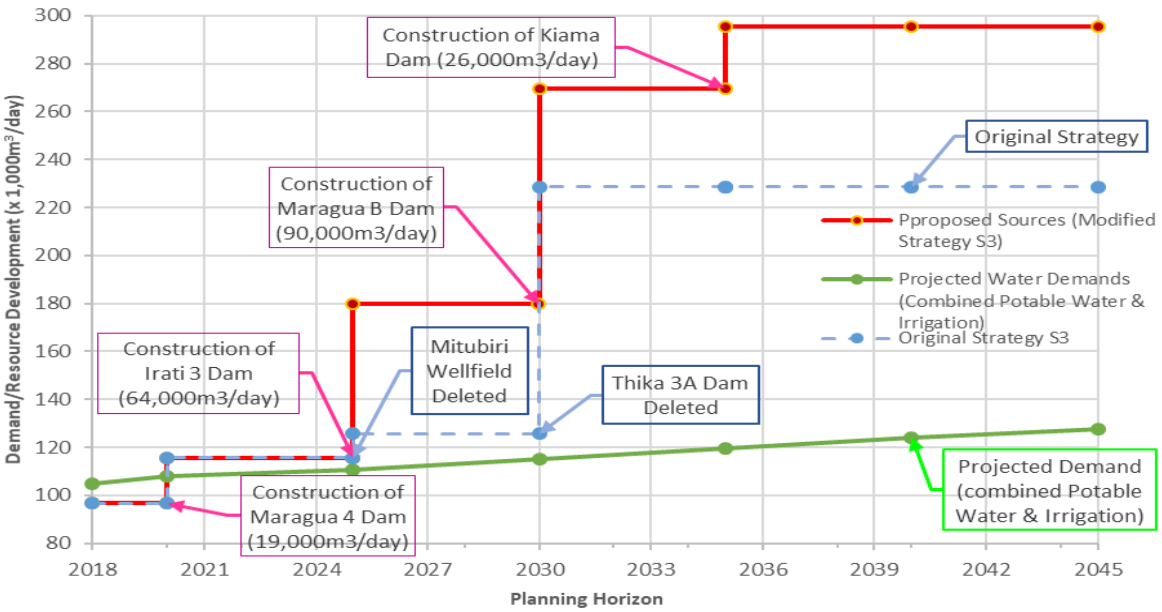

Figure 2.21: Updated Water Balance for the proposed Strategies under Modified Strategy S3

2.10.2 Modified strategy S4

The original Strategy S4 was built from Strategy S3, by deleting the Mitubiri Wellfield and abstracting more water from Thika 3A Dam to meet irrigation demands for Areas 9 and 10. The irrigation coverage area under Scenario S4 is 4,060Ha (31.5% of the total irrigable area) out of which 2,960Ha will require pumping, similar to that of Strategy S3.

Additional Sources proposed to irrigate the remaining 68.5% of the irrigable areas as well as elimination of pumping requirement under the Modified Strategy S4 are similar to those proposed under the preceding Strategy S3, hence resulting to a Modified Strategy similar to Modified Strategy S3 as shown in **Table 2.36** and presented graphically in **Figure 2.22** on **Page 2-56**.

Table 2.36: Proposed Sources to ensure 100% irrigation coverage under Modified Strategy S4

S/No.	Proposed Sources	Yield (m^3/day)	Target Irrigation Areas	Nature of Supply
Original Proposed Sources				
1	Thika 3A Dam	106,000	Area 6*1 Area 7*1	Pumping (deleted) Pumping (deleted)
Additional Sources				
2	Irati 3 Dam	64,000	Area 1 Area 5 Area 9 Area 10	Gravity Gravity Gravity Gravity
3	Maragua B Dam	173,400	Area 2 Area 3 Area 4	Gravity Gravity Gravity
4	Kiama Dam	26,000	Area 6 Area 7	Gravity Gravity

**1 Pumping requirement to Areas 6&7 eliminated by Introduction of Kiama Dam Under the Modified Strategy S4*

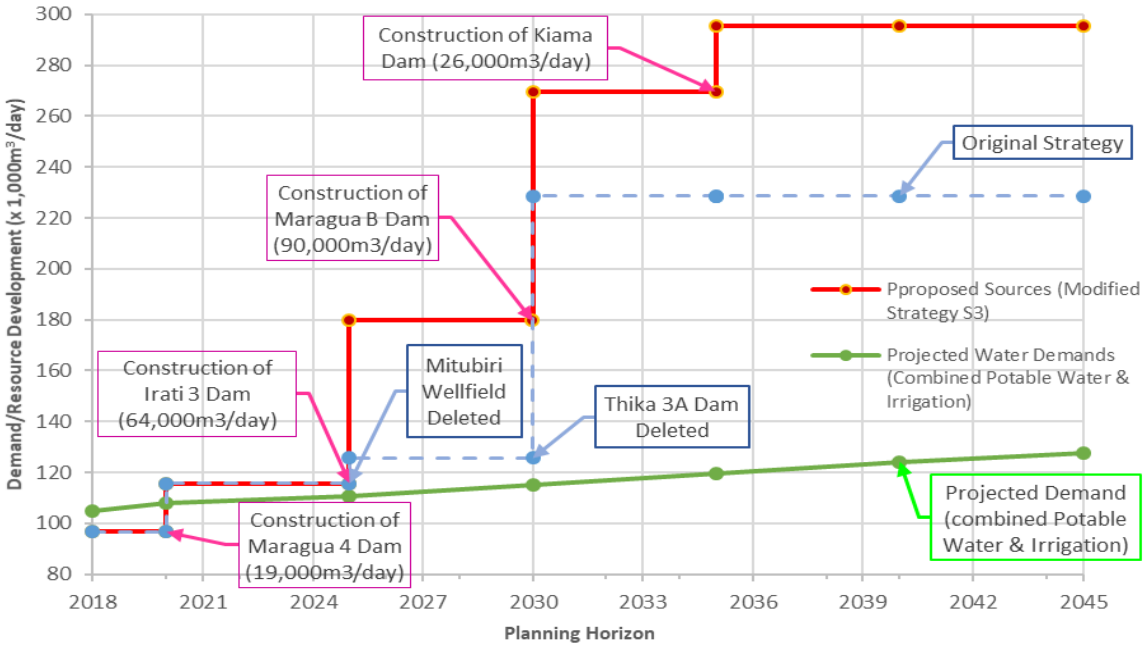

Figure 2.22: Updated Water Balance for the proposed Strategies under Modified Strategy S4

2.10.3 Modified Strategy S5

The original Strategy S5 entailed Construction of 55m high Maragua B Dam and Development of Mitubiri Wellfield as the principal sources to augment the existing sources in meeting projected Demands. Under the original Strategy S5 as described in **Section 2.8**, 5Nr. irrigable areas namely Area 2, Area 3, Area 4, Area 9 and Area 10 were considered, with a total area of 5,260Ha, approx. 40.8% of the total 12,900Ha of irrigable area identified for the entire Study Area. Under the original Strategy S5, part of the potable water demand was to be met by pumping from Maragua B Dam.

Additional sources proposed to irrigate the remaining 59.2% of irrigable area under the Modified Strategy S5 are summarized in **Table 2.37** below.

Table 2.37: Proposed Sources to ensure 100% irrigation coverage under Modified Strategy S5

S/No.	Proposed Sources	Yield (m^3/day)	Target Irrigation Areas	Nature of Supply
Original Proposed Sources				
1	Maragua B Dam	90,000	Area 2 Area 3 Area 4	Gravity Gravity
2	Mitubiri Wellfield	10,000	Area 9*[1] Area 10*[1]	Pumping (deleted) Pumping (deleted)
Additional Sources				
3	Irati 3 Dam	64,000	Area 1 Area 5 Area 9 Area 10	Gravity Gravity Gravity Gravity
4	Kiama Dam	26,000	Area 6 Area 7	Gravity Gravity

*[1] *Mitubiri Wellfield replaced by supply from proposed Irati 3 Dam, to eliminate pumping costs*

Under the Modified Strategy S5, the Mitubiri Wellfield, which had been proposed under the original Strategy S5 to irrigate Areas 9 & 10 (Gatanga Scheme) has been deleted. The Scheme is now proposed to be irrigated from Irati 3 Dam. Similarly, the potable water demand that required pumping from Maragua B Dam under the original Strategy S5 will be supplied by gravity from Irati 3 Dam, under the Modified Strategy S5. Maragua B Dam under the Modified Strategy S5 has been proposed to be constructed to a height of 35m, safe yield 90,000m^3/day.

A new small Dam has been proposed on Kiama River, upstream of the Thika 3A Dam Site, to meet irrigation demands for Areas 6 & 7 (Makindi and Thika 3A Schemes), hence ensuring all irrigation demands are met by gravity supply.

Figure 2.23 shows a graphical presentation of the Strategies under Modified Strategy S5.

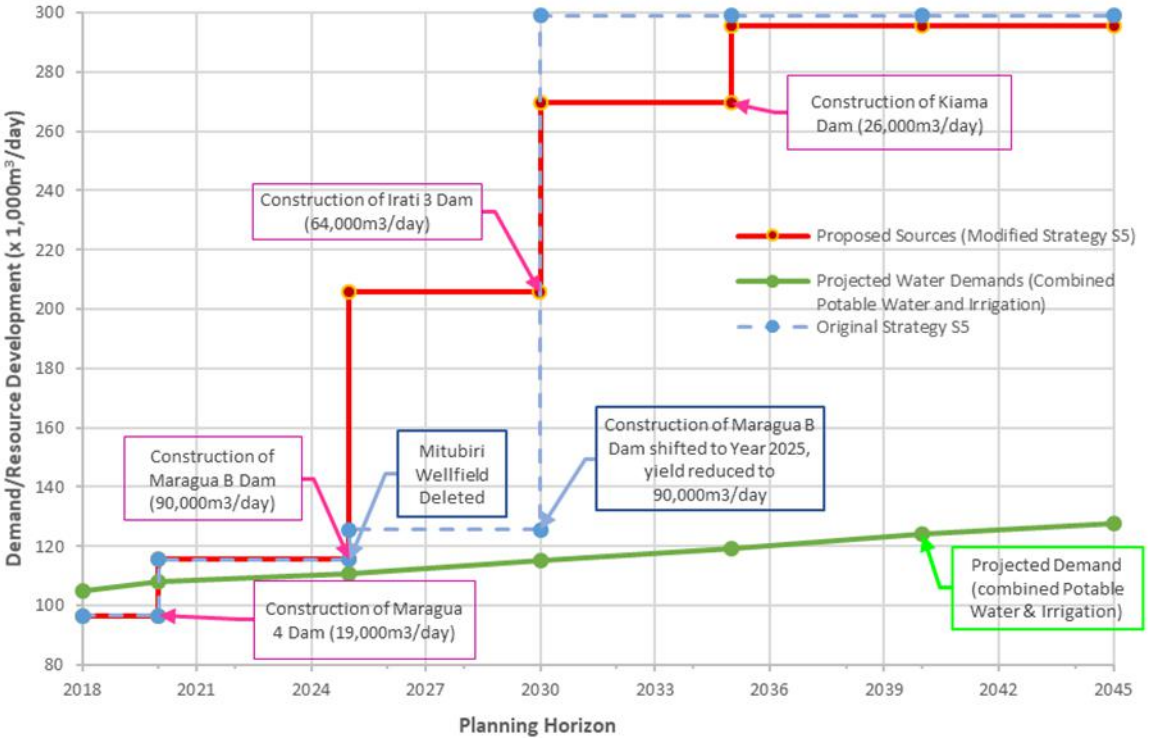

Figure 2.23: Updated Water Balance for the proposed Strategies under Modified Strategy S5

3.0 CONTEXT OF PLANNING, POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

The setting leading to the preparation of the Integrated Water and Irrigation Masterplan for Murang'a County arises from policies, plans and programmes at the national, regional and county levels as described in the sections below.

3.1 National Plans

3.1.1 National Water Policy

The National Water Policy (NWP) of Kenya was developed in 1999 as the National Policy on Water Resources Management and Development (NWP 1999). Although it is effective at present, it is currently in the process of revision to align with the new Constitution of Kenya to be the National Water Policy 2012. Based on the NWP 1999, the Water Act was established in 2002.

The NWP 1999 aims to achieve sustainable development and management of the water sector by providing a framework in which the desired targets/goals are set, outlining the necessary measures to guide the entire range of actions and to synchronize all water related activities and actors.

The NWP 1999 set the following specific policy objectives covering four basic areas of water resources management, water supply and sewerage development, institutional arrangement and financing of water sector:

- Preserve, conserve and protect available water resources and allocate it in a sustainable, rational and economical way.
- Supply of water of good quality and in quantities that are sufficient to meet the various water needs including poverty alleviation, while ensuring safe disposal of wastewater and environmental protection.
- Establish an efficient and effective institutional framework to achieve systematic development and management of the water sector.
- Develop a sound and sustainable financing system for effective water resources management, water supply and sanitation development.

3.1.2 National Development Targets

The GOK published Kenya Vision 2030 in 2007, which is the country's new development blueprint covering the period from 2008 to 2030. Kenya Vision 2030 was aimed at transforming Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by the year 2030.

Kenya Vision 2030 was based on three pillars – the economic, the social and the political. The economic pillar aims to achieve an average gross domestic product (GDP) growth rate of 10% per annum beginning in 2012. The social pillar seeks to build a just and cohesive society with social equity in a clean and secure environment. The political pillar aims to realize a democratic political system and protects the rights and freedoms of every individual in Kenyan society.

The national development targets on the water sector in Kenya Vision 2030 are as follows:

- Water and sanitation; to ensure that improved water and sanitation are available and accessible to all by 2030,
- Agriculture; to increase the area under irrigation to 1.2 million ha by 2030 for increase of agricultural production,
- Environment: to be a nation that has a clean, secure and sustainable environment by 2030, and
- Energy: to generate more energy and increase efficiency in the energy sector.

3.1.3 National Water Master Plan (NWMP 2013)

Aiming to ensure proper development and management of water resources in the country, the Government of Kenya (GOK) formulated the National Water Master Plan in 1992 (NWMP 1992) with technical assistance from the Japan International Cooperation Agency (JICA). Since then, the GOK has been implementing the projects proposed in the NWMP 1992.

The Kenya Vision 2030 was prepared in 2007 and the country's new development blueprint was presented. Water is defined as an essential resource to support the development activities planned under Vision 2030. In order to achieve Vision 2030, the proper implementation system and planning of water resources management are essential to be able to cope with the increasing water demands of domestic, irrigation, industries, etc. while conserving the catchments' sustainability.

The situation in the water sector has changed overtime and the change necessitated the renewal of NWMP (1992) to the current National Water Master Plan (NWMP 2030)

NWMP 2030 aims to present a framework for water resources development and management consistent with the country's social and economic development activities.

In line with the National Water Policy 1999 and targets of the Kenya Vision 2030, the specific objectives of water resources development and management in the NWMP 2030 were set as follows:

Specific Objectives for Water Resources Development:

- Allocation of water for the reserve, international obligation and inter-basin water transfer is kept, to meet basic water needs and to protect water environment.
- Improved water and sanitation are available and accessible to all by 2030.
- Irrigation development is undertaken to the maximum within available water resources towards the national target in order to increase agricultural production.
- Livestock, wildlife and inland fisheries are provided with water in sufficient quantities.
- Hydropower development is undertaken to its maximum potential and as one component of multipurpose projects for effective use of water resources.
- Domestic and industrial water supply is ensured for 10-year probable drought and irrigation water supply for 5-year probable drought.

Specific Objectives for Water Resources Management:

- All water resources are managed, regulated and conserved in an effective and efficient manner by involving the stakeholders, guaranteeing sustained access to water and equitable allocation of water while ensuring environmental sustainability.
- Human and economic damages by flood and drought are minimized to protect people's lives and properties.
- Impacts on the natural environment by water resources development activities are minimized for protection of the natural environment.
- Organizational and institutional capacity of water resources management is strengthened at the national and regional level based on the national water policy.

NWMP 2030 is prepared for six catchment areas which are management units of WRMA. NWMP 2030consist of the following nine component plans:

Development Plans

- Water Supply Development Plan
- Sanitation Development Plan
- Irrigation Development Plan
- Hydropower Development Plan
- Water Resources Development Plan

Management Plans

- Water Resources Management Plan
- Flood and Drought Disaster Management Plan
- Environmental Management Plan

Sub Section (7.3) of the Master plan Water Supply Development Target referenced to Kenya Vision 2030 which aims to ensure that improved water and sanitation are available and accessible to all by 2030. Based on the policy of Kenya Vision 2030, Water Service Strategic Plan 2009 prepared by the MWI, the targets for water supply development plan of the NWMP 2030 were set as follows.

- Increase coverage of improved supply to 100% in both urban and rural areas
- Increase coverage of piped water supply by registered WSPs to 100% of the urban population
- Increase unit water supply amount to suitable national standard levels
- Decrease NRW rate to 20% for efficient water use.

3.2 Regional Plans

3.2.1 Nairobi Water Master Plan

The Master Plan for developing new water sources for Nairobi City and Satellite Towns was prepared with support from the World Bank and the French Development Agency. Upon completion, the plan was officially launched in September 2012. The plan provides least cost development options to be implemented in a number of phases between 2012 and 2030 to ensure adequate supply of safe water to Nairobi city and Satellite Towns up to the year 2035.

The preparation of the master plan involved reviewing various water supply scenarios. Each scenario was examined first for technical soundness. An economic analysis was carried out to identify the least cost option, establish the financial costs and economic benefits for each scenario. In addition, environmental and social impacts were analyzed. Finally, a multicriteria analysis was carried out to rank and determine the optimal options for meeting the 2035 demands for Nairobi and Satellite Towns.

The Nairobi Water Master Plan dubbed 'Feasibility Study and Master Plan for Nairobi and Satellite Towns' provides mitigation measure against the water crisis that cuts across several sectors of the economy. The master plan proposes development of water sources for Nairobi in the following phases:

- Phase 1: Well fields development in Kiunyu area (2014) then in Ruiru area (2015);
- Phase 2: Northern Collector Tunnel Phase I from Maragua, Gikigie and Irati Rivers to Thika reservoir (2016)
- Phase 3: Northern Collector Tunnel Phase II connecting South Mathioya, Hembe, Githugi, and North Mathioya rivers to Northern Collector Phase 1 and Thika Reservoir (2018);
- Phase 4: Ndarugu 1 Dam with natural inflow (2024);
- Phase 5: Diversion and transfer from Chania River to Komu River to supplement inflow to Ndarugu 1 Reservoir (2031).

3.2.2 Murang'a County Intergraded Development Plan

Murang'a County Integrated Development Plan 2018-2022 Chapter four tabulates the strategic programmes and sub-programmes by sector while chapter 5 shows resource mobilization strategies, sources and allocations by sector. Also, chapter 5 outlines the governance structure of the county Chapter 6 outlines how programmes and projects will be monitored and evaluated in compliance with Section 108(1) (c) of the County Government Act

Sub sections (4.3.10) under Water and Irrigation) provided that the sector comprises of two sub-sectors:

- Irrigation, Drainage and Water Storage Sub-sector
- Water and sanitation Sub-sector

The plan provides Strategic Objectives as listed below under Irrigation, Drainage and Water Storage Sub-sector:

- To increase utilization of land through irrigation, drainage and water storage
- To mobilize and promote efficient utilization of resources
- To strengthen institutional capacity
- To mainstream governance, HIV/AIDS, and gender in irrigation schemes
- To provide Monitoring and Evaluation

The plan provides Strategic Objectives as listed below under Irrigation, Water and sanitation Sub-sector:

- To increase the proportion of population accessing safe water
- To increase the proportion of urban population accessing improved sewerage
- To increase the strategic water storage

3.3 Policy Framework

Four policy frameworks are considered relevant to development planning as envisaged in the Master Plan for the proposed Integrated Water and Irrigation Masterplan for Murang'a County as summarized below:

- Policy Framework for development planning.
- Policy Framework for Devolved Government
- Policy Framework for development of Water Services in Kenya
- Policy Framework for environmental management.

3.3.1 Policy Framework for Development Planning

The mandate for development planning: The policy framework for development planning in Kenya is vested in the Constitution and the long-term development blueprint - Kenyan Vision 2030. Chapter Four of the Constitution focuses on the Bill of Rights. Article 19 (1) describes the Bill of Rights as "an integral part of Kenya's democratic state" and "as the framework for social, economic and cultural policies". Article 69 (2) states that: - "every person has a duty to cooperate with State Organs and other persons to protect and conserve the environment; and ensure ecologically sustainable development and use of natural resources".

Chapter Eleven of the constitution describes development planning through devolution. Article 174 defines the object of devolution of government including (f) "to promote social and economic development and the provision of proximate, easily accessible services throughout Kenya". It also allows county assemblies to receive and approve plans and policies for the development and management of its infrastructure and institutions (Article 185(4) (b)). However, it also notes that the structure of the development plans and budgets of counties shall be prescribed through national legislation (Article 220. (2)(a)). In Chapter Twelve, the Principles of Public Finance is positioned, including Article 201. (b)(iii) stating that "expenditure shall promote the equitable development of the country, including by making special provision for marginalized groups and areas"

Kenya Vision 2030: In order to have a development strategy that answers to the aspirations for a prosperous society, the Government developed the Kenya Vision 2030, and launched in June 2008. Through the Vision, Kenya is anticipated to transform into a newly- industrializing, middle income country providing a high quality of life to all its citizens in a clean and secure environment by the year 2030. At the point of development, the Vision aimed at meeting the Millennium Development Goals (MDGs) while making the country globally competitive.

The overarching vision is "A globally Competitive and Prosperous Nation with a high quality of life by the year 2030". The vision is anchored on three pillars namely Economic, Social and Political pillars

The social pillar of Vision 2030 seeks to create "**a just, cohesive and equitable social development in a clean and secure environment".** It, therefore, presents comprehensive social interventions aimed at improving the quality of life of all Kenyans and Kenyan residents. The vision classifies interventions in the social pillar into six broad areas of focus. These include education, health, **water and sanitation, environment**, housing and urbanization, and gender, youth and vulnerable groups.

3.3.2 Policy Framework for Devolved Government

Devolution under the Constitution of Kenya, 2010 entails the transfer of fiscal, administrative and political power to the devolved entities with citizens playing a central role in governance. This is a departure from the past where power and resources were centralized, and citizens had minimal participation in governance. The devolved system created a two-tier government: the national and the 47 County governments listed in the First Schedule to the Constitution. Both levels of government are distinct and interdependent and are required to conduct their mutual relations on the basis of consultation and cooperation.

The devolved system operates within the context of overarching national and county frameworks. Such frameworks include Kenya Vision 2030, Medium Term Plans (MTPs), national and county strategic plans, and County Integrated Development Plans (CIDPs). Additional frameworks include the policies and guidelines of Ministries Departments and Agencies (MDAs) as well as constitutional commissions and independent offices, with specific roles in the devolved governance and service delivery.

Currently, there is no sessional paper to drive devolution though a draft policy was published in 2015 (GOK, 2015). The draft policy, once adopted, will provide a framework to harness the gains and opportunities of devolution, respond to the challenges and emerging issues, and fill in any gaps in the existing policy framework on devolution. The policy aims to provide a framework for:

- Efficient and effective service delivery at both levels of government.
- Enhance the alignment of roles, coordination, and collaboration among citizens, governments and non-state actors in the devolution implementation process; and
- Monitoring and evaluation mechanisms to ensure better management of devolution for high impact service delivery at both levels of government.

The draft policy focuses on the critical foundations of devolved governance including the objects of devolution. These are: Leadership and Governance; Equity and Inclusivity, Capacity Building and Public Service Delivery; Decentralized Units, Transfer of Powers and Functions and Intergovernmental Relations; Public Finance Management; and Public Participation and informed Citizen Engagement.

3.3.3 Policy Framework for Environment Management

The Constitution embodies elaborate provisions with considerable implications for sustainable development. These range from environmental principles and implications of Multilateral Environmental Agreements (MEAs) to the right to clean and healthy environment enshrined in the Bill of Rights. Its Chapter V is entirely dedicated to land and environment. It also embodies a host of social and economic rights of an environmental character, such as the right to water, food and shelter – among others.

The National Environment Policy (2012) provides a holistic framework to guide the management of the environment and natural resources in Kenya. It further ensures that the linkage between the environment and poverty reduction is integrated in all government processes and institutions in order to facilitate and realize sustainable development at all levels in the context of green economy enhancing social inclusion, improving human welfare and creating opportunities for employment and maintaining the healthy functioning of ecosystem.

National Environment Policy (NEP): 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. The Project area is ecological zone V and VI. Ecosystems under these zones are sensitive to any activity out of character with the ecosystem. Therefore, during implementation of the strategies proper environment assessment will be undertaken in order to ensure that the ecosystems are not destabilized.

The National Environment Action Plan Framework 2009 – 2013: The NEAP framework recognizes that the high population growth rate and expansion of economic activities have caused pressure on water resources. This is expected to increase unless urgent measures are taken to boost supply and rationalize demand. Water resources are under pressure caused by soil erosion and siltation, water catchments destruction, low level compliance to water quality regulations, inefficient water use strategies, invasive alien species, uncontrolled sand harvesting and over-abstraction of water resources. The framework proposes such interventions as:

- Implementation of soil and water conservation measures; Provision of incentives for conservation of water catchments
- Enforcement of EMCA, 2015 and other subsidiary regulations
- Enforcement of the Water Act 2016 and other related legislations.
- Promotion of integrated water resource management.
- Enforcement of EMCA, 2015 and other subsidiary regulations
  Enforcement of the Water Act 2016 and other related legislations.

The Sustainable Development Goals (SDGs): The concept of the SDGs was born at the United Nations Conference on Sustainable Development, Rio+20, in 2012. The objective was to produce a set of universally applicable goals that balances the three

dimensions of sustainable development: environmental, social and economic. The Investments will therefore contribute towards achieving this goal through the proposed dam project.

The National Environmental Sanitation and Hygiene Policy-July 2007: The Policy is devoted to environmental sanitation and hygiene in Kenya as a major contribution to the dignity, health, welfare, social well-being and prosperity of all Kenyan residents. The Policy recognizes that healthy and hygienic behavior and practices begin with the individual. The implementation of the Policy will greatly increase the demand for sanitation, hygiene, food safety, improved housing, use of safe drinking water, waste management, vector control at the household level and encourage communities to take responsibility for improving the sanitary conditions of their immediate environment.

3.3.4 Policy Framework relevant to the Master Plan

The water sector in Kenya is guided by the Kenya Vision 2030 and other sector policies and strategies. The water sector is guided by the Water Act 2016, the Water Policy 1999 and the water strategic plan 2013-2017, among other instruments. Detailed policy provisions in management and governance of water resources issues are summarized in the **Table 3.1** below.

Table 3.1: Policy Framework Relevant to the Master Plan

No	Policy	Applicability
1	Constitution of Kenya (CoK) 2010	Article 43 (1) provides that every person has the right – (b) to accessible and adequate housing, to reasonable standards or sanitation; and (d) to clean and safe water in adequate quantities. These provisions cover oblige state organs and bind them to provide not just high quality or clean and safe water but also adequate quantities to all people that they will serve. Also, the Constitution of Kenya provides for sound management and sustainable development of all of Kenya's Projects, both public and private investments. It also calls for the duty given to the Project proponent to cooperate with State organs and other persons to protect and conserve the environment as mentioned in Part II.
2	National Policy on Water Resources Management and Development (Sessional Paper No.1 of 1999).	The management of water resources in Kenya is guided by four specific policy objectives, namely: • Preserve, conserve, and protect available water resources and allocate it in a sustainable rational and economic way. • Supply water of good quality in sufficient quantities to meet the various water needs, including poverty alleviation, while ensuring the safe disposal of wastewater and environmental protection. • Establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector; and • Develop a sound and sustainable financing system for effective water resources management, water supply and sanitation development.
3	The National Water Policy 2012 (Draft)	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 resources for livelihoods of Kenyans through:

No	Policy	Applicability
		• Progressive restoration and protection of ecological systems and biodiversity in strategic water catchments. • increasing per capita water availability above the international benchmark of 1000 m. by 2030. • Maximizing use of trans-boundary water resources in coordination with other riparian countries. • Enhancing storm water management and rainwater harvesting. • Enhancing inter-basin water transfer in Kenya as a strategic intervention for optimized used of water resources. • Improving effluent waters treatment and recycling for use. • Ensuring sustainable groundwater resources for present and future generations; and • Developing a water management system which contributes to the protection of the environment.
4	Kenya Vision 2030	The Kenya Vision 2030 is the current national development blueprint for period 2008 to 2030. The vision has three pillars – economic, social and political. It is recognized that Kenya is a water scarce Country but stated (Kenya, 2007: 115) that the Vision for the water and sanitation sector is "to ensure water and improved sanitation services availability. The Project will directly contribute towards achievement of objectives of vision under the environment and social pillar through provision of the planned dam project.
5	National Climate Change Response Strategy, 2010	The strategy paper recognizes that Kenya is a water scarce country and offers a variety of strategies for ensuring that the resource is utilized in ways that recognize that it is a finite resource. The paper also argues that interventions in the water sector should take a participatory approach involving different water users including gender groups, socioeconomic groups, planners and policy makers in water resource management (Kenya, 2010: 53).
6	The National Land Policy (Sessional Paper No. 3 of 2009)	The policy regulates rights over land and provides for sustainable growth, investment and the reduction of poverty in line with the Government s overall development objectives. Specifically, "the policy offers a framework of policies and laws designed to ensure the maintenance of a system of land administration and management The overall object of the national land policy is to secure land rights and provide for sustainable growth, investment, and the reduction of poverty in line with the governments overall development objectives.
7	Economic Recovery for Wealth and Employment Creation Strategy 2006	The overall goal of the strategy is to ensure clear improvement in the social and economic wellbeing of all Kenyans; thereby giving Kenyans a better deal in their lives, and in their struggle to build a modern and prosperous nation. The key areas covered in the strategy are: • Expanding and improving infrastructure. • Reforms in trade and industry. • Reforms in forestry. • Affordable shelter and housing. • Developing arid and semi-arid lands, and • Safeguarding environment and natural resources.
	Aberdare Protected Area Management Plan	The requirement for protected area planning is provided for under Section 44 and the Fifth Schedule (Annex 3) of the Wildlife Conservation and Management Act. The plans recognize and are consistent with other relevant legislation specifically section 38(c) of the Environment Management and Co-ordination Act EMCA (2015) that provide for operational guidelines for the planning and management of environment and natural resources. This plan will be relevant during construction of inlet works and raw water pipelines for strategies proposed with the aberdare forest

3.4 Legal Framework

The Constitution of Kenya embodies a number of principles place a positive obligation upon the Government of Kenya to enact legislation, policy or any other measure that will not violate the same. These, among others, include:

- Social-Economic rights.
- Right to own property.
- Land rights.
- The right to information.
- Public participation.
- National values and principles.
- The right to a clean and healthy environment.
- Public interest litigation; and
- Bill of Rights

The above principles are set to be achieved through the provisions of various acts of parliament as summarized in **Table 3.2** below**.**

Table 3.2: Legal Framework Relevant to the Master Plan

Policy	Applicability
EMCA 2015	The Environmental Management and Coordination Act of 1999 (EMCA) amended in 2015 was enacted to provide an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. EMCA does not repeal the sectoral legislation but seeks to coordinate the activities of the various institutions tasked to regulate the various sectors. These institutions are referred to as Lead Agencies in EMCA. Lead Agencies are defined in Section 2 as any Government ministry, department, parastatal, and State Corporation or local authority in which any law vests functions of control or management of any element of the environment or natural resource. EMCA addresses itself primarily to Environmental Impact Assessment (Section 58). The Environmental (Impact Assessment and Audit) Regulations of 2003, however, recognizes SEAs as a measure of environmental impact assessment at strategic level such as policy, plans and programmes. The Regulations section 42 and 43 address Strategic Environment Assessments; section 42(1) requires Lead Agencies in consultation with NEMA to subject all policy, plans and programmes for implementation to a Strategic Environment Assessments. Regulation 42(3) commits the Government and all Lead Agencies to incorporate principles of SEA in the development of sector or national policy. In EMCA, 2015, Strategic Environmental Assessment has been legislated (57(A.) (1). While the SEA Guidelines (NEMA, 2012) defines "Strategic Environment Assessment (SEA) as a tool/process for incorporating environment considerations into policies, programmes and plans.
Land Act, 2012	It is the substantive law governing land in Kenya and provides legal regime over administration of public and private lands. It also provides for the acquisition of land for public benefit. The government has the powers under this Act to acquire land for projects, which are intended to benefit the general public. This Act provides for the procedure to be followed during compulsory acquisition of land by the Government and the just compensation which should be paid promptly and in full to all persons whose interest in land has been affected.

Policy	Applicability
Water Act, 2016	Article 43 of the Constitution stipulates that every person in Kenya has the right to clean and safe water in adequate quantities and to reasonable standards of sanitation. In conformity to this constitutional requirement, the Water Act, 2016 was enacted. It is "AN ACT of Parliament to provide for the regulation, management and development of water resources, water and sewerage services; and for other connected purposes". The law provides for national public water works (Article 8(2)) that include water storage, water works for bulk distribution and provision of water services, inter-basin water transfer facilities, and reservoirs for impounding surface run-off and for regulating stream flows to synchronize them with water demand patterns which are of strategic or national importance. It vests the administration of water resources to the National Government (Article 9) and calls for public participation in the formulation of a National Water Resource Strategy (Article 10 (1)) on five-year cycles. The Strategy shall provide the Government's plans and programs for the protection, conservation, control and management of water resources (2). Article 10(3) gives the details of the contents of the National Water Resource Strategy, i.e.: (a) existing water resources and their defined riparian areas. (b) measures for the protection, conservation, control and management of water resources and approved land use for the riparian area. (c) minimum water reserve levels at national and county levels. (d) institutional capacity for water research and technological development. (e) functional responsibility for national and county governments in relation to water resources management; and (f) any other matters the Cabinet Secretary considers necessary. For the regulation of management and use of water resources, the Act establishes the **Water Resources Authority** as a body corporate that will, among others, enforce the Regulations made under the Act (Article 12). The Authority will be responsible for sustainable management of water resources including allocation plan within a basin. (28(3(c)(d))). The Act also establishes a **National Water Harvesting and Storage Authority** that will, among other things, be responsible for water resources storage and flood control (32. (1)(a)). While the interests and rights of consumers in the provision of water will be vested in the Water Services Regulatory Board (Article 70(1)).
County Government Act No. 17 of 2012	The preamble to the Act gives overriding object and purpose of the Act. It states that, 'An Act of Parliament to give effect to Chapter Eleven of the Constitution; to provide for county governments' powers, functions and responsibilities to deliver services and for connected purposes. Part II elaborate on the functions and powers of the county government, emphasizing its constitutional authority to enter into contracts, acquire and hold and dispose of assets, and delegate functions, such as through sub-contracts and partnerships. Part VI considers the foci and administration of decentralization to the sub-county level, including to urban areas and cities. Part VIII focuses on Citizen Participation stating that "citizen participation in county governments shall be based upon reasonable access to the process of formulating and implementing policies, laws, and regulations, including the approval of development proposals, projects and budgets, the granting of permits and the establishment of specific performance standards" (87(b)); and "promotion of public private partnerships, such as joint committees, technical teams, and citizen commissions, to encourage direct dialogue and concerted action on sustainable development" (87(f)).

Policy	Applicability
	On the aspect of public communication and access to information, the county governments are vested to "undertake advocacy on core development issues such as agriculture, education, health, security, economics, and sustainable environment among others" (94(c)). The County Government Act, 2012, provides the basis for spatial plans as statutory requirements in the county. The Act stipulates a 10-year spatial plan be developed by each county to provide for: (a) spatial depiction of the social and economic development programme of the county as articulated in the integrated county development plan. (b) a clear statement of how the spatial plan is linked to the regional, national and other county plans; and (c) a clear clarification on the anticipated sustainable development outcomes of the spatial plan.
Physical Planning Act 1996 (286) Revised in 2012	Section 16 of the Physical Planning Act (Chapter 286) provides that the Director may prepare a regional physical development plan. The plan shall consist of inter alia, a statement of policies and proposals with regard to the allocation of resources and the locations for development within the area. The Act requires the Director to invite any person interested to make representations to do so within sixty days of the publication of the plan. On approval of the regional physical development plan no development shall take place on any land unless it is in conformity with the plan. Section 24 provides for the Director to prepare also a local physical development plan whose purpose is to guide and coordinate development and for the control of the use and development of land. Physical planning thus provides a mechanism for the assessment of options and establishment of policy objectives and goals. These provisions notwithstanding, the physical planning process has so far not been used to elaborate policy options for development. This omission does not however detract from the potential of the physical planning process to facilitate the identification and regulation of policy options for resource development and use
The Urban Areas and Cities Act 2011	This Law passed in 2011 provides legal basis for classification of urban areas (City) when the population exceeds 500,000; a municipality when it exceeds 250,000; and a town when it exceeds 10,000) and requires the city and municipality to formulate County Integrated Development Plan (Article 36 of the Act).
Agriculture Act CAP 318	This Act of Parliament was revised in 2012 and enacted to promote and maintain a stable agriculture, provide for the conservation of the soil and its fertility, and stimulate the development of agricultural land in accordance with the accepted practices of good land management and good husbandry.
Irrigation Bill 2017	The Bill once enacted will endeavor to promote and regulate the development and management of irrigation in Kenya and for connected purposes Section 7. (1) of the Bill provides for establishment of an authority to be known as Establishment of the National Irrigation Development Authority. The authority shall be responsible for undertaking irrigation development, including infrastructure, in national or public and small holder schemes, including schemes which traverse or straddle more than one county. Section 14. (1) Each county government may within its area of Role of county jurisdiction establish a county irrigation development unit government. for the better carrying out of the county government's irrigation mandates in accordance with Part 2 of the Fourth Schedule of the Constitution. Each county government shall, for purposes of ensuring uniformity and national standards in the irrigation sub-sector, through its legislative and administrative

Policy	Applicability
	action, implement and act in accordance with the national policy guidelines issued by the Cabinet Secretary and approved by Parliament. The county irrigation development units established under subsection (1) shall have the following functions - formulate and implement county irrigation strategy in collaboration with relevant stakeholders, in line with national policies and strategies among others.
Occupational Health and Safety Act (OSHA 2007)	The Act provides Environment Health and Safety (EHS) Guidelines which shall be followed by both the Contractor and Supervising Consultant during implementation of the Project to avoid injuries and even loss of life to workers and neighboring community.
The Public Health Act (Cap.242)	This is an Act of Parliament that makes provision for securing and maintaining health. Part IX contains provision regarding sanitation and housing. Section 115 of the Act states that no person shall cause nuisance or cause to exist on any land or premises any condition liable to be injurious or dangerous to human health. Section 116 requires that Local Authorities take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to be injurious or dangerous to human health. Such nuisance or conditions are defined under section 118 as waste pipes, sewers, drainers or refuse pits in such state, situated or constructed as in the opinion of the medical officer of health to be offensive or injurious to health. Any noxious matter or wastewater flowing or discharged from any premises into the public street or into the gutter or side channel or watercourse, irrigation channel, or bed not approved for discharge is also deemed as nuisance. Other nuisances are accumulation of materials or refuse which in the opinion of the medical officer of health is likely to harbor rats or other vermin. The Act also contains provisions on discharges of pollutants into water sources. On responsibility of the Local Authorities Part XI, section 129, of the Act 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 Part XII, Section 136, states that all collections of water, sewage, rubbish, refuse and other fluids which permit or facilitate the breeding or multiplication of pests shall be deemed nuisances under this Act. This
HIV and AIDS Prevention and Control Act 2011	The object and purpose of this Act is to (a) promote public awareness about the causes, modes of transmission, consequences, means of prevention and control of HIV and AIDS; (b) extend to every person suspected or known to be infected with HIV and AIDS full protection of his human rights and civil liberties. The Act provisions will be applied during Project implementation phase where the contractor will be required to create awareness among workers and community at large
Sexual Offences Act 2006	An Act of Parliament that makes provision about sexual offences aims at prevention and the protection of all persons from harm from unlawful sexual acts and for connected purposes. Section 15, 17 and 18 focuses mainly on sexual offenses on minor (children).
Child Rights Act (Amendment Bill) 2014	This Act of Parliament makes provision for parental responsibility, fostering, adoption, custody, maintenance, guardianship, care and protection of children. It also makes provision for the administration of children's institutions, gives effect to the principles of the Convention on the Rights of the Child and the African Charter on the Rights and Welfare of the Child. The contractor under this Project will be required to comply to provisions of the Act during Project implementation
Labor Relations Act 2012	An Act of Parliament to consolidate the law relating to trade unions and trade disputes, to provide for the registration, regulation, management and

Policy	Applicability
	democratization of trade unions and employers organizations or federations, to promote sound labor relations through the protection and promotion of freedom of association. This act will be applied by labor force on site in addressing disputes related to working conditions.
National Gender and Equality Commission Act 2011	The over-arching goal for NGEC is to contribute to the reduction of gender inequalities and the discrimination against all, women, men, persons with disabilities, the youth, children, the elderly, minorities and marginalized communities. This Act will be applied during hiring of workforce on site
Public Participation Bill of 2016	The Bill is an Act of Parliament that provides a general framework for effective public participation and to give effect for the constitutional principles of democracy. The purpose of the act includes promotion of democracy and public participation of the people according to Article 10 of the Constitution, promote community ownership for public decisions and promote public participation and collaboration in governance processes. Therefore, adequate consultations were held within Malindi Project area as discussed in Chapter (6) of this report.
The Wildlife Conservation and Management Act CAP 376, 2013	This Act provides for the protection, conservation and management of wildlife in Kenya. The Act deals with areas declared as National Parks, under the Act. The Act controls activities within the park, which may lead to the disturbance of wild animals. Further the Act protects wildlife outside the parks. The Act prohibits killing of wildlife for any purpose whatsoever unless authorized by the KWS. There are a wide variety of wildlife within the aberdare Forest, where some inlet weirs and raw water main will be constructed with the protected forest hence compliance to provisions of the Act will be required.
The National Museums and 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; and for connected purposes. This act together with world bank policy OP 4.11 on Physical Cultural Resources will be quoted in the event that the project will encounter such materials, chance find procedures will be provided to specific ESIAs that will be prepared.

Policy	Applicability
Forest Conservation and Management Act 2016	The Forest Act, Cap 385 of 1962 (revised 1982, 1992 and 2005) and Forest Act 2005 addresses the reservation, protection, management, enforcement and utilization of forests and forest resources on Government land for the socio-economic development of the country. The Forest Act is applicable to gazetted forest areas (Forest Reserves) and specifically covers: (a) Gazettement, alteration of boundaries and de-gazettement of Forest Reserves (Section 4); (b) Declaration of Nature Reserves within Forest Reserves and regulation of activities within Nature Reserves (Section 5); (c) Issuance of licenses for activities within Forest Reserves (Section 7); (d) Prohibition of activities in Forest Reserves (removal of forest produce, grazing, cultivation, hunting, etc.) and on unalienated Government land (removal of trees, collection of honey, lighting of fires) except under license from the Director of Forest Services (Section 8); (e) Enforcement of the provisions of the Act, penalties and powers afforded to enforcing officers (Sections 9-14); (f) Power of the Minister to make rules with respect to sale and disposal of forest products, use and occupation of land, licensing and entry into forests (Section 15). This prerogative has been taken with the Forests (General) Rules, which sets forth rules for sale of forest produce and specifies royalty rates for these products. (g) Community participation as provided for under Section 46. This will not directly trigger section 8 of the act. However, for inlet works and raw water pipelines planned within the forest, a permit will be sought from KFS before works are undertaken
Fisheries Development and Management Act 2016	An ACT of Parliament to provide for the conservation, management and development of fisheries and other aquatic resources to enhance the livelihood of communities dependent on fishing and to establish the Kenya Fisheries Services, and for connected purposes. Through Kenya Fisheries Services, management of fish resources within the rivers will be ensured

3.5 World Bank Safeguards Policy

Applicable World Bank Operational Safeguard Polices are listed in **Table 3.3** below.

Table 3.3: Applicable World Bank Operational Safety Policies

Safeguards Policies	Provision	Relevance to the Project
World Bank OP 4.01 on Environmental Assessment	Provides framework for WB environmental safeguard policies and describes project screening and categorization to determine level of environmental assessment required. For category A and B projects the policy requires public consultation and disclosure to be undertaken as part of the EA process. If indigenous people are found to be affected, in addition to consultation, it is necessary to prepare a plan to avoid or mitigate adverse impacts on such groups and ensure that they have	An Environmental and Social Impact Assessment of the dam is required for sub-Projects that will be identified under the Master plan

Safeguards Policies	Provision	Relevance to the Project
	access to project benefits to the extent that they wish to.	
World Bank OP 4.12 on Involuntary Resettlement	The World Bank Involuntary Resettlement Policy OP 4.12 covers direct economic and social impacts that result from Bank-assisted investment projects.	A Resettlement Action Plan (RAP) has will be prepared to document cases of land acquisition that will be triggered by Sub Projects under the Master Plan
World Bank OP 4.10 on Physical Cultural Resources	Provides for measures to protect cultural heritage from the adverse impacts of project activities and support its preservation;	chance find procedures will be provided for EIAs prepared for Sub Projects under the Master Plan
Operational Policy 4.04 – Natural Habitats	Outlines the WB policy on biodiversity conservation taking into account ecosystem services and natural resource management and use by project affected people. Projects must assess potential impacts on biodiversity and the policy strictly limits circumstances under which damage to natural habitats can occur as well as prohibiting projects which are likely to lead to result in significant loss of critical natural habitats	The dam designs will require to release required environment flow (Q80) for downstream flows
Operational Policy OP 4.37 on Dam Safety	For the life of any dam, the owner is responsible for ensuring that appropriate measures are taken, and sufficient resources provided for the safety of the dam, irrespective of its funding sources or construction status. Because there are serious consequences if a dam does not function properly or fails, the Bank is concerned about the safety of new dams it finances and existing dams on which a Bank-financed project is directly dependent. When the Bank finances a project that includes the construction of a new dam, it is required that the dam be designed, and its construction supervised by experienced and competent professionals. It also requires that the borrower adopt and implement certain dam safety measures for the design, bid tendering, construction, operation, and maintenance of the dam and associated works. The Bank distinguishes between small and large dams. Small dams are normally less than 15 meters in height. This category includes, for example, farm ponds, local silt retention dams, and low embankment tanks. Large dams are 15 meters or more in height. Dams that are between 10 and 15 meters in height are treated as large dams if they present special design complexities--for example, an unusually large flood-handling requirement, location in a zone of high seismicity, foundations that are complex and difficult to prepare, or retention of toxic materials. Dams under 10 meters in height are treated as large dams if they are expected to become large dams during the operation of the facility.	For large dams, the Bank requires: Reviews by an independent panel of experts (the Panel) of the investigation, design, and construction of the dam and the start of operations. Preparation and implementation of detailed plans: a plan for construction supervision and quality assurance, an instrumentation plan, an operation and maintenance plan, and an emergency preparedness plan. Prequalification of bidders during procurement and bid tendering, and Periodic safety inspections of the dam after completion.

3.6 Institutional framework for SEA Process

This Study recognizes 2 institutional set-ups that are critical to the successful execution of the EIA process as outlined below.

Institutional framework under EMCA 1999 Cap 387: In 2001, the Government established the administrative structures to implement EMCA, 1999 as follows: -

The National Environment Council: The National Environment Council (the Council) is responsible for policy formulation and directions for the purposes of the EMCA Act. The Council also sets national goals and objectives, and determines policies and priorities for the protection of the environment.

The National Environmental Management Authority: EMCA 1999 allows for formation of the National Environmental Management Authority (NEMA) as the body charged with overall responsibility of exercising general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment. Under the Act, NEMA was established in 2001 when the first Director General was appointed by the President.

Activities of NEMA are rolled out through three core directorates in charge of Enforcement, Education and Policy. To facilitate coordination of environmental matters at District level as per requirements of EMCA 1999, NEMA has established County Environmental Committees (CEC) traditionally chaired by respective County Commissioners and bringing together representatives from all the ministries; representatives from local authorities within the province/district; two farmers / pastoral representatives; two representatives from NGOs involved in environmental management in the province/district; and a representative of each regional development authority in the province/district. To each CEC in the country is attached a County Environmental Coordinator who, as the NEMA Officer on the ground is charged with responsibility of overseeing environmental coordination among diverse sectors and while serving as secretary to the CEC.

Thus, this SESA Study recognizes NEMA as the environmental regulator in Kenya.

4.0 BIO-PHYSICAL BASELINE OF THE PROJECT AREA

4.1 Location and Size

Murang'a County is one of the five Counties in Central Region of the Republic of Kenya that formed the former Central Province. It lies between latitudes 0^o 34' South and 1^0 07' South and Longitudes 36^o East and 37^o 27' East, covering an estimated area of approx. 2,558.8 Km^2. Murasng'a County shares common borders with Nyeri County to the North, Nyandarua County to the West, Kiambu County to the South, Kirinyaga County to the North East and Machakos and Embu Counties to the East.

Figure 4.1 on **Page 4-2** shows a Location Map of Murang'a County, with an inset showing the location of Murang'a County on the Map of Kenya.

4.2 Topographical and Natural Conditions

Murang'a County lies between 914m above sea level (amsl) in the East and 3,353m above mean sea level (amsl) along the slopes of the Aberdare Ranges in the West. The highest areas in the west have deeply dissected topography and are drained by several rivers. All the rivers flow from the Aberdare Ranges to the West, South Eastward to join Tana River.

The higher grounds forming part of the upper reaches of the Aberdare Ranges is typically characterized by mountains and major scarps and marks source of several rivers draining the County. The terrain is dissected making the area prone to landslides and gulley erosion. The land falls rapidly to the east, punctuated by numerous hills and very deep valleys that are steep sided, sometimes as deep as 100m. Most of these valleys have streams and rivers flowing in them. However, they even out at an altitude of about 1500m, at which the only prominent physical features visible are the hills. At an altitude of about 1100m, the land rolls out into dry plains. The relief intensity is 300 metres or more and the slopes can be over 30% but are in places between 3 and 8%.

The low altitude area cuts across major portions of the Kangema, Kiharu, Kigumo and Kandara Divisions. This is the area of mountain foot ridges and consists of dissected lower slopes of major older volcanoes and mountains with difference between high and low-lying areas of up to 100m and slopes of up to 16%. The lower regions of the Murang'a County constitute a major portion of the Makuyu Division although minor portions of the Kigumo and Kiharu Divisions are included. The Topography in this area is low level with minor variations in topographical features.

4.3 Climatic Conditions

Murang'a County is characterized by three climatic regions namely:

- The Western region with an Equatorial type of climate;
- The Central region with a sub-tropical climate;
- The Eastern part with semi-arid conditions.

The Climatic Regions are shown in **Figure 4.2** on **Page 4-3.**

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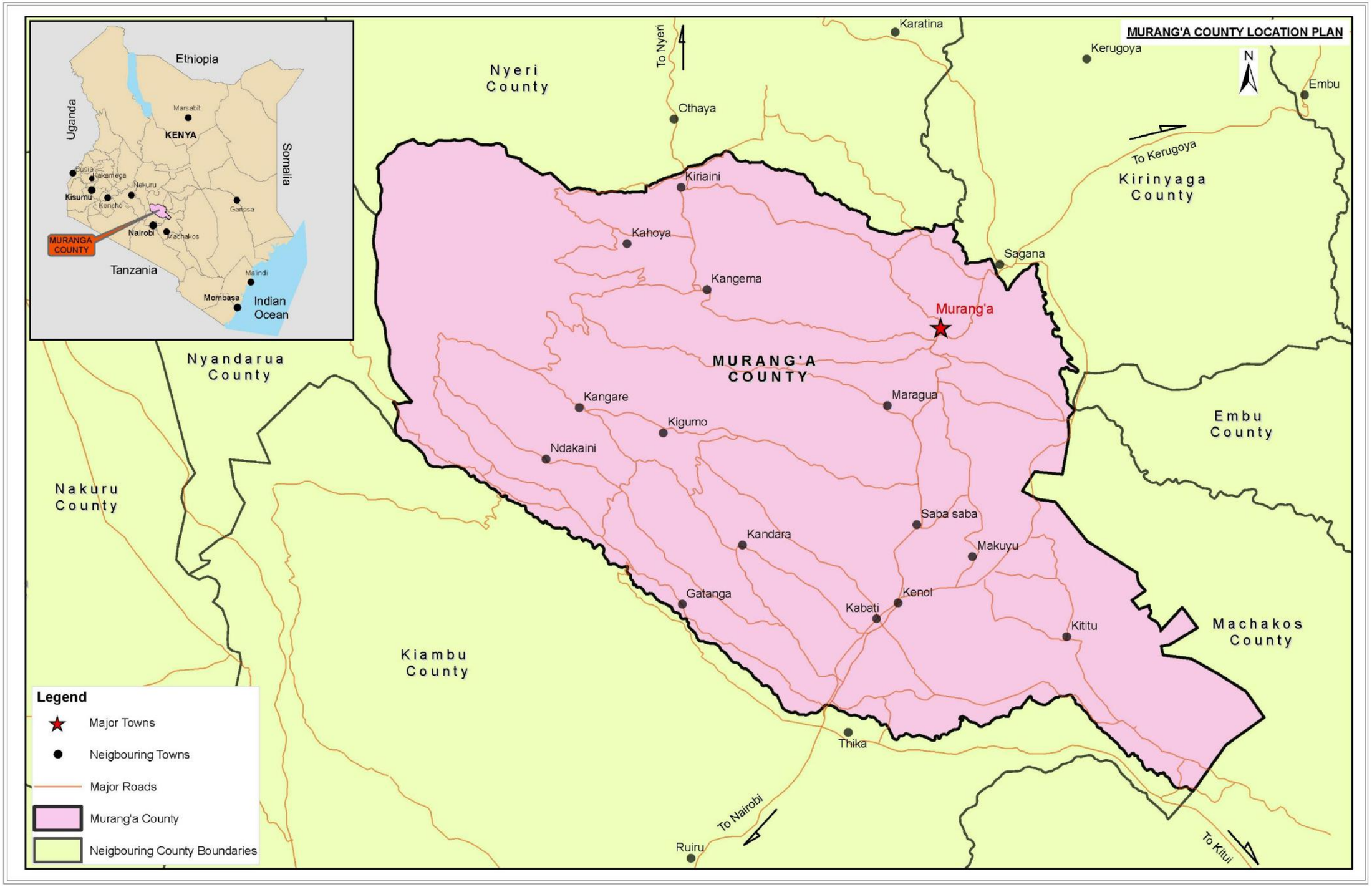

Figure 4.1: Location Map of Murang'a County

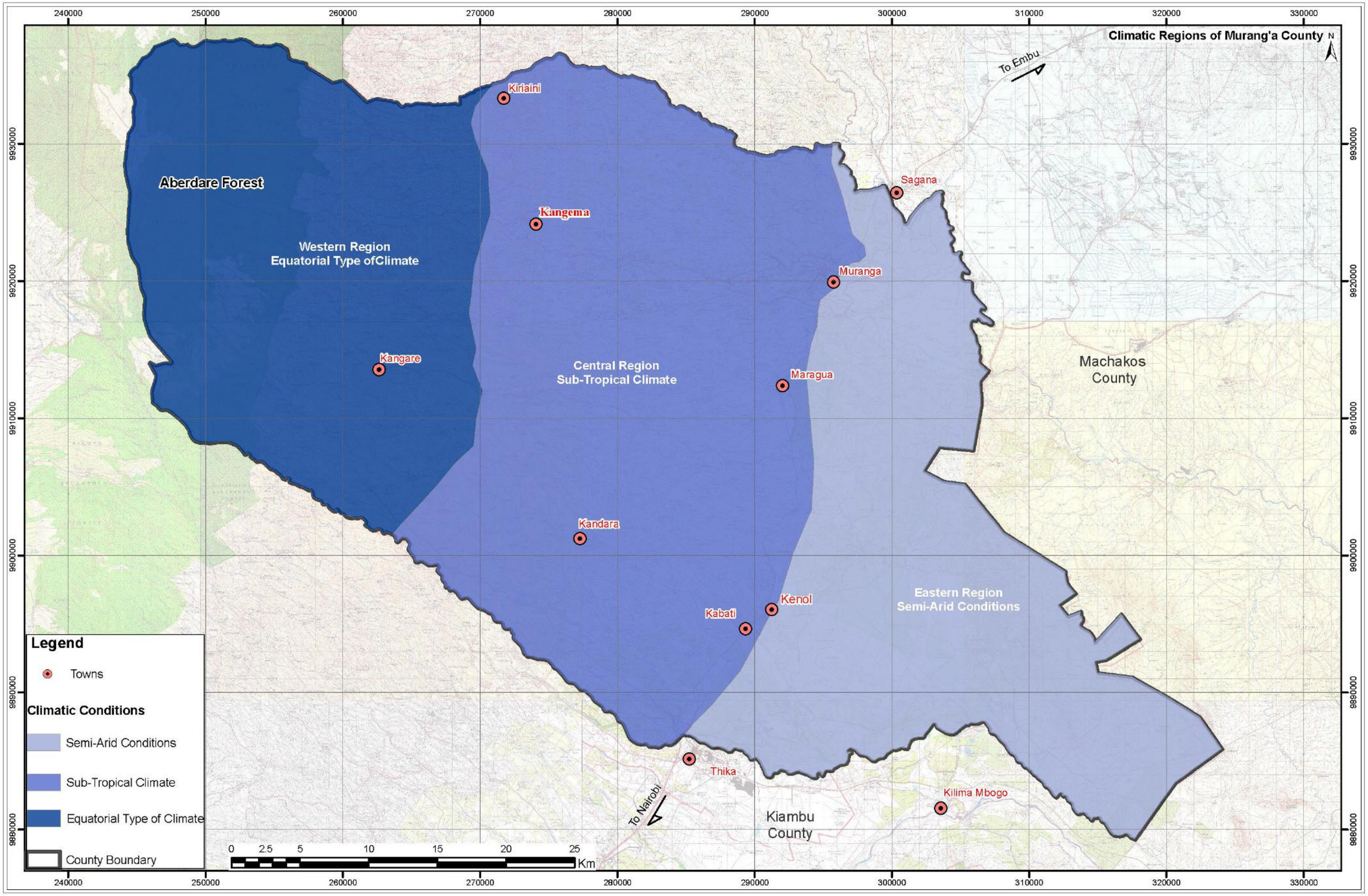

Figure 4.2: Climatic Regions in Murang'a County

The County experiences a mild tropical climate with an average annual temperature of around 24°C and an annual rainfall range between 900 mm and 2,700 mm. Mean annual rainfall is 1,504 mm against a National average of 680 mm (National Water Master Plan, 2013). 50% of the time, the annual rainfall is 1,515 mm.

Murang'a County is among the wettest in the Country, together with Kisii, Nyamira and Kakamega Counties. The long rains fall in the Months of March, April and May, with the highest Rainfall recorded in the month of April. The short rains are received during the Months of October and November.

The rains are associated with the Northward and Southward movement of the Intertropical Convergence Zone (ITCZ), respectively (Ogallo 1993). The western regions of Kangema, Gatanga, and higher parts of Kigumo and Kandara, are generally wet and humid due to the influence of the Aberdares and Mt. Kenya. The Eastern region, lower parts of Kigumo, Kandara, Kiharu and Maragua Constituencies receive less rain and crop production requires irrigation.

4.4 Geology

The Geology of the County consists of Volcanic Rocks of the Pleistocene age and basement system Rock of Achaean type. Volcanic rocks occupy the Western part of the County bordering the Aberdare's while rocks of the basement system are in the Eastern part. Porous beds and disconformities within the Volcanic rock system form important aquifers, collecting and moving Ground Water, thus regulating water supply from wells and boreholes.

Figure 4.3 on **Page 4-5** shows the Geology of Murang'a County.

4.5 Ecological Conditions

Agro-ecological zoning as applied by the Food and Agricultural Organization (FAO), defines zones based on combinations of soil, landform and climatic characteristics. The particular parameters used in the definition focus attention on the climatic and soil management requirements of crops and on the management systems under which the crops are grown under rain-fed conditions. Agro-Ecological Zones (AEZ) in Murang'a County are presented in **Table 4.1** below and shown **Figure 4.3** on **Page 4-6**.

Table 4.1: Agro Ecological Zones in Murang'a County

AEZ	Name of Zone	Description	Area (km^2)	Altitude (masl)	Annual Mean Temp (DEG C)	Annual Mean Rainfall (mm)
TA1 & TA2	Tropical Alpine1 and 2	National Park	21			
UH0	Upper Highland 0	Forest Reserve	259	over 2,430		
UH1	Upper Highland 1	Sheep - dairy zone	64	2,130 - 2,430	14.9 - 13.0	2,200 - 2,500
LH1	Lower Highland 1	Tea-dairy zone	386	1,730 - 2,130	18.0 - 15.0	1,700 - 2,400
UM1	Upper Midland 1	Coffee-Tea zone	316	1,670 - 1,800	18.8 - 18.0	1,700 - 1,900
UM2	Upper Midland 2	Main coffee zone	527	1,500 - 1,670	19.7 - 18.8	1,300 - 1,620

AEZ	Name of Zone	Description	Area (km^2)	Altitude (masl)	Annual Mean Temp (DEG C)	Annual Mean Rainfall (mm)
UM3	Upper Midland 3	Marginal coffee zone	235	1,340 - 1,500	20.7 - 19.7	900 - 1,350
UM3 (-4)	Upper Midland 3 to 4	Transition: marginal coffee to maize - sunflower zone	131			
UM4	Upper Midland 4	Maize - sunflower zone	397	1,340 - 1,520	20.7 - 19.5	900 - 1,100
LM3	Lower Midland 3	Cotton zone	76	1,160 - 1,340	21.7 - 20.8	980 - 1,100
LM4	Lower Midland 4	Marginal cotton zone	132	1,060 - 1,160	22.3 - 21.7	890 - 980
		Total	**2,542**			

Source: *Farm Management Handbook of Kenya 2009; MIBP - GIS based analysis*

4.6 Flora

Generally, the County falls within the "Midlands" vegetation zone. With high mean temperatures and moderate annual rainfall, this area originally supported dry forest and moist woodland. It has five indigenous gazetted forests covering a total area of 254.4 Km2, which include; Gatare, Karua, Kimakia, Kiambicho and Wanjerere forests. These forests are divided into two zones; the tropical montane forest zone located along the Aberdare ranges and the semi-arid forest zone located in the lower parts of the county. However, the County has 270,879 acres under farm forestry in over 204,500 farms.

Due to the high population density, most indigenous vegetation has been cleared to give way to small-scale agricultural use. Unlike the high grounds where coffee is the major cash crop, farming in the lowlands is generally of subsistence nature.

On the volcanic plateau, the original vegetation of dry woodland and bush particularly along the major river courses has largely given way to intensive agricultural use. Coffee is the most abundant crop, but most coffee farms are poorly maintained following a slump in raw prices on the world market. Other crops include maize, beans and horticultural developments, which are practiced at subsistence level.

The plains are covered with short grasses and support little or no shrubs. In contrast, the adjacent red sandy soils are marked by high bush density. Along the riparian zones of some of the seasonal streams, the vegetation cover is generally extremely dense.

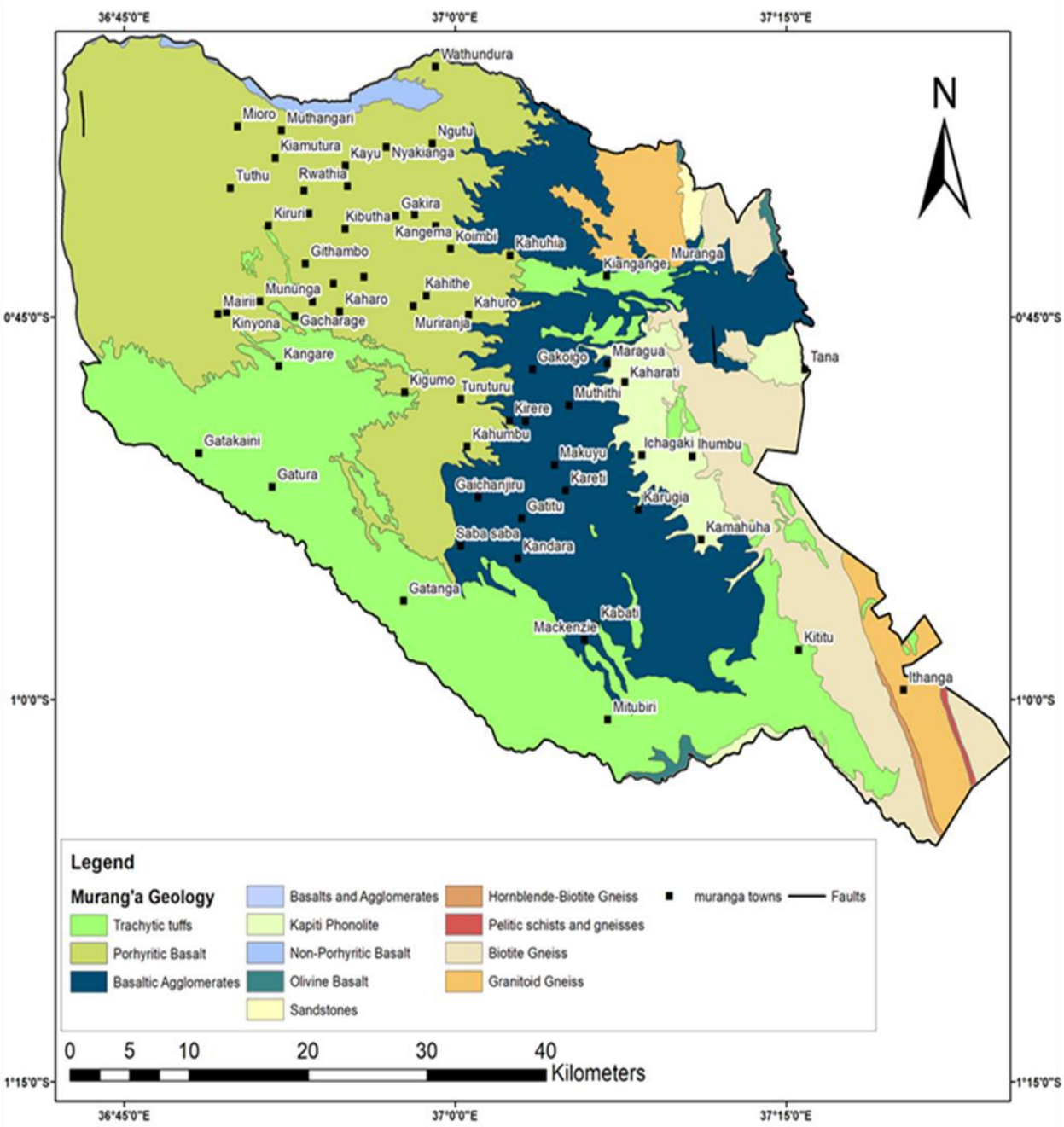

Figure 4.3: Geology of Murang'a County

4.6.1 Tree Species with the Project area

The vegetation cover in the project area consists of moist savannas, dry savannas and farmlands. The natural biological environment of the project area has however been substantially changed by human settlements. Most of the land in this area is under cash crop plantations of Due to the homogeneity of the area which is covered by farmlands, there were no major fauna of conservational importance identified along the project area.

From literature the frequency of major woody species identified in the project is summarised in **Table 4.7** on **Page 4-7**.

Table 4.2: Tree Species with the Project area

Local Name	Scientific Name	Status
Mutati	Polyscias kikuyensis	Dominant
Muiri	Prunus Africana	Dominant
Mugumo	Ficus sycomorus	Rare
Muthai	Schefflera spp	
Mukohokoho	Monimiaceace spp	Dominant
Mutundu	Croton macrostachyus	Dominant
Muirugi		Dominant
Mugaita	Rapanea rododendroides	Dominant
Mutheoera		Rare
Muagu	Rausonia lucida	Dominant
Muerere	Tabernaemontana stapfiana	Dominant
Githirathiru		Dominant
Munyawa	Fraxinus berlandrine	Dominant
Mukuhakuha	Macaranga kilimandscharica	Dominant
Mutuya	Myrianthus holstii	Dominant
Mukurue	Albizia gummiflora	Dominant
Mubera		Rare
Mutati	Polyscias kikuyuensis	Dominant
Mukoe	Syzygium cordatum	Dominant
Muhehe	Pistacia aethiopica	Rare
Munuga	Ekebergia capensis	
Muna	Aningeria adolfifriendericci	Rare
Muthaduku	Acacia mearnsii	Rare
Muiruthi	Diospyros abyssinica	Dominant
Muthakwa	Vernonia auriculifera	Dominant
Muthare	Pracaena staudneri	
Muirungi	Catha edulis	
Murigitathi	Mystroxylon aethopicum	Dominant
Mucharage	Olea kapensis	Rare
Muenyere	Cussonia spicata	Dominant
Muthaiti	Ocotea usambarensis	

Maragua B Dam Vegetation Cover

Thika 3A Dam Site Vegetation Cover

4.6.2 Farmland Vegetation

The entire Project area is interspersed through cultivated fields with arable farming, settled areas and large scale areas with cash crop plantations of tea and banana plantations in the lower altitudes. Eucalyptus spp and Grevillea were the widespread exotic trees species in the farmland in the study area. This species were noted to have the highest density and

frequency in occurrence in the area. Their dominance is attributed to their economic value because of the ready market for the harvested tree products. Most farmers practise arable farming along the river ecosystem. The main types of crops observed in the study area include bananas, yams, maize, arrow roots, beans and Napier grasses.

Maragua 4 treatment works farmlands

Food Crops at Maragua B Dam Site

4.6.3 Riparian Vegetation

The Strategies for Water and Irrigation Development for Murang'a County will focus on Maragua, Kayahwe, Irati and Thika River Catchemnt. The riparian in the study area encompass both indigenous and exotic trees. However, the exotic trees were noted to be more frequent and dense than the indigenous ones. Grevillea, Eucalyptus and Wattle trees were the most frequent with higher percentage cover in the area compared to the indigenous Prunus africana, Olea africana, Croton megalocarpus, Spathodea campanulata and Dombeya.

From the field assessment, most of the riparian vegetation has been cleared to pave way for agricultural activities and other anthropogenic activities. This is evident along most of the rivers where crops have been planted up to the lower tidal zone of the river. Where the riparian vegetation exists, it was observed that the vegetation strips rarely extend beyond a width of five meters from the river bank as indicated in photographs below.

Maragua B Dam Site Riverine Vegetation

Kiama River Vegetation (Woodlots)

4.6.4 Grassland Vegetation

Most of the study area is covered with grass species. These grasses are found on the farmlands, undergrowth on trees, on open grounds and settled areas. Grasses play an important ecological function to the ecosystem. For instance, they provide a good ground

cover in an area hence curbing the impact of soil erosion. The most dominant grass within the project area include Themeda triandria, Cynodon dactylon, Chloris gayana, Digitaria, Eragrostis superba, Paspalllum, Cyperus rotundus, Sedge grass and planted Napier grass. However, sedge grasses were mainly observed along the river bank and swampy areas while Napier grass was widely planted along the riparian of Thika River and Irati. Digitaria spp. is categorised as an invader in range management hence quickly colonizes disturbed and bare areas. These species are also unpalatable thus not a preferred grass for grazing animals.

Mathioya Irrigation Scheme Vegetation Cover

Sabasaba Irrigation Scheme Vegetation Cover

4.6.5 Invasive Species

Invasive plant species are common on disturbed or modified environment, which implies that during construction of the discussed strategies chances of such species dispersing to other areas will be significant. The Wildlife (Conservation and Management) Act of 2013 has listed all the nationally declared invasive alien species in Kenya. Invasive alien species have a tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition and function of natural ecosystems.

Therefore, it is important that all these alien species be managed by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species. Alien plant species easily invade disturbed/cleared areas with disastrous impacts on the natural community. Invaders and weed species must be controlled to prevent further spread to other areas and it is recommended that all individuals of the invader species be removed and eradicated.

Lantana camara is found in the entire project area while Thevetia peruviana and Datura stramonium are found within the entire Project area.

Invasive Lantana Camara within Irati River

Invasive Datura stramonium spp.

These are the nationally declared alien species in the wildlife and Conservation Act. All the above listed species easily colonizes disturbed and bare areas therefore none of them should be used to revegetate the area after construction. In cases where soil will be borrowed elsewhere to the proposed site, caution should be taken to ensure that the propagules are not transferred to new sites. The construction site should also be monitored during operation to check for any invasive/colonizers sprouting in the area. When such species are spotted along the pipeline, they should be uprooted. Other invasive species include; Mauritius thorn, Acacia melanoxylon, Acacia meansii and Rubus stendineri specie

4.6.6 Flora listed under the IUCN Red List

Flora of conservation importance are species that are listed in the Wildlife Conservation and Management Act 2013, CITES and IUCN Red List as protected species. Such species are endangered, threatened or vulnerable to extinction with continuous exploitation. There is no protected forest within the project area. Apart from Prunus africana and Vitex keniensis which is listed as vulnerable tree under the sixth schedule of the Wildlife Conservation and Management Act of 2013, no other flora of conservation importance was noted in the project area. Prunus africana and Vitex keniensis (Meru Aok) in the project area is however mainly planted within farmlands, tea and coffee plantation and residential areas.

Endanered Prunus Africana Tree

Endangered Vitex Keniensis (Meru Oak Tree)

4.7 Fauna

The project area is dominated by anthropogenic activities which have modified natural environment, there are few terrestrial wild fauna in the project area of influence which is predominantly settled areas. Fauna in the proposed project area is mainly comprised of various bird species, domestic animals and aquatic fresh water fish species within the rivers (Thika, Irati and Maragua Rivers).

4.7.1 Fish Diversity

The rivers flowing from Aberdare Forest Ecosystem have various species of fish which include the brown and rainbow trout fish that were introduced in the moorland streams in 1905 and 1915 respectively. The proposed water resources development strategies which involve constructions of dams, intake works and water treatment works could lead to aquatic and terrestrial habitat fragmentation. This concept well explained by the Habitat connectivity which is the degree to which separate patches of habitat are connected. Greater habitat connectivity means animals are able to travel between these patches (Kate M 2018).

Therefore, A dam acts as a barrier between the upstream and downstream movement of migratory river animals, and fish such as (Barbus, Snake Catfish, Rainbow Trout, Guppy fish in Thika, Maragua and Irati upstream, midstream, and downstream respectively. This reduces connectivity of both water and terrestrial organism. Different species – *Oncorhyncus mykiss* (Rainbow trout), *Clarius theodare* (Snake catfish), *Barbus* amphigramma (Barbus) and *Poecilla reticulata* (Guppy) –Have been recorded along the Aberdare river system. Photographs below present images of some of the fish species existing within the project catchment.

None of these species is listed as of conservation concern in the IUCN red data list and the Kenya wildlife conservation and management Act of 2013.

Clarius theodare (Snake catfish)

Barbus amphigramma (Barbus)

Currently, there is limited riverine fishery along Thika, Irati and Maragua rivers. The upstream trout is usually caught by fishing using drift nets and handlines. Mid-stream, a mix of catfish, trout and Barbus was evident within the river basins.

4.7.2 Avian Diversity with the Project Area

Over 290 species of birds have been recorded in the entire Project area because of the influence of the Aberdare forest reserve. Of these, the Jackson's francolin is categorized as being regionally endemic wheras the Aberdare cisticola is rated as being globally threatened. Black river ducks, forest and moorland francolins, white napped ravens, streaky seed eaters, hill chats, alpine swifts and four species of sunbirds including the scarlet – tufted malachite sunbird which is found in the moorlands. Birds of prey are common which include the mountain augur buzzard, crowned eagle, hawk eagle and African goshawk.

The Aberdare mountain range holds 52 of Kenya's 67 Afrotropical highlands species of birds and 6 of 8 restricted range species in the Kenyan mountains. Globally threatened bird species found in the mountain range are Sharpe's Longclaw, Abbott's Starling, Aberdare Cisticola and Jackson's Widowbird. Birds with a restricted range and found in the Aberdare range are Jackson's Francolin and Hunters Cisticola. Regionally threatened bird species are African green Ibis, Ayre's Hawk Eagle, African Crowned Eagle, Stripped Flufftail, Bailon's Crake, African Grass owl, Cape Eagle Owl and Long-tailed Widowbird. Various sites within and around the Aberdare are listed as Important Bird Areas (IBA) by Nature Kenya. These include Ol bolossat, Kinangop, Kimakia, Gatare and Kikuyu escarpment

However, the project will not directly interact with the forest ecosystem. Therefore, no important bird of conservation observed in the project area as listed in the Wildlife and Conservation Act and IUCN Red List. This is attributed to the numerous exotic trees in the area that are planted for commercial purposes. Exotic trees are not preferred habitat for avifauna. However, caution should be taken where indigenous trees like Acacia, Podocarpus and Ficus trees exist because such trees form habitat for the birds where they form nests. Some of the avifauna species observed in the project area are listed in **Table 4.3** below.

Table 4.3: Avian Species within the Project Area

Weavers	Ploceus spp
African black duck	Anas sparsa leucostigma
Greenbul	Andropadus
Eagles	Polemaetus bellicosus
Speckled mouse birds	Colius striatus
Blue-naped mousebird	Urocolius macrourus
Blue-napped mousebird	Streptopelia spp
Doves	Streptopelia spp
Speckled pigeon	Columba guinea
Golden breasted bunting	
Camaroptera	Camaroptera
Slate colored boubou	Laniarius funebris
Common fiscal	Lanius collaris humeralis
Fire finch	Lagonosticta senegala
Bee-eater	Merops spp.
Sunbird	Nectarinia
Red bishop	Euplectes franciscanus
White-browned scrub robin	Cercotrichas leucophyrs
Cattle egret	Bubulcus ibis
Red fronted tinkerbird	Pogoniulus pusillus affinis
Barbet	Trocholaema
Superb starling	Lamprotonis superbus

**Source: Aberdare Forest Management Plan 2014-2019*

Weavers Birds Ploceus spp

Sun Bird Spp

5.0 SOCIAL ECONOMIC BASELINE OF THE PROJECT AREA

5.1 Administrative Units and Towns/ Urban Centres in Murang'a county

5.1.1 Administrative Units within Murang'a County

Murang'a County is made of Seven (7) Constituencies namely: - Kiharu, Kangema, Gatanga, Mathioya, Kigumo, Kandara and Maragua Constituencies, with Eight (8) Sub-Counties namely: - Kiharu, Kahuro, Kangema, Gatanga, Mathioya, Kigumo, Kandara and Maragua. The Sub-Counties are divided into Thirty (30) Divisions, One Hundred (100) Locations and Two Hundred and Sixty (260) Sub-Locations.

Table 5.2 below gives a summary of the Administrative Centres within Murang'a County while **Figure 5.1** on **Page 5-2** shows Administrative Boundaries within the County.

Table 5.1: Administrative Units in Murang'a County

No.	Constituency	Land Area (Km^2)	No. of Sub-Counties	No. of Divisions	No. of Locations	No. of Sub-Locations
1	Kiharu	409.9	2	7	24	53
2	Kangema	173.6	1	3	11	33
3	Gatanga	599.0	1	7	21	59
4	Mathioya	351.3	1	4	12	25
5	Kigumo	242.1	1	3	12	28
6	Kandara	235.9	1	3	9	28
7	Maragua	547.2	1	3	11	34
Total		**2,558.9**	**8**	**30**	**100**	**260**

Source: *Murang'a County Integrated Plan 2018-2022*

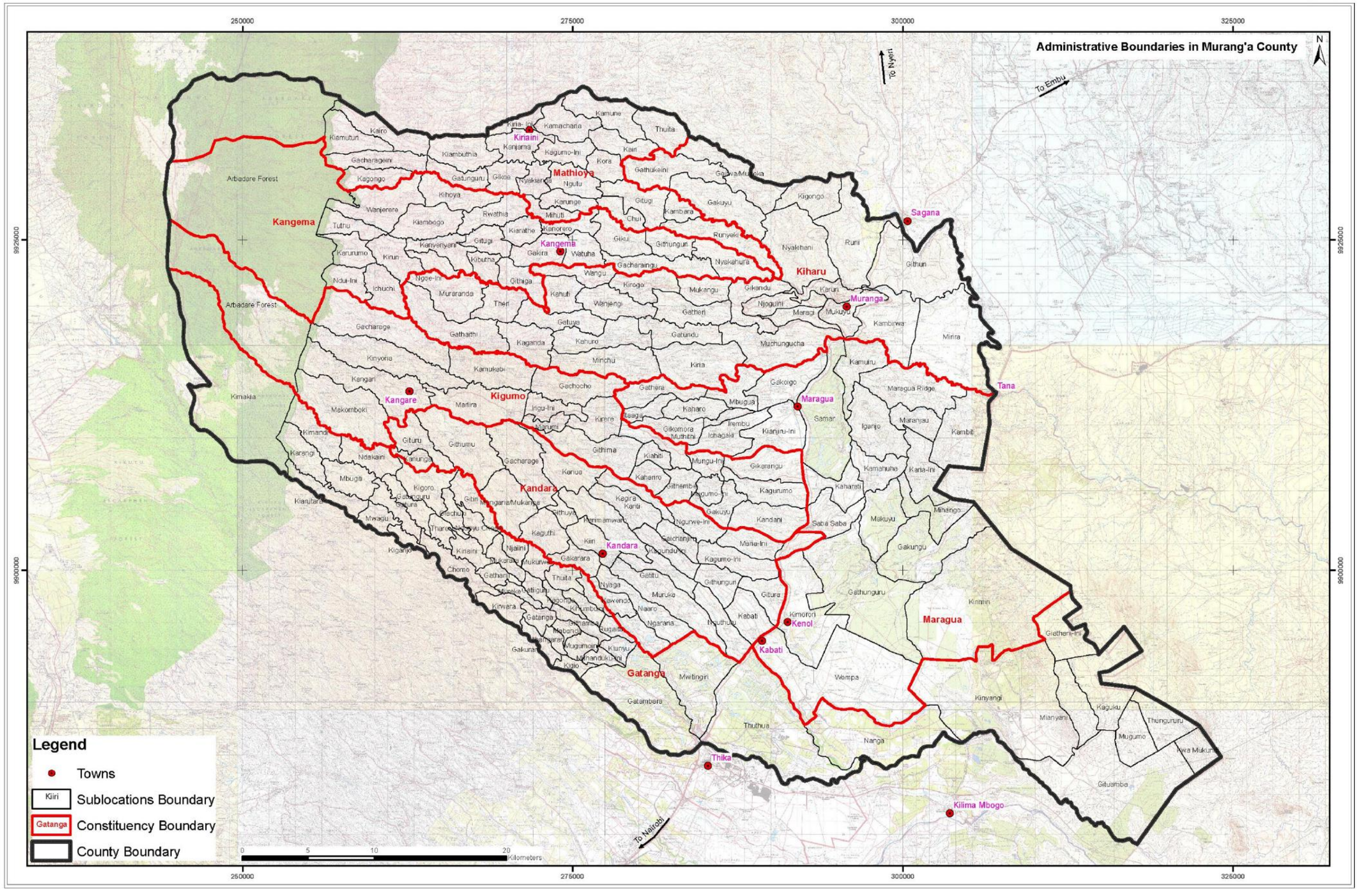

Figure 5.1: Administrative Boundaries for Murang'a County

5.1.2 Towns/ Urban Centres within Murang'a County

Murang'a Town

Murang'a Town, formerly known as Fort Hall, is the main Town within the region and the County Head Quarters for Murang'a County. It is centrally located in the County and offers administrative and socio-economic services to locals and the entire region. The Town lies on latitude 0° 43' S and longitude 37° 8' E, approx. 80km to the North of Nairobi. It is situated approx. 10km to the North of Maragua Town and approx. 15km to the South West of Sagana Town.

Murang'a Town has an estimated current population of 35,860 (Year 2018), projected from the 2009 Kenya Population and Housing Census results as published by the Kenya National Bureau of Statistics (KNBS). It is characterized by relatively high rates of urban growth, attributed to available infrastructure and facilities.

Under the Urban Areas and Cities Act of 2011, Murang'a Town has been classified as a Township. The Town is characterized by linear/ribbon development patterns or clustered pattern.

Other Towns/ Urban Centres within Murang'a County

In addition to Murang'a Municipality, the KNBS 2009 National Population Census categorized the following 5Nr., Towns within former Districts forming Murang'a County as Urban Centres;

Table 5.2: Urban Centres Within Murang'a County

S/No.	Urban Centre	Status
1	Murang'a	Municipality
2	Maragua	Town Council
3	Kangari	Other Centre
4	Makuyu/ Kenol	Town Council
5	Kabati	Other Centre
6	Kiria-ini	Other Centre

The above listed Uran Centres have also been adopted in the Integrated County Development Plan for Murang'a County.

Under the previously submitted Water Resources Options Report, Kandara and Kangema Towns were also classified as Urban Centres, for purposes of the Study.

In total, 8Nr. Towns have been adopted as Urban Centres, including Murang'a Town, with the rest of the County categorized as Rural Areas.

5.1.3 Categorization of Urban Centres within Murang'a County

As detailed in the Water Resources options Report, for purposes of Water Demand assessment, Urban Centres within Murang'a County were classified into Urbanization Levels based on Urbanization Rate and trend, Infrastructure development, etc., in line with the Urban Areas and Cities Act. The Urbanization Levels and criteria adopted are summarized in **Table 5.3** below.

Table 5.3: Categories of Urban Centres in Murang'a County

Level	Towns
Level 1 (Urban Centres) • Largest urbanized area in the County • Well defined infrastructure and facilities that attract rapid growth e.g., transport networks, educational facilities, hospitals, etc. • High rate of urbanization • Numerous scenarios of urban sprawl, urban decay, informal settlements proliferation, traffic congestion, land fragmentation, uncontrolled development.	**Murang'a Town and Makuyu/Kenol**
Level 2 (Urban Centres) • High rates of urban growth • Growth majorly influenced by available infrastructure and facilities • Characterized by linear/ribbon development patterns or clustered pattern (especially those near learning institutions) • Urban sprawl to agricultural land, inadequate of basic infrastructure and services, unplanned/uncontrolled development.	**Maragua Town, Kabati, Kangari, Kiri-aini, Kangema and Kandara**
Level 3 (Rural Centres) • Slow urbanization process with minimal or no sprawl • Developments are not influenced by any major infrastructure provisions or major facilities • Minimal influence of urban development to Agriculture land fragmentation • Unplanned / uncontrolled development • Lack /inadequate infrastructure and services	**All Rural Centres in the County**

Source: Urban Areas and Cities Act of 2011, Murang'a County CIDP

Figure 5-2 on **Page 5-6** shows the Locations of major Urban Centres (Level 1 and Level 2) within Murang'a County.

5.1.4 Human Settlement and Economic Activities

The County is characterized by very dense rural settlements in which land subdivision into narrow strips of land is common. Since most of the County consists of ridges and valleys, land parcels are mostly subdivided in such a way that each parcel has access to a road on one side and a river/ stream on the opposite side. Subdivision into sizes that are not agriculturally viable is common. Some of the subdivisions do not meet the requirements for registration, hence are not registered.

According to the Murang'a County Integrated Development Plan (2018 – 2022), there are an total of 513 Market Centres in the County. Major shopping centres include Kahati, Kahuro, Kandara, Kangari, Kangema, Kamahuha, Kenol, Kigumo, Kiriaini. Kirwara, Makuyu, Maragua and Saba Saba.

89% of the population in the County live in rural areas while 11% live in urban areas, thus making agriculture the main economic activity in the County.

Approximately 40% of the households within the County live in stone/ brick walled houses, 58% of the households live in mud/ wood walled houses while 2% of the households live in grass straw/tin walled houses. Approximately 95% of the units are roofed with corrugated iron sheets and 5% are roofed with makuti and grass. 60% of the housing units have earth floor while 40% have cement floor.

Human settlement patterns in Murang'a County vary from Town to Town due to various reasons such as socio-cultural factors, topography and economic output. These settlement patterns can be categorized into three categories as follows:

- Linear Settlement; Settlement along roads, which are predominant all over the County.
- Scattered Settlement; This is where households are settled at distance from each other especially in the rural areas
- Nuclear Settlement, This type of settlement is characterised by a concentration of households in an area especially towns.

Agriculture is the backbone of the economy of Murang'a County. Residents are engaged in small scale farming and livestock keeping. The main cash crops in the County include Tea, Coffee, Avocado, Macadamia and Horticulture Crops among others. Horticultural crops include Tomatoes, Cabbages, Kales, Spinach and French Beans while food crops include Maize, Beans, Bananas, Sweet Potatoes and Cassava.

The acreage under food crops and cash crops are 329,234 and 177,637 respectively, indicating that the acreage under food crops is almost twice that under cash crops. Food crop farming is practiced in all parts of the County but cash crop farming is practiced in upper zones and in some lower zones of the County.

There are 13 tea factories and 161 coffee factories that serve farmers in the County.

Dairy farming is also popular in the County, with milk processing plants spread across various Urban Centres e.g. Kenya Cooperative Creameries and Mountain Fresh milk plants in Kangema.

Stone quarries within the County are the main source of building materials, especially building stones and coarse aggregates. Sand harvesting also acts as a source of income for locals on the border of Murang'a and Machakos Counties.

5.1.5 Infrastructure and Access

Murang'a County has an extensive road network with approx. 387 Km of tarmac roads, approx. 1,300Km of gravel roads and over 1230km of Earth roads. The Nairobi-Nanyuki Railway also traverses through the County, with a length of 65km within Murang'a County.

There is no established air strip in the County, but plans are underway to construct an air strip at Kambirwa, approx. 8 km from Murang'a Town.

Figure 5.2: Locations of Urban Centres within Murang'a County

5.2 Demographic Trends and Population Projections for the Study Area

A detailed analysis of demographic trends for the entire Study Area was carried out under the Water Resources Options Report submitted in November 2018. In the analysis, demographic data from the Kenya National Bureau of Statistics (KNBS) for the Census years 1969,1979,1989, 1999 and 2009 were analysed to establish trends in population size and intersensal Population Growth Rates in the Study Area.

Based on the observed trends in historical population growth, three (3) growth variants with tapering growth rates were formulated to create sensitivity scenarios of Population Projection from the base year (Year 2009) to the ultimate planning horizon (Year 2045) as follows:

- High variant growth rates (H) – Upper limit of Population growth in the Study Area
- Medium variant growth rate (M) – Moderate growth rates as depicted in the historical trends
- Lower variant growth rates (L) – Significant decline in growth rate compared to last intercensal period

Adopted Projected Population for the entire Study Area under the High, Medium and Low Variant growth scenarios as reported in the Water Resources Options Report are presented graphically in **Figure 5.3** below.

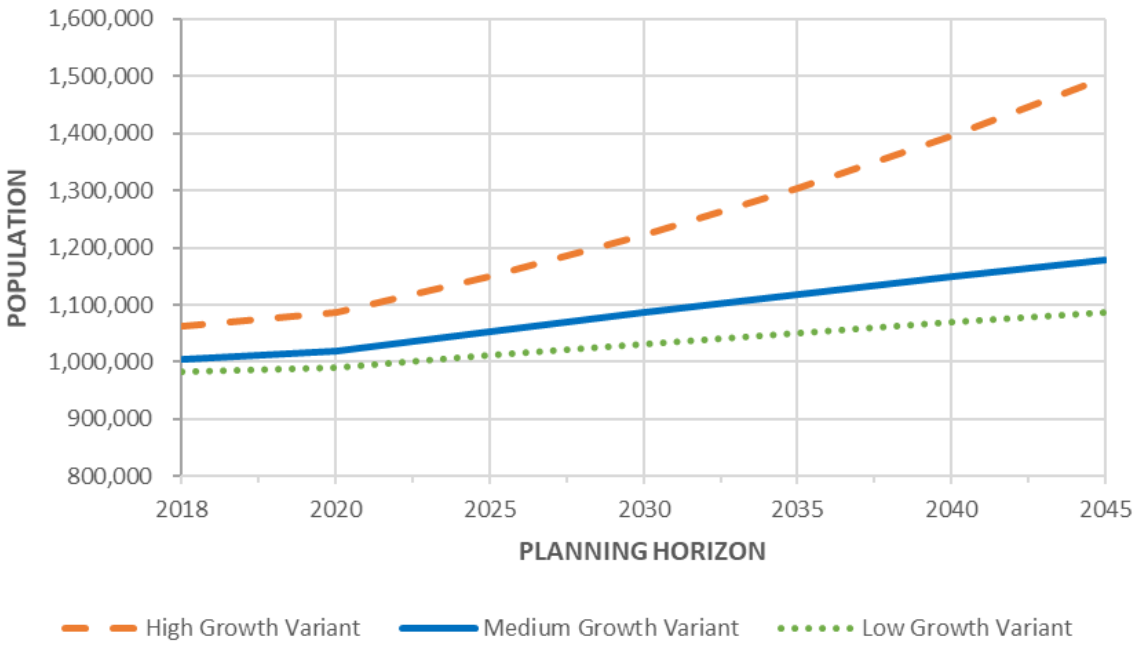

Figure 5.3: Summary Population Projection for Murang'a County under High, Medium and Low Variant Growth Scenarios

The results of the analysis were agreed upon with the various stake holders and the Medium Variant Growth Scenario adopted as the basis for Population Projections in Development of the Integrated Water and Irrigation Master Plan for Murang'a County.

Table 5.4 below shows the Medium Variant Growth Rates as adopted in the study.

Table 5.4: Medium Variant Growth Rates for various Areas within the Study Area

Area	2009-2018	2019-2020	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045
Murang'a Township	3.0%	2.5%	2.3%	2.0%	1.8%	1.5%	1.3%
Maragua Town	2.0%	1.8%	1.6%	1.5%	1.3%	1.1%	0.9%
Makuyu/Kenol Town	7.0%	5.5%	5.0%	4.0%	3.0%	2.5%	2.0%
Kabati Urban Centre	2.0%	1.8%	1.5%	1.3%	1.2%	1.0%	0.8%
Kangari Urban Centre	1.5%	1.3%	1.2%	1.0%	0.9%	0.8%	0.6%
Kiriiani Urban Centre	1.5%	1.3%	1.2%	1.0%	0.9%	0.8%	0.6%
Kangema Town	1.5%	1.3%	1.2%	1.0%	0.9%	0.8%	0.6%
Kandara Urban Centre	1.5%	1.3%	1.2%	1.0%	0.9%	0.8%	0.6%
Rural Areas	0.4%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%

Table 5.5 shows Population Projections for the various areas within Murang'a County, based on the Medium Variant Growth Scenario.

Table 5.5: Population Projections for the Period 2018 to 2045 for Murang'a County

Area	2018	2020	2025	2030	2035	2040	2045
Murang'a Township	35,860	37,676	42,212	46,606	50,954	54,892	58,554
Maragua Town	17,323	17,952	19,435	20,937	22,334	23,589	24,670
Makuyu / Kenol Town	47,587	52,965	67,598	82,244	95,343	107,872	119,099
Kabati Urban Centre	3,738	3,874	4,173	4,452	4,725	4,967	5,168
Kangari Urban Centre	3,213	3,297	3,500	3,678	3,847	4,003	4,125
Kiriiani Urban Centre	2,885	2,960	3,142	3,302	3,454	3,594	3,703
Kangema Town	3,160	3,243	3,442	3,618	3,784	3,937	4,057
Kandara Urban Centre	2,814	2,888	3,065	3,221	3,369	3,506	3,612
Total Urban Population	**116,580**	**124,855**	**146,568**	**168,059**	**187,810**	**206,361**	**222,989**
Rural Areas	**889,299**	**894,107**	**906,243**	**918,544**	**931,011**	**943,648**	**956,456**
Total Population	**1,005,879**	**1,018,962**	**1,052,812**	**1,086,602**	**1,118,821**	**1,150,009**	**1,179,446**

Figure 5.4 on **Page 5-9** gives a graphical presentation of the Urban, Rural and Total Population Projections for the Study Area under the adopted Medium Variant Growth Scenario.

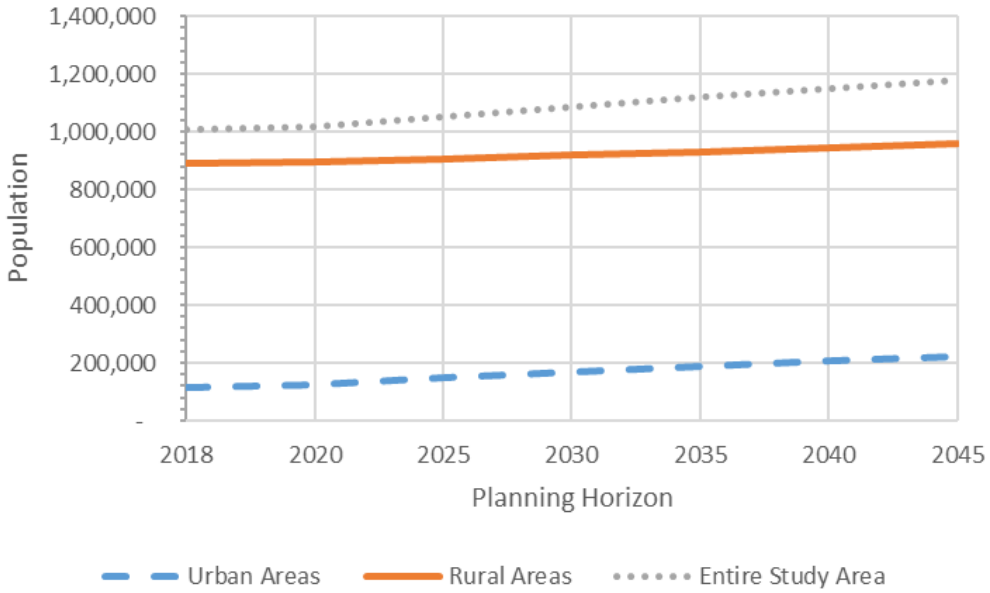

Figure 5.4: Adopted Population Projections for Study Area

5.3 Education

Murang'a County has 634 primary schools, 6,324 teachers, total enrolment of 214,986 and a transition rate (proportion of students from the primary level who move to the next level) of 70 percent. Again, at the county, net set secondary school enrolment rate is 71.04% for both boys and girls. On average 70% of the members of the community live between 1.1km and 4.9km to the nearest primary school. This figure tallies with results from the baseline survey study in the project area in which 100% of the surveyed population live less than 5kms from the nearest primary school.

Majority of the children who are of school going age in the project area are currently in school. Of the surveyed population 48.44% of persons in school accounted for children within the age bracket of 5-14 years as shown in **Table 5.5** below.

Table 5.6: Population (%) currently in school

Age Bracket	Currently in School	
	Yes	No
0-4	6.22	7.62
5-9	23.56	0.69
10-14	24.89	0.23
15-19	25.78	0.69
20-24	12.89	7.16
20-29	3.56	10.6
30-34	0.00	12.47
40-44	1.33	12.24
45-49	0.89	8.31
50-54	0.00	8.55
55-59	0.44	3.93
60-64	0.00	6.24
65+	0.00	6.70
Total	**100**	**100**

Majority of the household heads within the project area have attained basic primary education as reflected in the **Table 5.7** below. Only 10% and 9.52% of the household head and their spouses respectively have not attained any basic formal education. The analysis also found out that transition to tertiary education is low with only 3.75% and no spouse transitioned to tertiary level of education.

Table 5.7: Educational Level of Household Heads

Level of education	Household Head Population	Population Spouse of the Household Head
None	10.00	9.52
Primary	36.25	52.38
Secondary	35.00	38.10
Tertiary	15.00	0.00
University	3.75	0.00
Others	0.00	0.00
Total	100	**100.00**

To communicate and mobilise the community effectively during implementation of the project, the project implementation team should adopt communication strategies that will be understood by the non-educated and the educated members of the community. These mobilization strategies include, public meetings conducted or translated in the local language, radio adverts in the local language and posters posted in the accessible public places in both Swahili and Local languages.

5.4 Housing Conditions

Characteristics of housing for the people within Muranga County were assessed in terms of roofing, walls and floor to determine the quality of housing available for the use within the community as shown in **Table 5.8** below.

Table 5.8: Housing Characteristics

Roofing	Percentage of Use
Corrugated Iron Sheets	96.24
Thatched	2.26
Tiles	1.50
Walls	
Wood	66.92
mud	4.51
Bricks	3.01
Stone	25.56
Floor	
Earth	57.14
Cement	42.86

5.5 Water and Sanitation

Muranga is located within the Tana Catchment Area. The area has abundant water resources but there is inadequate infrastructure for water supply and distribution. According to the County Public Health office, about 40% of the population in Murang'a County have access to safe drinking water.

The County at large and project area are supplied by several water schemes. At the County level, there are 27 water supply schemes while at the project area most of the water supply schemes are managed by community members through water project committees. The water projects source their water from River Maragua and Irati. The two main existing water supply schemes in the project area are Gathaini Water Project and Karura Water Project.

The study established that majority (77.44%) of the community members have piped water system to their homesteads. This is supplemented by rainwater catchment which accounted for 69.17% of community's water source as indicated in **Table 5.9** below.

Table 5.9: Water Source

Water Source	Percentage
Piped to Homestead	53.00
Rainwater	22.00
River	11.00
Springs	5.00
Shallow Wells	4.51
Boreholes	2.26
Other Sources	1.50
Piped to community	0.75

Stand Tap located in Muchungucha (Murang'a)

Bombo Water Kiosk all funded by OBA[1]

[1] **Kenya Urban Water And Sanitation Output Based Aid (OBA) Program For Low Income Areas**

Water is used for multiple purposes including domestic purposes, livestock keeping, agricultural uses as well as small scale irrigation and industrial uses such as coffee processing. According to the County Irrigation Officer, the main sources of water for domestic and industrial use are rivers, springs, shallow wells, borehole and roof.

Human activities such as coffee processing and poor farming methods have resulted in pollution and siltation of water resources. Other sources of pollution include use of agrochemicals that end up in river systems. Point source pollution also occurs due to domestic activities carried out by the local community along river banks. Such activities include laundry, bathing and washing cars. During drought conditions, people also resort to farming in wetlands, riparian land and swamps to increase food production for domestic use.

Water pollution poses a risk to human health considering that there are people who source domestic water directly from the rivers. Key environmental issues in management and utilization of water resources in Muranga County are:

(i) Water scarcity due to declining sources;
(ii) Climate variability resulting to droughts;
(iii) Catchment's degradation due to poor farming methods and deforestation;
(iv) Poor allocation methods resulting to water related conflicts; and
(v) Decreased efficiency of water use due to numerous losses of the available.

5.6 Health

Upper Respiratory Tract Infections (URTI) are very common in the County which can be attributed to the increasing levels of atmospheric pollution caused by dust, smoke from Thika industries and increase in the number of petrol engines. The other health conditions Include cold in higher altitude areas is also a factor. Diarrheal diseases are also prevalent thus suggesting contamination of food and / or drinking water. This information is presented in **Table 5.10** below.

Table 5.10: Prevalence Disease

No	Disease
1	Upper respiratory tract infection
2	Skin disorders
3	Pneumonia
4	Diarrhea
5	Urinary tract infection
6	Normal accidents
7	Chicken pox
8	Eye infections
9	Rheumatism
10	Ear infections

**Source: Murang'a Public health Office, 2015*

The following interventions have been established by the Ministry of Health to improve the public health situation:

- Supervision and ensuring proper waste management at all levels of production storage, collection, transportation and disposal;
- Water quality analysis to ensure safe water supply; Improved sanitation and good Hygiene by carrying out health campaigns such as hand washing campaigns;
- Vector & Vermin control through proper waste management to keep away rodents, draining stagnant water to reduce mosquito breeding grounds.

Information of the available health facilities were obtained from the County Public Health Officers in the two Sub-Counties hosting the project. It was noted that Kangema has 13 healthy facilities categorised as listed in **Table 5.11** below:

Table 5.11: Health Facilities

Division	Category	No. of Facilities
Kinyona	Health Center	1
	Dispensaries	7
	Faith based organization	3
Kigumo	Sub-county hospital	1
	Health Center	1
	Dispensary	1
Muthithi	Health Center	1
	Dispensary	1

The biggest challenge that the sub counties in the project area face with regard to health is shortage of doctors. Within Kangema there are only four (4) doctors serving a total of 76,988 persons according to the 2009 Census. This translates to a doctor patient ratio of 1:19247. While in Kigumo there are only 2 doctors serving a population of 123,766 which translates to a doctor patient ratio of 2:61883. The main referral hospital for the two Sub-Counties is Muranga District Hospital.

5.7 Gender Issues

Table 5-12 below illustrates that the community is largely dominated by males in major household decision making. Gender imbalances still exist in decision making, resource control, and production processes mainly due to very strong traditional/cultural beliefs and practices. For instance, household heads will make decisions on family income, crop and animals to be sold as well as when to take children to school.

Women are usually left out of many development initiatives, and the perception exists that women's reproductive and domestic responsibilities should be their primary function. Women and girls are not encouraged to access education, by being forced to early marriages. This in term excludes them in decision making and as a result lack of access to income and other means of production as well as being discriminated against in property ownership and inheritance.

From **Table 5.12** and **Table 5-13** on **Page 5.14** indicate that men own and control all family resources but labour is mostly provided by women and girls except for livestock rearing. Workload in the families within the project area is on women and girls.

Table 5.12: Households Gender Roles

Resources	Men	Women	Boys	Girls
Digging	Yes	Yes	No	No
Cooking	No	Yes	No	Yes
Food collection	No	Yes	No	No
Vegetable Collection	No	Yes	No	No
Fetching Water	No	Yes	No	Yes
Washing utensils	No	Yes	No	Yes
Collection of Firewood	No	Yes	No	Yes
Looking after animals	Yes	No	yes	No
Washing clothes	No	Yes	No	Yes

Table 3-29 showing access and control of resources in the project area was developed in consultation with the beneficiary community through small group meetings. From the Table, men own and control most of the household resources such as land, livestock, trees and other income generating properties as indicated in **Table 5.13 below**.

Table 5.13: Access and Control of Resources by Gender

Resources	Who buys	Who owns	Who controls	Who uses
Land	M	M	M	M/F
Livestock	M	M	M	M/F
Other General Household property	M/F	M/F	M/F	M/F
Cars, motorcycle and bicycles	M	M	M	M/F
Livestock – small e.g., chicken	M/F	M/F	M/F	M/F
Subsistence crops	F	F	F	M/F

5.8 Community Problems

The major problems identified from literature review for Murang'a County are listed in **Table 5.14** below.

Table 5.14: Community Problems

Community Problem	Order of Severity
Youth unemployment	1
Poor Infrastructure	2
Lack of health facilities	3
Lack of land	4
Land slides	5
Water scarcity	6
Lack schools	7
Insecurity	8
Floods	9
Other unmentioned	10

5.9 Income Sources

The main economic activity within the project area is agricultural production. According to the County Development Plan approximately 57% of the population source their livelihood from agriculture. Of the above population, a majority grow cash crops. The major cash crops in the project area include tea and coffee. Horticultural crops which are grow at a small scale include tomatoes, cabbages, kales, spinach and French beans while food crops include maize, beans, bananas, sweet potatoes and cassava.

The main income source for the community living in the project area is farming (Table 3-31). This accounted for 35.87% of the primary sources of income and 7.14% of the secondary source of income. Agricultural production in the project area is mainly rain fed with most people producing tea as indicated in **Table 5.15** below.

Table 5.15: Income Sources

Primary Income	Percentage	Secondary Income	Percentage
None	39.51	None	80.40
Farming	35.87	Farming	7.14
Trading	9.88	Trading	1.67
Salaried	3.08	Salaried	1.22
Construction Site	1.06	Construction Site	2.89
Farm	3.04	Farm	0.61
N/A	2.13	N/A	5.78
Others	0.15	Others	0.30
Total	**100**	**Total**	**100**

5.10 Land Tenure Status

Land tenure in Kenya is classified into three categories, namely; – public land, community land and private land. Table 3-32 below shows that the most common land tenure system in the project area is private holding at 96.99% as illustrated in **Table 5.16** below.

Table 5.16: Land Tenure Status

Tenure System	Percentage Distribution
Private Land	96.99
Public Land	2.26
Community Land	0.75
Total	**100**

The land ownerships status stands at 97.74% own land while 2.3% are tenants and 0.75% are squatters as illustrated in **Table 5.17** below.

Table 5.17: Land OwnershipStatus

Land Ownership Status	Percentage Distribution
Landowners	97.74
Tenants	2.3
Squatters	0.75
Total	**100**

5.11 Land Use Potential

The two sub-counties within the project area fall in Agro Ecological Zone UHO (forest reserve), UH1 (sheep dairy zone), LH1 (tea-dairy zone), UM1 (coffee-tea zone), UM2 (main coffee zone), and UM3 (marginal coffee zone). This information is summarized in **Table 5.18** below.

Table 5.18: Land Use Potential

Agro-Ecological Zone	Potential Land Use	Current Land Use
UHO	Forest zone	Forest zone
UH1	Peas, carrots, cabbage, potatoes, maize, pyrethrum, pears, plums	Carrots, cabbage, maize, pears, plums
LH1	Peas, cabbages, lettuce, carrots, kales, potatoes, tea, loquats, passion fruits, pyrethrum, plums, kikuyu gras	Tea, dairy, potatoes, Cut flower
UM1	Cabbages, kales, passion fruit, onion, tomatoes, tea, coffee, citrus, pineapples, maize, bananas, potatoes, pawpaw, yams, kikuyu grass, napier grass, sweet potatoes vines	Tea, coffee, dairy, maize, beans, poultry, potatoes
UM2	Coffee, loquats, maize, beans, potatoes, cabbages, kales, tomatoes, onions, bananas, avocados, passion fruits, pineapples, citrus, star grass, napier grass	Coffee-main, dairy, maize, beans, macadamia, bananas, poultry, avocado, cut flower
UM2	Coffee, bananas, citrus, pawpaw, cassava, pigeon peas, maize, onion, cabbages, beans, pineapples, macadamia nuts, high grass savanna, napier, banana grass, sweet potatoes vines	Coffee (marginal), bananas, maize, beans, mangoes, french beans, tomatoes

Crops grown in the area include subsistence crops such as maize, beans and bananas while tea is the main cash crop. They also grow horticultural crops, such as kales, cabbages, tomatoes and onions and sell in the nearby urban centers. Livestock husbandry is also practiced within the project area whereby farmers keep cattle, goats/sheep, donkeys, pigs, chicken and pets including cats and dogs. Livestock provides meat, milk, eggs and a cash income.

5.12 Energy for Cooking

Table 3-35 presents the source of energy used by households in the project area. Firewood was the main source of cooking fuel accounting for about 70.68% followed by charcoal (18.05%). Ranking third was Liquid Petroleum Gas (LPG) accounting for 11.28% of the responses. In terms of lighting, battery lamps were the most prevalent at 55.64%. This is closely followed by the population that use kerosene lamp as indicated in **Table 5.19** on **Page 5-17**.

Table 5.19: Source of Energy

	Source	Percentage Distribution
Cooking Energy		
	Firewood	70.68
	Charcoal	18.05
	Liquid Petroleum Gas	11.250
Lighting Energy	Battery Lamp	55.64
	Kerosene Lamp	37.59
	LPG Lamp	3.76
	Electricity	2.26
	Other sources	0.75

An 11KVA power supply is available in the project area. In addition to trade centers and mainly rural homes, the line also serves a number of tea factories along the project area. However, from the above table, only 2.26% of the surveyed households use electricity for lighting. This may be attributed to the prevailing high electricity connection fee. Extension of the 11kVa supply lines to the specific project sites would be readily achievable.

6.0 STAKEHOLDER ENGAGEMENT PROCESS

Consultation with stakeholders is a key element of this SESA. Iterative consultations have been carried out during the SESA study in order to identify priority issues that require in-depth analysis during the SESA. Consultations also play a critical role in building environmental constituencies and exploring means of continuously improving beneficial environmental and social effects associated with the implementation of the Master plan. This Chapter outlines the approach and outcome of the stakeholder analysis and consultations in respect of the Master Plan.

6.1 Legal and Policy Provisions to Stakeholder Engagement

A summary of legal provisions that guide stakeholder consultations is presented in **Table 6.1** below.

Table 6.1: Legal and Policy Provisions for Public Consultations

Level	Statutes
National (Kenya)	Kenya Constitution 2010 Articles 10(2), 35, 69(1), 118, 174(c), 184(1)(c), 196, 201(a), 232(1)d
	Public Participation Bill 2016
	The Environmental Management and Coordination Act (EMCA), 2015 and subsequent regulations of Environment Impact Assessment and Audit Regulation of 2003
International	• World Bank Group (WBG) Environmental Assessment Policy (OP 4.01) • World Bank Group (WBG) Environmental, Health and Safety (EHS) Guidelines • IFC Performance Standards on Environmental and Social Sustainability Performance Standard 1

6.1.1 Kenyan Constitution 2010 on Stakeholder Engagement

Table 6.2 below provides in detail sections of the Kenya Constitution which require public participation in governance.

Table 6.2: Kenya Constitution Provision for Public Participation

Article	Public Participation Provision
Article 10(2)	Article 10(2) of the Constitution Provides **national values and principles of governance** in this Article bind all State organs, State officers, public officers and all persons whenever any of them whenever they (c) makes or implements public policy decisions. The national values and principles of governance as provided in the constitution include; patriotism, national unity, sharing and devolution of power, the rule of law, democracy and **participation of the people** and **sustainable development**.
Article (35)	Article (35) of the same constitution provides for **Access to information**, the articles indicates that every citizen has the right of access to information held by the State; an information held by another person and required for the exercise or protection of any right or fundamental freedom. The same article provides that The State shall **publish and publicize** any important information affecting the nation.

Article	Public Participation Provision
Articles 174(c)	Articles 174(c) state objectives of devolutions, among them is that devolution 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 and to recognize the right of communities to manage their own affairs and to further their development
Article 184	Article 184 is exclusive on **urban areas and Cities**, the article provides that National legislation shall provide for the governance and management of urban areas and cities and shall, among other provision provide for **participation by residents in the governance** of urban areas and cities.
Article 201(a)	Article 201(a) provides Principles of public finance which require openness and accountability, including public participation in financial matters;
Article 232(1)	Article 232(1) provides values and principles of public service include among others involvement of the people in the process of policy making;

6.1.2 The Public Participation Bill 2016

The Bill when enacted by parliament it will be referred to as "Public Participation Act". The bill provides general guidelines of ensuring public participation in nation governance. The bill will give effect to articles of constitution referred in sub chapter above namely Articles 10(2), 35, 69(1), 118, 174(c), 184(1)(c), 196, 201(a), 232(1)d.

The bill provides that public participation shall be guided by the below listed:

- The public, communities and organizations to be affected by a decision shall have a right to be consulted and involved in the decision making process;
- Provision of effective mechanisms for the involvement of the public, communities, organizations and citizens that would be affected by or that would be interested in a decision;
- Participants' equitable access to the information they need to participate in a meaningful manner;
- That public views shall be taken into consideration in decision making;
- Development of appropriate feedback mechanisms;
- Adherence to the national values under Article 10 of the Constitution;
- Adherence to the principles of leadership and integrity set out in Chapter Six of the Constitution;
- Adherence to the principles of public participation as may be prescribed by any written law; and
- Promotion of sustainable decisions recognizing the needs and interests of all participants, including decision makers.

6.1.3 EMCA 1999 Cap 387 through the Legal Notice No. 101: The Environmental (Impact, Audit and Strategic Assessment) Regulations, 2003

The principle Act of Parliament is the Environmental Management and Coordination Act (EMCA) 1999 Cap 387 and the subsequent Regulation, the Environmental Impact Assessment and Audit Regulations 2003..

The regulation requires that during the process of conducting Scoping, Environmental Impact Assessment the Proponent shall in consultation with the Authority here in referred to National Environment Management Authority (NEMA); seek the views of persons who may be affected by the Project. In seeking the views of the public, after the approval of the scoping report, of the proposed project by the Authority, the proponent shall publicize the project and its anticipated effects and benefits by;

- Putting up posters in strategic public places in the vicinity of the site of the proposed project informing the affected parties and communities of the proposed project;
- Publishing a notice on the proposed project for two successive weeks in a newspaper that has a nation-wide circulation;
- Making an announcement of the notice in both official and local languages in a radio with a nation-wide coverage for at least once a week for two consecutive weeks.
- Hold at least three public meetings with the affected parties and communities to explain the project and its effects, and to receive their oral or written comments; ensure that appropriate notices are sent out at least one week prior to the meetings and that the venue and times of the meetings are convenient for the affected communities and the other concerned parties; and
- Ensure, in consultation with the Authority that a suitably qualified co-coordinator is appointed to receive and record both oral and written comments and any translations thereof received during all public meetings for onward transmission to the Authority.
- Stakeholders of high importance with high influence on the Project
- Stakeholders of High importance with low influence on the Project
- Stakeholders of less importance with low influence on the Project.

6.2 Approach to Stakeholder Analysis

The purpose of Stakeholder meetings at Scoping was to sensitize stakeholders regarding the Scoping Process and get their concurrence on core issues identified for investigation in the detailed SESA. Essentially, it is comments from the Stakeholders at this stage which informed the Terms of Reference for the Detailed SESA Study. The process of stakeholder engagement for this SESA took place at Two Stages namely:- Scoping Stage and Detailed SESA Stage Consultation.

Modalities for engagement: Upon stratification, all stake-holders categories were approached and arrangements for engagement made. Engagements took any participatory methods such as Key Informant Interviews, Focus Group Discussions and Formal Meetings as the need arose.

The approach of stakeholder identification and consultation in the SESA applied three core criteria as follows:

(i) Stakeholders with fundamental right holder to strategic resources in the Masterplan area.
(ii) Stakeholders with legal mandate within target jurisdiction to safeguard resources. Stakeholders identified under this category include those in National Government, County Government and State Corporations whose mandates confer jurisdiction over areas targeted Master plan area.

(iii) Stakeholders of high importance with high influence on the project
(iv) Stakeholders of High importance with low influence on the project
(v) Stakeholders of less importance with low influence on the project

Table 6.3 below presents an overview of stakeholder consultations held with Key Informants in Murang'a, the outcome of such consultations is highlighted in sections below.

Table 6.3: Stakeholders Consulted during SESA and Masterplan Preparation

Mode of Engagement	Target Group	Stakeholder Met	Number of Meetings
Formal meeting	Proponent	Athi Water Works Development Agency	Several
	Line Ministries	GoK Ministries (Ministry of Water and Sanitation)	Several
	County Commissioners	Kigumo, Kangema, Maragua etc.)	1
	Governor	Murang'a County	2 (County showed up in 1 meeting)
	Are MPS	Maragua and Mathioya	1
Key Informant Interviews	County Government officials	County Chief Officer Water and Irrigation	3
		County Chief Officer Lands Physical Planning	1
	Water Service Providers	Gatanga Community Water Scheme	5
		MUSWASCO	3
		MUWASCO	3
		Kahuti Water and Sanitation Company	3
		Gatamathi Water and Sanitation Company	3
	Regional Development Authorities	Water Resources Authority (WRA) (Nairobi office)	1
		Kenya Wildlife Services	1
		Kenya Forest Services	1
		NEMA	
		TARDA	1
	Research Institutions	Research mandate	1
	Plantations	Del monte, Kakuzi	1

6.2.1 Mobilization for Public Workshops and Meetings

The stakeholder consultations and civic engagement process to help develop an inclusive plan commenced on 28th February 2018 and has been ongoing with stakeholders in the planning area with the aim of triggering public awakening about the project and result in useful feedback for refinement of the plan. Public Workshops and meeting were organized with the Project area as per schedule presented in **Table 6.4** and **Table 6.5** on **Page 6-5**.

Table 6.4: Schedule of Consultative Meetings

Date of Consultation	Stakeholder	Purpose of Consultations
28th February 2018	Introductory Meeting with Murang'a County Government	Introducing Project Consultants and Project to Murang'a County Leadership
6th June 2018	Inception workshop with Murang'a County Stakeholders at golden breeze palm hotel – Kenol town	Introducing Project Consultants and Project objectives to Murang'a County Leadership and broader Stakeholders.
29th October 2019	Technical Workshop with Murang'a County Government Technical Officers	Introducing Project options to Murang'a County Technical Leadership and broader Stakeholders
22nd November 2019	Consultative Workshop with Murang'a County Members of County Assembly	Introducing Project options to Murang'a County Political Leadership and broader Stakeholders

Table 6.5: Schedule of Key Informant Interviews (KII)

Date of Consultation	Stakeholder	Purpose of Consultations
20th June 2019	KWS consultations at ESIA	KII interview to gather KWS input to the SEA study with regards to wildlife conservation
13th June 2019	WRA Consultations (at Head Office)	KII interview to gather WRA input to the SEA study with regards to water resources conservation
18th June 2019	Gatanga Community Water	KII interview to gather WSP input to the SEA study with regards to water resources utilization for provision of domestic water to community.
22nd June 2019	Kenya Forest Services – Gatare Station	KII interview to gather KFS input to the SEA study with regards to forest conservation
19th June 2019	County Chief Officer Water and Irrigation	KII interview to gather WSP input to the SEA study with regards to water resources utilization for provision of domestic water to community

From **Table 6.6** on **Page 6-6**, core issues have been identified and analysed further in sections below towards informing the scope for further investigations during the detailed SEA stage.

Table 6.6: Stakeholder Stakeholder Consultations Outcome

Stakeholder	Comment Made	Engagement Concern
Athi Water Works Development Agency Ministry of Water and Sanitation	• Master Plan Inception and Progress • Ok with dam selection sites • Insisted to also look at small dams • Proposed cascading dams • Proposed HEP production on Maragua B dam	Dam Location and the need to limit displacement impacts
Kenya Wildlife Services	• Proper documentation of wildlife and flora listed under the IUCN red list protected under CITES • Undertake further engagement during actual implementation of the strategies	Ensures projects within the forest like the inlet works do not interfere with wildlife corridors
Kenya Forest Services	Obtain consent to work in the protected forest reserves	Obtain consent to work in the protected forest reserves
Water Resources Authority (WRA) (Nairobi office)	Ok with the project objective and availed the data required	Streamflow Data Collection, ensure downstream environment reserve is maintained
All WSPs	• Promised to share any relevant information required for the study • Urged AWWDA to also look in the rehabilitation of the existing systems • On the irrigation schemes and areas being chosen, conflicts with local community members might be triggered if consultations not done adequately. • Possibility of dedication some dams for domestic water supply only • Athi Water Services Board should focus more on helping the Water Service Providers to deal with non-revenue water resulting from dilapidated transmission and distribution mains.	Continuous consultations required throughout preparation and implementation of the Plan
Murang'a County Chief Officer Water and Irrigation	Small capacity dams be given priority due to cost and time of completion. Additional locations that would be studied for dam construction include Maishathe along Mathioya River. Further consultations with the relevant stakeholders would be needed in future so as to ensure that no one is left out by the process.	The Masterplan has provided staged implementation of the preferred strategies. This will address the challenge of funding.

7.0 SITE SPECIFIC ASSESSMENT

This chapter provides specific baseline assessment of Dam sites, Water Intake Sites, Water Treatment Sites and irrigation field identified under the Water Resources Report discussed in chapter 2. The strategies and sites identified are presented in **Table 7.1** below.

Table 7.1: Water Resources Development Strategies

Strategy	Sites
Strategy S1	Development of Irati 3 Dam and Mitubiri Wellfield
Strategy S2	Development of Kayahwe 4 Dam and Mitubiri Wellfield
Strategy S3	Development of Thika 3A Dam and Mitubiri Wellfield
Strategy S4	Development of Thika 3A Dam
Strategy S5	Development of Maragua B Dam and Mitubiri Wellfield

7.1 Dam Sites Specific Assessment

In addition to detailed analysis of the general baseline situational analysis of the project area discussed in chapter 4 and 5 of this report, baseline situation of identified dam sites is presented in sub sections below. A summary of likely environment and social risks are summarized in **Table 7.2** below.

Table 7.2: Environment and Social Impacts

Environment Impacts	• Downstream Environment Flows • Potential Impact on fisheries within the target rivers • Restriction of movement of migratory fish like the Barbus & Catfish • Proliferation of invasive species like *Lantana Camara* and *Datura stramonium,* other invasive species include *Mauritius thorn*, *Acacia melanoxylon*, *Acacia meansii* and *Rubus stendineri* specie. • Impacts on terrestrial ecology within the target Rivers • Impact on Biodiversity within the catchment • Sedimentation of target rivers • Water Quality Impacts • Water Loss Impacts
Social Impacts	• Dam Safety Impacts – downstream flooding risks • Disruption of Crops and woodlots during construction • Land Acquisition and Displacement Impacts • Social Disruptions including Public Utilities • Labor Influx, Gender Based Violence and Children Protection

7.1.1 Kiama Dam Site

The dam is located in Murang'a County, Gatanga Sub-county within Nguba village. The proposal as presented in the Water Resource Report is to dam Kiama River near Thika-Ndakaini road. There are no sensitive environmental receptors around the site. **Table 7.3** on **Page 7-2** presents an overview of general environment and social issues of the site while photographs below present an overview of the site.

Table 7.3: Environment and Social Assessment of Kiama Dam Site

Environment Issues	• The site is located within farmlands therefore no sensitive receptors were observed on site. • There might be reduced stream flows for downstream users. Therefore, Q80 reserve flow will be released at all times to downstream users to eliminate water related conflicts • Aquatic habitat fragmentation which leads to restriction of migratory fish movement like the *catfish, trout and Barbus* reported within Kiama River. • Less significant loss of vegetation cover during clearing of vegetation cover (tree woodlots and farm crops) • Sedimentation of Kiama River during dam construction triggered by destruction of soil structure during evacuation.
Social Issues	• The proposed dam site lies on private land; therefore, resettlement issues will be triggered. • In the event of dam break, flooding risks could destroy property including Thika-Ndakaini Road network that links Thika and Gatanga towns. • There is subsistence farming being practiced within the proposed project area the most predominant crops are maize, beans and bananas. Farmers who depend on such farmlands will require livelihood restoration measure. • During implementation, the project might lead to issues of Gender based violence, Labor influx and Child labor.

Kiama River at Dam Site

Section of Thika Ndakaini Road downstream the Dam

7.1.2 Irati Dam Site

The dam is located in Murang'a County within Gatanga Sub-county on Irati River. There are no sensitive environmental receptors around the site. **Table 7.4** on **Page 7-3** presents an overview of general environment and social issues of the site while photographs below present an overview of the site.

Table 7.4: Evironment and Social Assessment of Irati Dam Site

Environment Issues	• The site is located with farmlands therefore no sensitive receptors were observed • There might be reduced stream flows for downstream users, Q80 has to be allowed to eliminate water related conflicts • Aquatic habitat fragmentation which leads to restriction of migratory fish movement like the *catfish, trout and Barbus* • Less significant loss of vegetation cover during clearing of vegetation cover (tree woodlots and farm crops) • Increased Sedimentation of Irati River during dam construction triggered by destruction of soil structure during evacuation
Social Issues	• Dam Safety Impacts – downstream flooding risks • Disruption of Crops and woodlots during construction • Land Acquisition and Displacement Impacts • Social Disruptions including Public Utilities destruction • During implementation, the project might lead to issues of Gender based violence, Labor influx and Child labor.

Section of Irati River at the Dam Site

General Irati Dam SiteOverview

7.1.3 Maragua B Dam Site

The dam is located in Murang'a County, Gatanga Maragua Sub-County, Ihumbi Village approximately 5kms from Maragua Town. There are no sensitive environmental receptors around the site. **Table 7.5** on **Page 7-4** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.5: Evironment and Social Assessment of Maragua B Dam Site

Environment Issues	• Risks of rock and mud slides / fall within the dam reservoir, evidence of previous rock fall was observed on site. • There might be reduced stream flows for downstream users triggering water related conflicts. • Interference with movement of migratory fish species like the cat and mud fish. • Proliferation of Invasive species. The site has dominant number of invasive species like the *Datura stramonium and Lantana Camara.* • Soil erosion and degradation likely to occur due to the steep slopes of the area leading to increased sedimentation of Maragua River.
Social Issues	• Dam Safety Impacts related to downstream flooding in dam break events • Disruption of Crops and woodlots belonging to subsistence farmers. • Land Acquisition and Displacement Impacts • Social Disruptions including Public Utilities • The project during construction can lead to labor influx, sexual exploitation and abuse including abuse of children rights.

Overview of Maragua B Dam Site

Maragua B River at Dam Site

7.1.4 Kayahwe 4 Dam Site

The dam is located in Murang'a County, Kiharu Sub-County within Kiharu constituency. The nearest centre is Kahuro. There are no sensitive environmental receptors around the site. **Table 7.6** on **Page 7.5** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.6: Evironment and Social assessment of Maragua B Dam Site

Environment Issues	• There might be reduced stream flows for downstream users which could cause water related conflicts. • Interference with movement of migratory fish species like the cat and mud fish • Risks of rockslides along the dam impound area a major concern as it has already occurred and destroyed pipes. • Proliferation of Invasive species. The site has dominant number of invasive species like the *Datura stramonium and Lantana Camara*
Social Issues	• The site of the proposed dam lies on private land which will have to be acquired • There is domestic farming ongoing on the land hence loss of livelihood to be faced. Crops grown are maize, beans and bananas which might be affected • Possible destruction of social economic infrastructures example a coffee processing factory located within the dam reservoir might require relocation.

General Overview of the Kayahwe 4 Dam Site

Coffee Factory at the Proposed Site

7.1.5 Maragua 4 Dam Site

The dam is located in Murang'a County on the boarder of Kigumo and Kiharu Sub-County boundaries located between Gacharage and Gatara ridges. There are no sensitive environmental receptors around the site. **Table 7.7** on **Page 7-6** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.7: Evironment and Social Assessment of Maragua 4 Dam Site

Environment Issues	• There might be reduced stream flows for downstream users. • Interference with movement of migratory fish species like the cat and mud fish • Risks of rockslides along the dam impound area a major concern as it has already occurred and destroyed pipes. • Proliferation of Invasive species. The site has dominant number of invasive species like the *Datura stramonium and Lantana Camara.* • Soil erosion and degradation likely to occur due to the steep slopes of the area leading to increased sedimentation of Maragua River.
Social Issues	• Dam Safety Impacts – downstream flooding risks • Disruption of Crops and woodlots during construction • Land Acquisition and Displacement Impacts • Social Disruptions including Public Utilities • The project during construction can lead to labor influx, sexual exploitation and abuse including abuse of children rights.

General Overview of the Maragua 4 Dam Site

Proposed Water Treatment Site for Maragua 4

7.1.6 Irati 3 Dam Site

The dam is located in Murang'a County, Kigumo Sub-county. The proposal is to dam Irati River near Kangare-Kangema road. There are no sensitive environmental receptors around the site. **Table 7.8** on **Page 7-7** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.8: Evironment and Social Assement of Irati 3 Dam Site

Environment Issues	• The site is located with farmlands therefore no sensitive receptors were observed • There might be reduced stream flows for downstream users, Q80 has to be allowed to eliminate water related conflicts • Aquatic habitat fragmentation which leads to restriction of migratory fish movement like the *catfish, trout and Barbus* • Less significant loss of vegetation cover during clearing of vegetation cover (tree woodlots and farm crops) • Increased Sedimentation of Irati River during dam construction triggered by destruction of soil structure during evacuation.
Social Issues	• Risk of flooding in case of dam break could affect Kangare-Kangema Road cutting off the road network that links Kangare and Kangema towns. • Disruption of Crops and woodlots • Land Acquisition and Displacement Impacts and resettlement of population • Social networks disruptions including public utilities such coffee and tea buying centres • Labor Influx, Gender Based Violence and Children abuse during project implementation

General Overview of the Irati 3 site Dam Site

Sample Households likely to be displaced Irati 3

7.1.7 Makomboki Water Inlet Site

The inlet site is located in Murang'a County, the site is inside the Aberdare forest- Gatare section along Irati River. The site is and existing inlet works undergoing rehabilitation. The intake serves Kanderendu, Kimotho, Gatiani, Nguruweini and Makomboki areas. **Table 7.9** on **Page 7-8** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.9: Evironment and Social Assesssmen of Makomboki Inlet Site

Environment Issues	• Disruption of wildlife movement corridors at the weir site and raw water corridor along Irati River • Irati River flow regime disruption, reduced stream flows triggered by abstraction. • Potential Impact on fisheries within Irati river due to aquatic habitat fragmentation • Restriction of movement of migratory fish like the Barbus & Catfish • Excavation activities could result to destruction of soil structure therefore causing river sedimentation.
Social Issues	• No resettlement and land acquisition because the site is located inside the forest along Githika River. • Human wildlife conflict likely to occur during the construction activity as elephants have been reported to frequent the area.

General Overview of Makomboki Dam Site

Gatare Forest Station

7.2 Water Treatment Site Specific Assessment

Sub sections below present specific environment and social assessment of water Treatment sites as detailed in the water resources report.

7.2.1 Kiama Water Treatment Site

The Water treatment site is located in Murang'a County, Gatanga Sub-county, Nguba village, the proposed site is about 500 meters from the proposed dam axis. There are no sensitive environmental receptors around the site. **Table 7.10** on **Page 7-9** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.10: Evironment and Social Assessment of Kiama Water Treatment Site

Environment Issues	• Loss of vegetation diversity which provide habitat to terrestrial fauna and other related ecosystems benefits within the Project area. • Vegetation clearing, soil erosion and siltation of Kiama River • Water quality pollution from construction activities which include solid and effluents waste • Interference with drainage and hydrology within Project site • Interruption of existing infrastructure such as roads, community waterlines and power lines • Water Discharges during flushing/cleaning of pipes to remove sediments
Social Issues	• The proposed site lies on private land; therefore, resettlement issues will be triggered. • There is subsistence farming being practiced within the proposed project area the most predominant crops are maize, beans and bananas, such farmlands could be destructed. • Small scale coffee farming is evident in the area, this might lead to loss of income if uprooted. • During implementation, the project might lead to issues of Gender based violence, Labor influx and Child labor.

Coffee Plantation on Site Kiama W/T Site

General Overview of the Site Kiama W/T Site

7.2.2 Wanyaga Water Treatment Site

The Water treatment site is located in Murang'a County, Gatanga Sub-county. The proposed site is about 3 km from the existing weir but away from the forest. The weir was constructed in the 1970s inside Aberdare forest on Thika River. The site is located at the edge of the Aberdare Forest which implies that adequate consultations and approvals from the Kenya Forest Services (KFS) will be sought prior to construction of the site. **Table 7.11** on **Page 7.10** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.11: Evironment and Social Asseemnt of Wanyaga Water Treatment Site

Environment Issues	• The project might lead to destruction of flora and fauna since the area has a variety of vegetation and also borders Aberdare forest • During construction waste and oil spillages if not properly handled could pollute Thika River. • Dust, noise and exhaust fumes from construction equipment might disturb residents who reside near the area. • Soil erosion might occur if disturbed soil is not properly stabilized and re-vegetated.
Social Issues	• The proposed dam site lies on forest land; therefore, Kenya forest service must be consulted. • Construction activities might result in human wildlife conflict if the electric fence surrounding the area is breached. • During implementation, the project might lead to issues of Gender based violence, Labor influx and Child labor.

A tea buying centre near the Wanyaga T/W site

an existing water storage tank at the site

7.2.3 Chathanda Water Treatment Site

The Water is located in Murang'a County, Kigumo Sub-county along Kangare-Karega Road. Proposed site is located about 1km from Ikumbi Shopping Centre at existing Tank (kwakimbugi). **Table 7.9** on **Page 7-11** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.12: Evironment and Social of Chathanda Water Treatment Site

Environment Issues	• Loss of vegetation diversity which provide habitat to terrestrial fauna and other related ecosystems benefits within the Project area. • Vegetation clearing, soil erosion and siltation of Kiama River • Water quality pollution from construction activities which include solid and effluents waste • Interference with drainage and hydrology within Project site • Interruption of existing infrastructure such as roads, community waterlines and power lines • Water Discharges during flushing/cleaning of pipes to remove sediments
Social Issues	• Disruption of Crops and woodlots at the target • Land Acquisition and Displacement Impacts • Social Disruptions including Public Utilities • Labor Influx, Gender Based Violence and Children labor during project construction

An existing water storage tank near the site Chathanda T/Work

General view of the area Chathanda Treatment Site

7.2.4 Kigoro Water Treatment Site

The Water treatment site is located in Murang'a County, Maragua Sub-county within Kigoro village. Major receptors around are the Gituamba AP post and Kawamantha Primary School. **Table 7.12** on **Page 7-12** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.13: Evironment and Social Assessemnt of Kigoro Water Treatment Site

Environment Issues	• Loss of vegetation diversity which provide habitat to terrestrial fauna and other related ecosystems benefits within the Project area. • Vegetation clearing, soil erosion and siltation of Kiama River • Water quality pollution from construction activities which include solid and effluents waste • Interference with drainage and hydrology within Project site • Interruption of existing infrastructure such as roads, community waterlines and power lines • Water Discharges during flushing/cleaning of pipes to remove sediments
Social Issues	• Disruption of Crops and woodlots • Land Acquisition and Displacement Impacts • Social Disruptions including Public Utilities • Labor Influx, Gender Based Violence and Children labor during Project construction

Access Road to Kigoro Treatment Site

A storage tank currently in use for supplying Murang'a Town

7.2.5 Githika Water Treatment Site

The Water Treatment site is located in Murang'a County, outside the forest- Gatare section approximately 2km from the Makomboki intake. The site has an ongoing construction of a storage and distribution tank, Land is owned by the Kenya Forest Service. **Table 7.14** on **Page 7-13** presents an overview of general environment and social issues while photographs below present an overview of the site.

Table 7.14: Evironment and Social Assessemnt of Githika Water Treatment Site

Environment Issues	• Loss of vegetation diversity which provide habitat to terrestrial fauna and other related ecosystems benefits within the Project area. • Vegetation clearing, soil erosion and siltation of Kiama River • Water quality pollution from construction activities which include solid and effluents waste • Interference with drainage and hydrology within Project site • Interruption of existing infrastructure such as roads, community waterlines and power lines • Water Discharges during flushing/cleaning of pipes to remove sediments.
Social Issues	• Disruption of Crops and woodlots • Land Acquisition and Displacement Impacts • Social Disruptions including Public Utilities • Labor Influx, Gender Based Violence and Children labor during project construction

Storage tank at Githika Water Treatment Site

Access Road to Githika Water Treatment Site

7.3 Irrigation Site Specific Assessment

Mathioya Irrigation scheme located in Kiharu Sub-County, Kiharu Constituency, along Murang'a Kangema road. The other irrigation scheme is referred to as Saba Saba Irrigation Scheme located downstream of Irati river sub catchment. The proposed irrigation schemes will be located within existing people's farmlands whereby households will be supplied with piped raw water for irrigation. The preferred irrigation mode will be use of regulated sprinklers which are capable of conserving water. However, irrigation schemes are associated with the below listed challenges:

- Reduced water volumes especially during dry seasons
- Inadequate water flows in the rivers sometimes triggering conflicts with downstream users,
- Unsustainable farming methods upstream resulting in river water contamination by pesticides and fertilizers
- Water infrastructure within protected reserves and forest destruction by wild animals especially elephants
- Illegal connections by persons who are not members of the schemes
- Continuous cultivation increasing soil susceptibility to erosion

- Long term fertilizer and pesticide application negatively impacting soil pH levels.
- Lack of water storage reservoirs
- Lack of ready market for farm produce.

Photographs below present an overview of irrigation fields identified under the Water Resources Development Report.

Saba Saba Irrigation area

Mathioya Irrigation area

8.0 IMPACT PREDICTION AND ANALYSIS

Chapters 3 through to 5 above has documented legal and policy framework, environmental and social baseline preceding development of the Water Resources Development Strategies. It is the outcome of impact assessment that informs decision making on the future direction of a Master plan in which case, a full proof system for impact prediction and analysis is fundamental to the integrity of a SEA process.

In this Chapter the potential environmental impacts of implementation of the strategies are predicted and assessed, and mitigation strategies are proposed. Insights and feedback received from stakeholders during the preparation of this Study also inform this impact assessment process.

8.1 Environment and Social Screening Findings

The screening process was undertaken to determine the potential impacts of the Water and Irrigation Master Plan for Murang'a Town on the Environment. The process of Environment and Social screening of potential Impacts likely to be triggered by the plan involved review and applicability of the assessment as detailed under in the SEA Guidelines of 2011 sub section (3.1) on Screening. The guideline lists scenarios under which a program requires to be subjected to SEA for instance as listed below among others:

(i) The Plan is likely to result in significant environmental effects, taking into account the magnitude, duration and spatial extent of effect
(ii) The cumulative nature of the effects (i.e., the additive and synergistic effects) are likely to be significant.
(iii) social and/or ecological systems have low resilience and high vulnerability to disturbance or impact (e.g., poor communities, sensitive ecosystems).
(iv) the Plan is likely to result in major changes in actions, behaviors or decisions by individuals, businesses, NGOs or government, that could lead to the stimulation of development of infrastructure or other changes in urban or rural land.

Therefore, based on SESA Guidelines listed above, **Tables 8.1** below provides detailed screening findings of Environment Screening risks associated development or implementation of the Water Resources Development Strategies.

Table 8.1: Environment Risks Screening of Identified Strategies

Will the Sub-Project:	Yes	No
Reduce the quantity of water for the downstream users?	√	
Lead to aquatic habitat fragmentation negatively impacting migratory aquatic fauna like *barbus fish spp.*	√	
Create a risk of increased soil erosion leading to sedimentation of rivers	√	
Create a risk of increased deforestation through clearing of vegetation cover	√	
Create a risk of increasing any other soil degradation through mud slides or rock falls	√	

Will the Sub-Project:	Yes	No
Affect soil salinity and alkalinity triggered by unsustainable irrigation practices?	√	
Divert or dam the water resource from its natural course/location?	√	
Cause pollution of aquatic ecosystems by sedimentation, oil spillage, effluents, etc.?	√	
Involve drainage of wetlands or other permanently flooded areas?		√
Result in the lowering of groundwater level or depletion of groundwater, through drilling of wells?	√	
Create waste that could adversely affect local soils, vegetation, rivers and streams or groundwater?		√
Affect any watershed?	√	
Be located within or near environmentally sensitive areas (e.g., intact natural forests, mangroves, wetlands) or threatened species?	√	
Adversely affect environmentally sensitive areas or critical habitats – wetlands, woodlots, natural forests, rivers, protected areas including national parks, reserves or local sanctuaries, etc.)?		√
Affect the indigenous biodiversity (flora and fauna)?		√
Cause any loss or degradation of any natural habitats, either directly (through project works) or indirectly?		√

Table 8.2 below provides detailed screening findings of social risk associated development or implementation of the Water Resources Development Strategies

Table 8.2: Social Risks Screening of Identified Strategies

Will the Sub-Project:	Yes	No
Displace people from their current settlement?	√	
Project Impacts on people's assets and sources of livelihood	√	
Interfere with the normal health and safety of the worker/employee/ Community		√
Reduce the employment opportunities for the surrounding communities		√
Reduce settlement (no further area allocated to settlements)		√
Reduce income for the local communities?		√
Increase insecurity due to introduction of the project?		√
Increase exposure of the community to communicable diseases such as HIV/AIDS?		√
Induce conflict related to downstream water users?	√	
Have machinery and/or equipment installed for value addition?		√
Introduce new practices and habits?		√
Lead to child delinquency (school dropouts, child abuse, child labor, etc.?		√
Lead to gender disparity?		√
Lead to poor diets?		√
Increase human-wildlife conflicts?		√

Table 8.3 below provides detailed screening findings of Vulnerable and Marginalized Groups (VMGs) risks associated development or implementation of the Water Resources Development Strategies

Table 8.3: **Vulnerable and Marginalized Groups (VMGs) Screening of Identified Strategies**

Are there:	Yes	No
People who meet requirements for OP 4.10 living within the boundaries of, or near the project?	√	
Members of these VMGs in the area who could benefit from the project?	√	
VMGs livelihoods to be affected by the subproject?	√	

Table 8.4 below provides detailed screening findings of Land Acquisition and Access to Natural Resources risks associated development or implementation of the Water Resources Development Strategies.

Table 8.4: Land Acquisition and Access to Resources Screening of Identified Strategies

Will the sub-project:	**Yes**	**No**
Require that land (public or private) be acquired (temporarily or permanently) for its development?	√	
Project triggers disruption or demolition impacts to people's assets or sources of livelihood.	√	
Use land that is currently occupied or regularly used for productive purposes (e.g., gardening, farming, pasture, fishing locations, forests)	√	
Result in temporary or permanent loss of kitchen gardens, and trees	√	
Adversely affect small communal cultural property such as funeral and burial sites, or sacred groves?		√
Result in involuntary restriction of access by people to legally designated parks and protected areas?		√
Reduce people's access to the pasture, water, public services or other resources that they depend on?		√

8.2 Environment and Social Impacts Scoping

The scoping assessment identified applicable legal and policy frameworks and detailed in chapter 3 of this SESA. Through literature review and field assessment, stakeholder analysis was developed as detailed in chapter 6. The scoping assessment also identified geographical coverage to be Thika, Sabasaba, Mathioya and Maragua River catchment all located with Murang'a County.

Therefore, from the screening assessment, significant environment and social areas of interest related to implementation of the Water Resources Development Strategies are presented in **Table 8.5** on **Page 8-4.**

Table 8.5: Environment and Social Impacts at Scoping Stage

Impact	Applicable Dam	Severity Ranking	Mitigation
Impacts on terrestrial and aquatic flora	All Dams sites	Score 52 (Medium)	✓ At the time of ESIA, a Biomass Survey will be undertaken to determine the quantity of woodlots likely to be destroyed, the report will propose appropriate offsets through re afforestation programs to be initiated within the Project. ✓ Encourage upstream community driven catchment conservation and management programs, such programs should be initiated through the Project in liaison with the Kenya Forest Services and local Forest Catchment Associations.
Downstream Environmental Flows.	Irati 3 Dam	Score 85 (High)	✓ Maintain at least steady base environment flow of the stream to sustain ecological and social requirements downstream based on the ecological flow values calculated. ✓ Irati River at RGS 4BE08 is fully exploited with only 2,590m3/day Q_{95} available, therefore, there will be a demand for full downstream Reserve Flows required until development of future storage options. ✓ Ensure compliance with water resource regulation at all times, this will be achieved through weirs and offtakes that will be able to provide variable yields depending on the volume of flow ✓ Provide mandatory buffer area for conservation of the river line and dam ecosystem through the review of riparian land ownership,
	Maragua B dam, Irati 3 Dam and Kayahwe 4 Dam	Score 52 (Medium)	
Impacts on terrestrial and aquatic fauna	All Dams sites	Score 52 (Medium)	✓ A detailed analysis of the Biodiversity Survey within the ecosystem and specifically the specific project location to be undertaken during ESIA. ✓ The project design at the abstraction weirs should take into consideration free movement of fish species and other aquatic organisms. ✓ To protect the proposed dams, intensive catchment management strategies will be developed among them, practicing re-afforestation, soil erosion control, land use control and settlement and urban development planning among other initiatives.
Sedimentation and Siltation Impacts	All Dams sites	Score 52 (Medium)	✓ A water pan (silt trap) may be established downstream of the dam which will act as a soil trap to hold the excessive silt during construction. ✓ The steep slopes surrounding the dam construction should be stabilized, compacted and strengthen to reduce on erosion and potential landslides as a result of deep cutting, drainage channels should be installed only when necessary, ✓ Encourage re-afforestation and improved farming systems upstream of the dam.
Water Quality Impacts	All Dams sites	Score 52 (Medium)	✓ Define a buffer zone for reservoir protection against siltation, waste deposit, pesticide use.

Impact	Applicable Dam	Severity Ranking	Mitigation
			✓ Encourage re-afforestation and improved farming systems upstream of the dams ✓ Identification of point sources of water pollution from upstream farms for the purpose of management. ✓ Institute a water quality monitoring system and maintaining appropriate records on water quality, ✓ Best management practices will be utilized during site clearing and construction to minimize erosion and sedimentation
Dam Safety Impacts	All Dams sites	Score 75 (Medium to High)	✓ Review the dam design and dam construction by independent panel of experts ✓ Prepare and implement relevant plans (plan for construction supervision and quality assurance, an instrumentation plan, an operation and maintenance plan), ✓ Ensure frequent maintenance of the dam structures ✓ Ensure soil structure around the sites (Intake, dam and Water treatment sites) is protected
Land Acquisition, Displacement and other Social Impacts	All Dams sites	Score 65 (Medium to High)	✓ Land acquisition and displacement impacts will be mitigated through preparation of a detailed Resettlement Action Plan (RAP) ✓ Provision of alternative routes and water points to community members to compensate the submerged water points and routes. ✓ Appropriate compensation of all loses including loss of livelihood suffered by PAPs. ✓ Development of a labor management plan, Children Protection Strategy, and HIV / Aids control and management strategy at Project construction period.

8.3 Detailed Bio-physical Impacts Prediction and Assessment

8.3.1 Impacts on Vegetation Resources (Flora)

The sites (Irati 3, Kayahwe 4, Thika 3A and Maragua B Dams including Mitubiri wells) identified under the Water Resources Development Report for Integrated Water and Irrigation Masterplan for Murang'a County will not directly impact on the Aberdare Forest Resources which is the major vegetation resource located close to the proposed dam sites.

However, from literature, unregulated and excessive water use for irrigation has reduced reliability of downstream water supply particularly in Nyandarua around Kirima Muruai and Geta areas. Small-scale irrigation projects abstracting water from rivers flowing from the forest reserve are many and some without having the necessary water permits. There are also cases of inefficient water use where some projects use open fallows, use of sprinklers is rampant and leads to water loss, poor management of piping systems with a lot of leakages and poor farming methods where there is excessive irrigation.

About Aberdare Forest Reserve

Aberdare Forest Reserve and the adjoining forest were gazetted under Forest Department now Kenya Forest Service with the aim of forest and water conservation and socio-economic development. The forest reserve is administered under 19 forest stations spread throughout the forest reserve. The forest stations are administered through 6 Forest Zones managed by Zonal Forest Managers within Central Highlands Conservancy.

Aberdare forest was first gazetted as a forest reserve under legal notice No 7 of 1943 and covered an area of 181,594.3 ha. The first degazettement of the Forest Reserve was the creation of the Aberdare National Park in 1950 covering an area of 57,220 ha. And later an additional area of 19,364 ha was degazetted from the Forest Reserve vide legal notice No. 171 of 1968 and gazetted under the National Park vide legal notice No. 172 of 1968. Thus, total area converted to Park is 76,700 ha and represent over 86% of total area degazetted

The Aberdare Forest Reserve is located to the east of the Great Rift Valley, between 360 30' E, 00 05' S and 360 55'E, 00 450S. The Forest Reserve is situated within Central Kenya in four (4) Counties. These are Kiambu, Murang'a, Nyeri and Nyandarua as shown in **Figure 8.1** on **Page 8-7.**

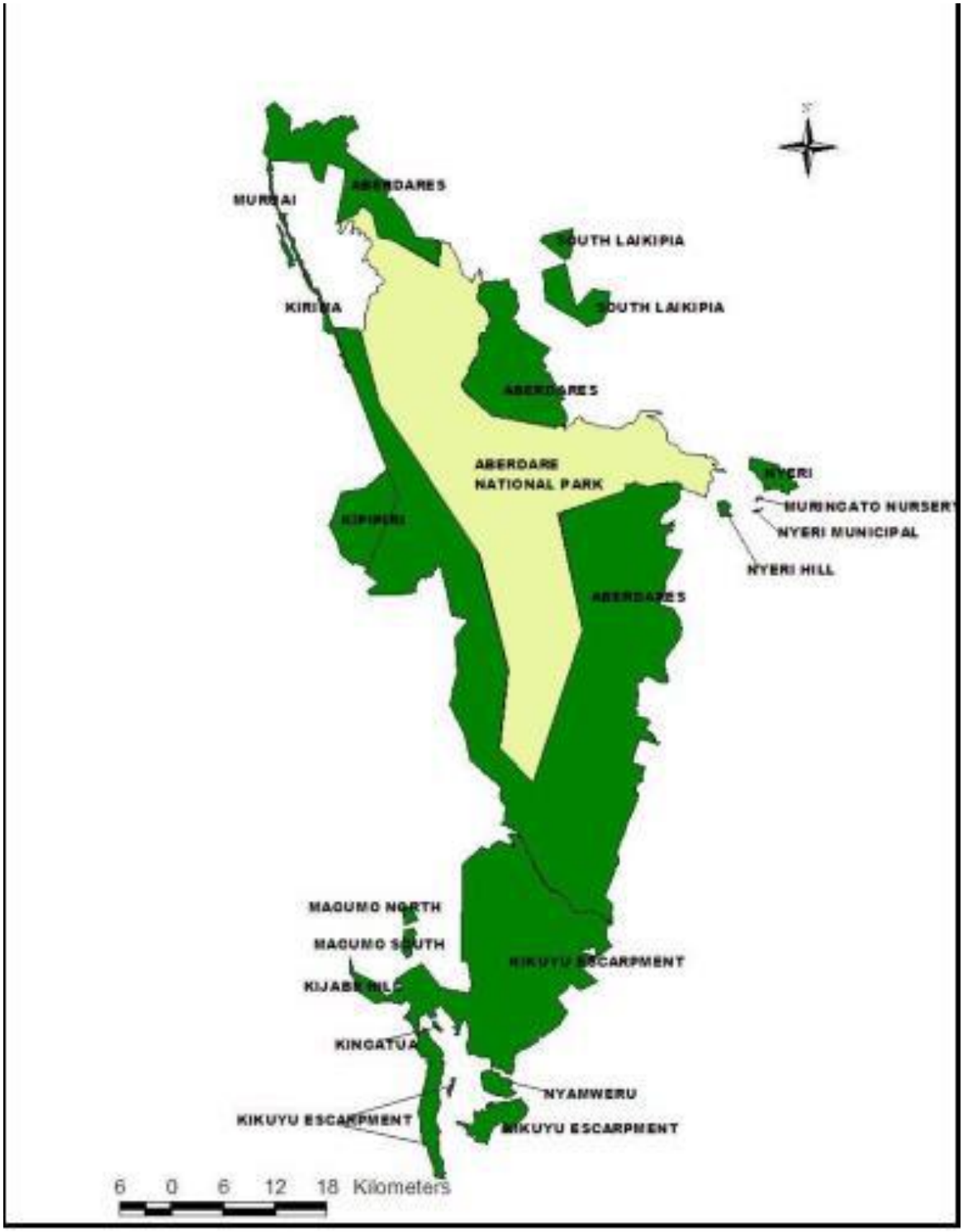

Figure 8.1: Map Showing Aberdare Forest Reserve Block *Source Aberdare Forest Management Plan 2014-2019*

The Aberdare Ranges encompasses one of the five important water catchment zones in Kenya. It provides water to feed four out of Kenya's six drainage basins. The major rivers from the Aberdare Forest are Tana and Athi rivers which flow into the Indian Ocean. These river basins are the focus of Water Resources Development Strategy report which focuses on Mathioya, Sabasaba, Thika and Maragua catchment.

The semi-permanent Ewaso Nyiro which drains into Lorian swamp in northern Kenya and River Malewa that drains into Lake Naivasha. In addition, numerous tributaries flow from all sides of the Aberdare increasing their volume downstream. Higher up the moorlands and afro-alpine zones, numerous water bogs marking the source of streams and rivers dot the slopes.

Aberdare range supplies all the water to Nairobi through Sasumua and Ndakaini dam. It also supplies water to the major towns in the neighboring Counties. Together with Mt Kenya, they contribute 70% of the country's hydropower produced by Tana River. Many water intakes have been constructed in the forest to supply water to the forest adjacent communities for irrigation and for domestic purposes.

Aberdare Forest Reserve drains into four main river basins of Kenya. These are Tana, Athi, Ewaso Nyiro and Lake Naivasha. Rivers flowing to Ewaso North Basin include Engare ongibit and Ewaso Narok. The rivers draining to Lake Naivasha Basin include Malewa, Wanjohi, Kitiri, Turasha, Kaheho, Sugurui and Pesi. The rivers draining into Tana basin include Chania, Gura, Magura, Gikururu, Karuru, Thika, Karimu, North Mathioya, South Mathioya, Maragua and Amboni (Honi). The rivers draining to Athi River include Thika, Chania and Ruiru River.

Impact Prediction and Ranking

Vegetation is a dominant part of most riverine ecosystems, where it fulfils a number of critical functions. Aquatic and riparian vegetation stabilize river channels, banks and floodplains; contribute towards the attenuation of floods; influence water temperature and quality; and provide habitat, refuge and migration corridors for terrestrial and aquatic fauna.

The process of construction of the dam implies removal of existing vegetation while clearing the areas to be inundated and/or possibility of submerging of others potentially losing certain species. There is also potential disruption of habitats downstream of the dam area as a result of construction activities through discharge of excessive particulate matter, cement residuals and other construction materials into the river course.

Earthworks and land fragmentation during construction activities will contribute to terrestrial flora disruption through total vegetation removal. The entire terrestrial habitat will be disturbed permanently because the project area will be covered with water. The reservoir will affect the productive agricultural land, hence affecting the general biodiversity. The proposed dam's reservoir area is dominated by domestic woodlot **significant at Thika 3A Dam**, **less significant at Maragua B Dam site, Irati 3 Dam and Kayahwe 4 Dam site**. Photographs on **Page 8.9** illustrates woodlots within the identified dam areas.

Significant Woodlot at Thika 3A Dam Reservoir Area

Less Significant Woodlot at Maragua B Dam Reservoir Area

The severity of terrestrial and aquatic flora impact will be rated as indicated below while **Table 8.6** presents impact ranking adopted.

1. **Low to Medium**– Flow exceeded (Q_{95}) and regulated stripping of vegetation cover and provision for compensatory off set of stripped vegetation.
2. **Medium Impact** – Flow equalled to (Q_{95}) and regulated stripping of vegetation cover and provision for compensatory off set of stripped vegetation.
3. **Medium to High** – Flow below (Q_{95}) and indiscriminate stripping of vegetation cover with no provision for compensatory off set of stripped vegetation.

Table 8.6: Impact on Terrestrial and Aquatic Flora Impact Ranking

Impact Sources	**Impact Source Discussion**		**Mitigation Efficiency**
Environment flow releases and vegetation stripping	1. Environmental flow below Q_{95} within the river will adversely impact on downstream ecological ecosystem. 2. Design of dam weirs including inlet or outlet shafts that restricts movement of fish and other aquatic fauna		**Medium**
Reversibility of impact	yes		
Affected Environment	**Terrestrial and Aquatic ecosystems**		
Magnitude	***Extent***	Beyond County– 5	
	Intensity	Medium-3	
	Duration	Long term -2	
	Probability	Likely-3	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (5+3+2+3) x4= 52 (Medium)	Medium

Mitigation Measures

- ✓ Therefore, at the time of ESIA, **a Biomass Survey** will be undertaken to determine the quantity of woodlots likely to be destroyed, the report will propose appropriate offsets through re afforestation programs to be initiated within the Project.
- ✓ Evaluate opportunities of full or partial removal of vegetation, stripping of vegetation should only be allowed within the dam area to be submerged.
- ✓ Encourage upstream community driven catchment conservation and management programs, such programs should be initiated through the Project in liaison with the Kenya Forest Services and local Forest Catchment Associations.

8.3.2 Downstream Environmental Flow Impacts

The flow reserve is defined as "that quantity and quality of water required (a) to satisfy basic human needs for all people who are or may be supplied from the water resource; and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the water resource."

Environmental Flow Release (EFR) requirements is the index of natural low flow, Q95. However, release of a Q95 flow is equivalent to a constant low flow – more or less equivalent to a drought flow. The water rules 2007 and water Act 2016 section 63 (1) provides Normal Flow as (Q80) and flood flow (Q50). Therefore, as discussed in Rafik Harji and Richard Davis2 1999, the downstream impacts on biophysical and social environment arise primarily from changes in the quantity, timing, and quality of the flow pattern of rivers.

The Aberdare Ranges encompasses one of the five important water catchment zones in Kenya. It provides water to feed four out of Kenya's six drainage basins. The major rivers from the Aberdare Forest are Tana and Athi which flow into the Indian Ocean, the semi-permanent Ewaso Nyiro which drains into Lorian swamp in northern Kenya and River Malewa that drains into Lake Naivasha. In addition, numerous tributaries flow from all sides of the Aberdare increasing their volume downstream. Higher up the moorlands and afro-alpine zones, numerous water bogs marking the source of streams and rivers dot the slopes.

Aberdare range supplies all the water to Nairobi through Sasumua and Ndakaini dam. It also supplies water to the major towns in the neighboring Counties. Together with Mt Kenya, they contribute 70% of the country's hydropower produced by Tana River. Many water intakes have been constructed in the forest to supply water to the forest adjacent communities for irrigation and for domestic purposes.

Aberdare Forest Reserve drains into four main river basins of Kenya. These are Tana, Athi, Ewaso Nyiro and Lake Naivasha. Rivers flowing to Ewaso North Basin include Engare ongibit and Ewaso Narok. The rivers draining to Lake Naivasha Basin include Malewa, Wanjohi, Kitiri, Turasha, Kaheho, Sugurui and Pesi. The rivers draining into Tana basin include Chania, Gura, Magura, Gikururu, Karuru, Thika, Karimu, North Mathioya,

[2] Environmental Flows in Water Resources Plans, Policies and Projects IBRCD/World Bank 1999

South Mathioya, Maragua and Amboni (Honi). The rivers draining to Athi River include Thika, Chania and Ruiru River as illustrated in **Figure 8.2** below.

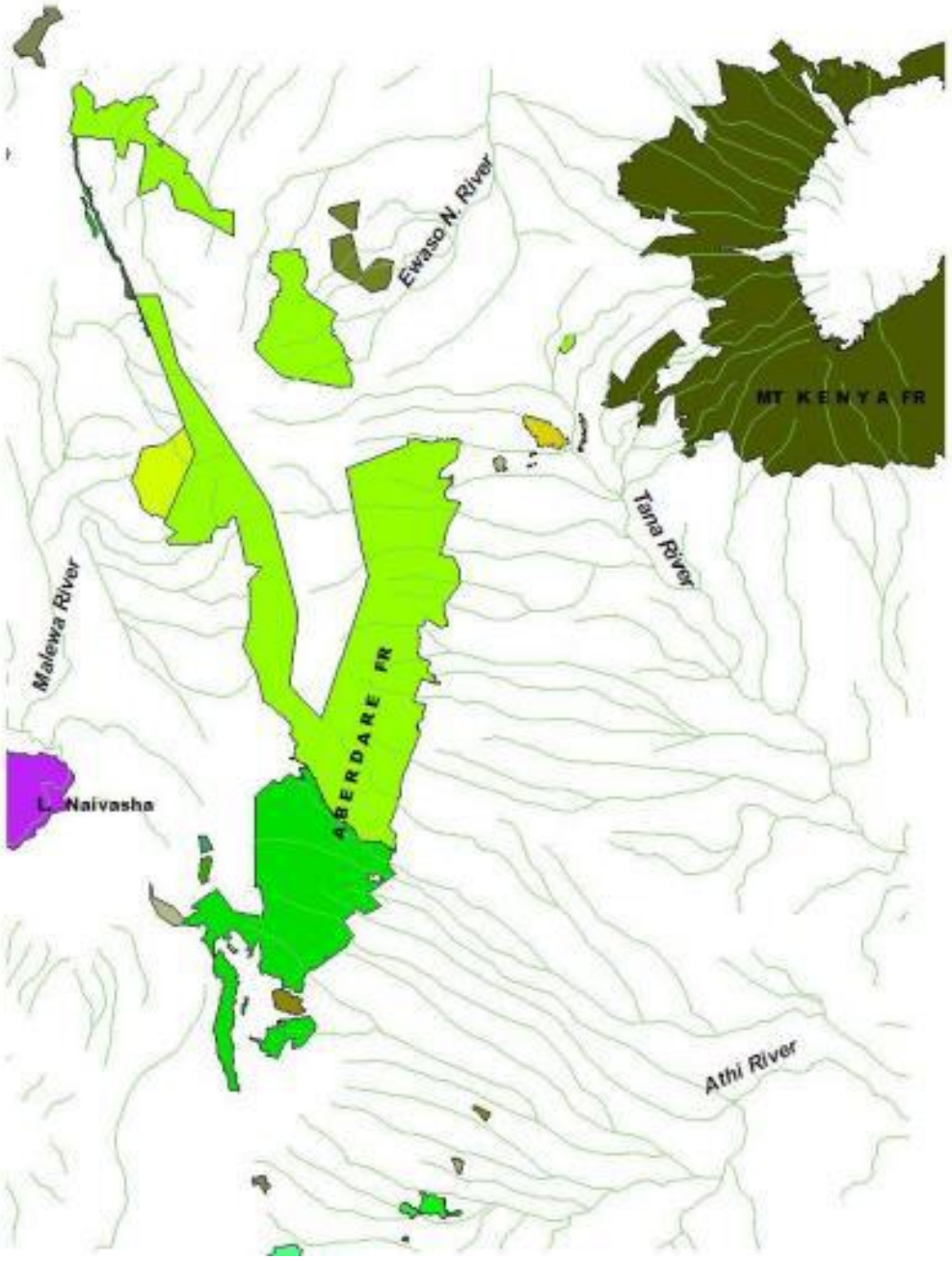

Figure 8.2: Map Showing Aberdare Forest Reserve Major River Catchment
Source Aberdare Forest Management Plan 2014-2019

Murang'a County is drained by four major perennial rivers namely **Mathioya River**, **Maragua River**, **Saba Saba River** and **Thika River** and their tributaries as indicated in **figure 8.3** on **page 8.12**. The rivers have their headwaters originating from the eastern slopes of the Aberdares. The Water Resources Authority (WRA) has installed several river gauging stations (RGS). However, data obtained from most of the RGSs were considered to be inadequate.

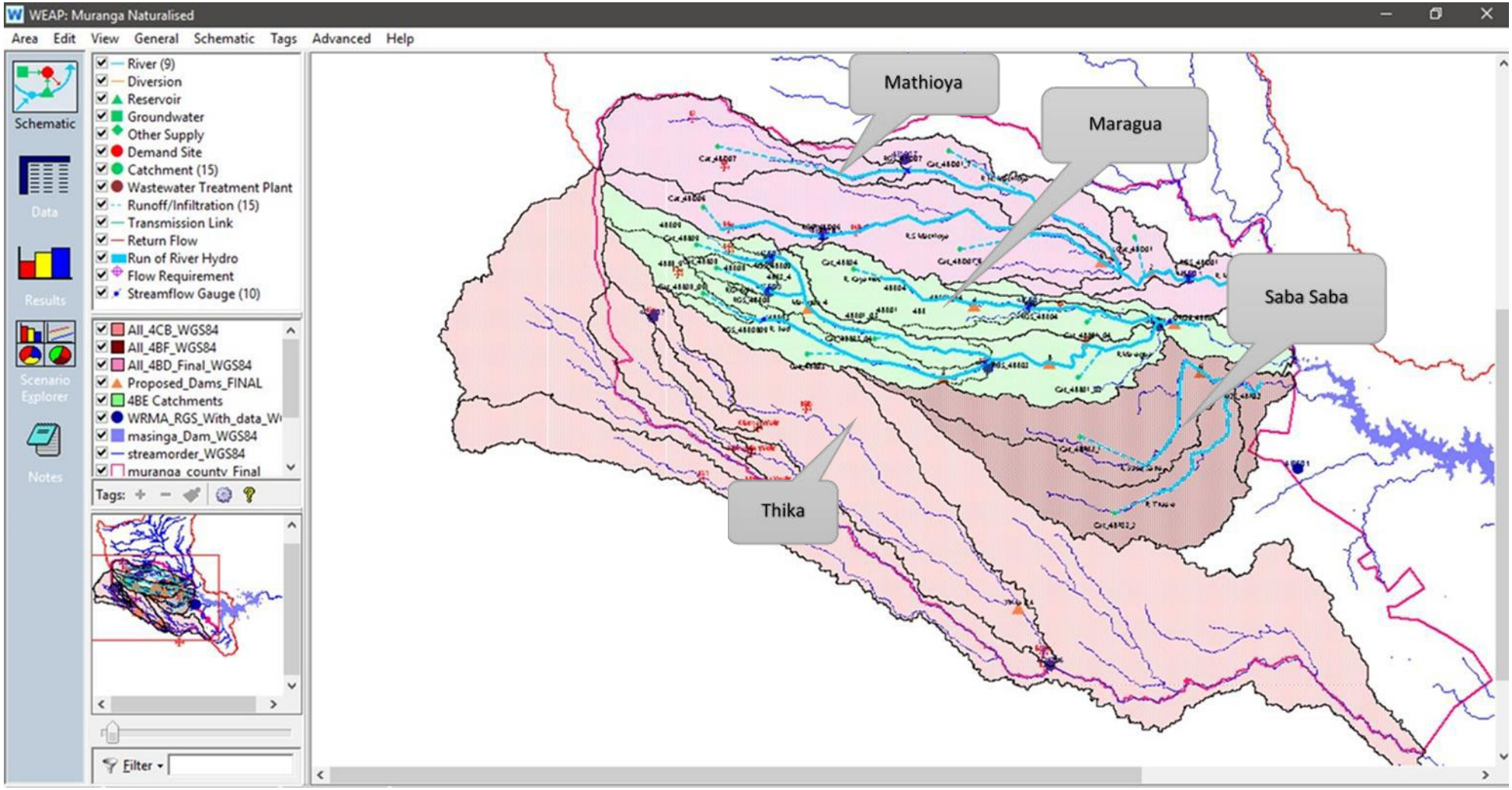

Figure 8.3: Mathioya, Sabasaba, Thika and Maragua target sub catchment to Tana River Catchment

Therefore. as discussed in Rafik Harji and Richard Davis3 1999, the downstream impacts on biophysical and social environment arise primarily from changes in the quantity, timing, and quality of the flow pattern of rivers. Applicable typically impacts that might be triggered on the river regime if environment flows are not adequately maintained on proposed Thika 3A dam, Maragua B dam, Irati 3 Dam and Kayahwe 4 Dam could include.

- Reduced abundance of fish and other invertebrates such as crabs
- Reductions in floodplain sediment and nutrient deposition
- Reductions in areas available for floodplain grazing, cropping, and fuelwoods
- Reductions in water to terrestrial habitats and aquatic habitats important for biodiversity
- Reduced access to domestic, irrigation, and livestock water supplies
- Reductions in groundwater recharge

As provided for by the hydrological assessment indicating the available water quantities required for environmental flow is summarized in **Table 8.7** below.

Table 8.7: Environment Flows for Proposed Dams

Catchment	Environment Flow
Maragua Catchment Proposed Dams (Maragua B dam, Irati 3 Dam and Kayahwe 4 Dam)	For Maragua catchment, available water that meets Q_{80} - Q_{95} as measured from 4BE08 is 2,590m3/day, 4BE09 is 15,550m^3/day, and 4BE01 is 95,904m 3/day. Hydrological analysis shows the Irati River at RGS 4BE08 is fully exploited. Similarly, abstractions on Maragua River at RGS 4BE09 should be assessed carefully. Towards the catchment outlet, the potential for water development is large as a result of significant contribution of the intermediate catchments. Nonetheless, storage options should be investigated for any future development of the water resource. Further investigations and monitoring of river abstractions is necessary to understand the existing situation.
Thika Catchment **Proposed Dam (**Thika 3A dam,**)**	The available flow Q_{80} - Q_{95} for abstraction from the catchment at RGS 4CB04 is 32,832m^3/day. This flow can be used for domestic water supply. However, for development of irrigation schemes, the available flood discharge would have to be used i.e., 40,654m^3/day. It is recommended to develop storage within the catchment to capture flood flows to ensure higher reliabilities of supply.

[3] Environmental Flows in Water Resources Plans, Policies and Projects IBRCD/World Bank 1999


Maragua River and an overview of Maragua B dam Reservoir Area

Environment Flow Ranking - As provided by Leopold (1971), environment flow impact assessment was determined based on available flood flow (Q_{80}) and environmental flow (Q_{95}). Therefore, as provided in **Table 8.7** above ranking for environmental severity will be as indicated below:

1. **Low Impact**– Flow exceeded (Q_{95}).
2. **Medium Impact** – Flow equalled to (Q_{95}).
3. **High Impact**– Flow below (Q_{95}).

Table 8.8 below analyses Environment flow impact in a scenario where provision of environmental flow releases Q_{95} on Irati River at RGS 4BE08 is fully exploited.

Table 8.8: Environmental Flow Impact Ranking – High Impact (Irati 3 Dam)

Nature of Impact	**Impact Source Discussion**		**Mitigation Efficiency**
Environment flow releases	**1. Maragua Catchment (Irati 3 Dam) -**Hydrological Assessment provides that Q_{80} - Q_{95} as measured from 4BE08 is 2,590m^3/day which is fully allocated, **2.** Therefore any development within the catchment should consider the above available water with an aim of supplementing the flow for downstream users.		**Medium**
Reversibility of impact	yes		
Affected Environment	**Terrestrial and Aquatic ecosystems**		
Magnitude	***Extent***	Beyond County– 5	
	Intensity	High -5	
	Duration	Long term -2	
	Probability	High-5	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (5+5+2+5) x5= 85 (High)	High

Table 8.9 on **Page 8-15** provides an analyses Environment flow impact in a scenario where provision of environmental flow releases Q_{95} on **Maragua** River at RGS 4BE09 where water is not fully allocated but requires further assessment with option of developing storage facilities. Similarly on Thika River RGS 4CB04 where normal flow is 32,832m^3/day.

Table 8.9: Environmental Flow Impact Ranking – Medium Impact (Maragua B dam and Kayahwe 4 Dam, Thika 3A dam)

Nature of Impact	Impact Source Discussion		Mitigation Efficiency
Environment flow releases	• **Proposed Dams (Maragua B dam and Kayahwe 4 Dam) -**Hydrological Assessment provides that Q_{80} - Q_{95} as measured from, 4BE09 is 15,550m3/day and 4BE01 is 95,904m 3/day. • **Proposed Dam (Thika 3A dam,)-**The available flow Q_{80} - Q_{95} for abstraction from the catchment at RGS 4CB04 is 32,832m^3/day • Therefore any development within the catchment should consider the above available water with an aim of supplementing the flow for downstream users.		**Medium**
Reversibility of impact	yes		
Affected Environment	**Terrestrial and Aquatic ecosystems**		
Magnitude	***Extent***	Beyond County– 5	
	Intensity	Medium-3	
	Duration	Long term -2	
	Probability	Likely-3	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (5+3+2+3) x4= 52 (Medium)	Medium

Mitigation Measures

- ✓ Maintain at least steady base flow of the stream to sustain ecological and social requirements downstream based on the ecological flow values calculated, key users downstream are the hydropower stations which include; WANJIL and MESCO HEP on Maragua and NDULA on Thika Catchment.
- ✓ Irati River at RGS 4BE08 is fully exploited with only 2,590m3/day Q_{95} available, therefore, there will be a demand for full downstream Reserve Flows required until development of future storage options.
- ✓ Ensure compliance with water resource regulation at all times, this will be achieved through weirs and offtakes that will be able to provide variable yields depending on the volume of flow similar to those guidelines described in the hydrological modelling discussed in chapter 8, it should be possible to produce a set of water supply structures that maximize potential yields at the same time as reducing impacts on downstream Reserve Flows
- ✓ Provide mandatory buffer area for conservation of the river line and dam ecosystem through the review of riparian land ownership.

8.3.3 Impact on Terrestrial and Aquatic Fauna

The proposed water resources development strategies which involve constructions of dams, intake works and water treatment works could lead to aquatic and terrestrial habitat fragmentation as explained in **sub section 4.7.1** on **page 4.11.** The dam barrier impact on normal river flow restricts upstream and downstream movement of migratory river fauna includling fish species such as (Barbus, Snake Catfish, Rainbow Trout, Guppy fish eported in Thika, Maragua and Irati upstream, midstream, and downstream respectively.

For avian fauna and as detailed in **sub section 4.72** on **Page 4-12**, there are over 290 species of birds have been recorded in the entire Project area because of the influence of the Aberdare forest reserve. However, the project will not directly interact with the forest ecosystem.

Therefore, no important bird of conservation observed in the project area as listed in the Wildlife and Conservation Act and IUCN Red List. This is attributed to the numerous exotic trees in the area that are planted for commercial purposes. Exotic trees are not preferred habitat for avifauna. However, caution should be taken where indigenous trees like Acacia, Podocarpus and Ficus trees exist because such trees form habitat for the birds where they form nest**.**

Ranking of Water Strategies impact in terresrtail and aquatic fauna is detailed in **Table 8.10** below.

Table 8.10: Ranking of Terrestrial an Aquatic Impacts

Impact Sources	Failure to adhere to Environmental Flow Releases provided as Q80 in the Water Resources Strategies report and indiscriminate deforestation of tree species which provide habitat for avian population.		**Mitigation Efficiency**
Nature of impact	• Reduced river flows impacting downstream biodiversity and ecosystem services including fish resources • Loss of habitat for avian fauna as a result of tree and bush clearing on site.		Medium
Reversibility of impact	No		
Affected areas	Fish and avian population		
Magnitude	***Extent***	Sub County – 4	
	Intensity	High-5	
	Duration	Permanent-5	
	Probability	High-5	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (4+5+5+5) x4= 76	Medium to High

Mitigation Measures

- ✓ Provided fish passes for upstream-migrating fish.
- ✓ For downstream migrating fish -screening and bypass, improved water gates, spillway designs should allow free movement of fish.
- ✓ Collection of wild fish and propagation for particular species.
- ✓ Through Water Resources Authority (WRA) and Water Resources users Association s (WRUAs) regulate abstractions within the river basin
- ✓ Initiate tree planting programs with the entire project.

8.3.4 Sedimentation and Siltation Impacts

At the time of Project construction, earth works within the river flood plains and sections of the adjoining riverbanks and lands will lead to increased soil erosion, siltation and sedimentation of downstream river channels. This loosening of the soil and the steep slope terrain will create a situation where rains freely wash down the silt into the downstream areas. The silt when washed down may contain high levels of organic matter and deposition of this may lead to anoxic conditions in the lower water levels with potential risks to the associated aquatic life. Siltation impact is anticipated to be

significant at the **Maragua B Dam site, Irati 3 Dam and Kayahwe 4 Dam site** where the vegetation cover is sparse and dominated by cropland, in Thika 3A Dam site, siltation impact could be minimal due to the fact that the location is densely vegetated with compact woodlots.

The severity of sedimentation impact will be rated as indicated below while **Table 8.11** presents impact ranking adopted.

1. **Low to Medium**– Erosion and sediment deposition control with emphasis on re afforestation programs.
2. **Medium Impact** – Erosion and sediment deposition control.
3. **Medium to High** –No provision for erosion and sediment deposition control.

Table 8.11: Sedimentation and Siltation Impact Ranking

Impact Sources	**Impact Source Discussion**		**Mitigation Efficiency**
Earth Works	1. Earth works within the river channels could trigger soil erosion 2. Un-regulated stripping of vegetation within the dam reservoir footprint.		**Medium**
Reversibility of impact	yes		
Affected Environment	**Terrestrial and Aquatic ecosystems**		
Magnitude	***Extent***	Beyond County– 5	
	Intensity	Medium-3	
	Duration	Long term -2	
	Probability	Likely-3	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (5+3+2+3) x4= 52 (Medium)	Medium

Mitigation Measures

It is recommended that construction be undertaken during the dry conditions to minimize erosion when the soil is loosened. The topsoil removed will be required to be moved to an alternative site where storm water cannot carry the soil to the streams.

- ✓ A water pan (silt trap) may be established downstream of the dams which will act as a soil trap to hold the excessive silt during construction.
- ✓ The steep slopes surrounding the dams' construction should be stabilized, compacted and strengthen to reduce on erosion and potential landslides as a result of deep cutting, drainage channels should be installed only when necessary,
- ✓ Encourage re-afforestation and improved farming systems upstream of the dams,
- ✓ Erosion and sediment monitoring and control plan should be prepared for the lifetime of the project.

8.3.5 Water Quality Impacts with the Rivers

The farming activities upstream are associated with increased soil erosion, excessive nutrients from pesticides and fertilizers used, these activities could lead to alteration of water quality within the river. Nutrients deposited into the dams may lead to eutrophication and growth of the aquatic vegetation hampering the natural flow of the rivers. On the other hand, reduction in the flow of water downstream will consequently result to increased concentration of pollutants downstream especially during the dry season.

At construction stage, project may encourage increased water turbidity within the dams' reservoir and downstream. There will also be potential water contamination from hydrocarbons mainly from the contractor's machineries. The severity of water quality impact will be rated as indicated below while **Table 8.12** presents impact ranking adopted.

1. **Low to Medium**– Enhanced upstream catchment management combined with sedimentation and siltation control during earth works.
2. **Medium Impact** – Enhanced upstream catchment management
3. **Medium to High** –No provision for upstream catchment management and sedimentation control.

Table 8.12: Water Quality Impact Ranking

Impact Sources	**Impact Source Discussion**		**Mitigation Efficiency**
Upstream catchment management and earth works	1. Earth works within the river channels could trigger soil erosion that ultimately lead to sedimentation and siltation. 2. Un-regulated stripping of vegetation within the dam reservoir footprint destabilizes soil structure hence exposing soil to agents of soil erosion.		**Medium**
Reversibility of impact	yes		
Affected Environment	**Terrestrial and Aquatic ecosystems**		
Magnitude	***Extent***	Beyond County– 5	
	Intensity	Medium-3	
	Duration	Long term -2	
	Probability	Likely-3	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (5+3+2+3) x4= 52 (Medium)	Medium

Mitigation Measures

- ✓ Define a buffer zone for reservoir protection against siltation, waste deposit, pesticide use.
- ✓ Encourage re-afforestation and improved farming systems upstream of the dams
- ✓ Identification of point sources of water pollution from upstream farms for the purpose of management,
- ✓ Institute a water quality monitoring system and maintaining appropriate records on water quality,
- ✓ Best management practices will be utilized during site clearing and construction to minimize erosion and sedimentation.

8.4 Social and Safety Impacts Prediction and Assessment

8.4.1 Dam Safety Impacts

According to the World Bank Operational Manual OP 4.37-Safety of Dams, any dam more that 15m is considered a large dam. The policy provides that such dams be designed and constructed supervised by experienced and competent professionals. It also requires that the borrower adopt and implement certain dam safety measures for the design, bid tendering, construction, operation, and maintenance of the dam and associated works.

Flood risk, dams assist in changing the intensity of flood peak within river channels in a safe way. In this matter, the dam has a real positive impact on the safety downstream ecosystems. Moreover, installation of metrological sensors and alarm in the catchment area of the dam acts as an early warning system to users downstream. However, the potential dam failure can result of fault in the design, use of sub-standard material during construction, deliberate sabotage, and landslide in the reservoir. Measures below are proposed under dam safety provisions.

The severity of impacts related to dam failure will be rated as indicated below while **Table 8.13** presents impact ranking adopted.

1. **Low to Medium** – Dam designs include safety provision and reviewed by World Bank panel of experts.
2. **Medium Impact** – Dam designs include safety provision
3. **Medium to High** – Dam design do not include safety provisions such as dam instrumentations.

Table 8.13: Dam Safety Ranking

Impact Sources	**Impact Source Discussion**		**Mitigation Efficiency**
Dam Break	Dam break that could lead to flooding risks downstream		**Medium**
Reversibility of impact	no		
Affected Environment	**Households and crop field downstream**		
Magnitude	***Extent***	Beyond County– 5	
	Intensity	High-5	
	Duration	Long term -2	
	Probability	Likely-3	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (5+5+2+3) x5= 75 (Medium to High)	Medium to High

Mitigation Measures

- ✓ Review the dam design and dam construction by independent panel of experts
- ✓ Prepare and implement relevant plans (plan for construction supervision and quality assurance, an instrumentation plan, emergency preparedness plan),
- ✓ Ensure frequent maintenance of the dam structures,
- ✓ Ensure use of high-quality standard materials during construction phase.

8.4.2 Land Acquisition, Displacement and other Social Impacts

The World Bank Involuntary Resettlement Policy OP 4.12 covers direct economic and social impacts that result from Bank-assisted investment projects. These impacts could be involuntary taking of land resulting in; (a) Relocation or loss of shelter, (b) Loss of assets or access to assets and (c) Loss of income sources or means of livelihood, whether or not the affected persons must move to another location. Therefore, a detailed Resettlement Action Plan (RAP) assessment will be undertaken to document cases of land acquisition within the dam. An abbreviated RAP will be prepared if the number of Project Affected Persons (PAPs) are less than 200, a full RAP will be prepared in the event of Project Affected Persons being more than 200.

In all the dam reservoir sites **Maragua B Dam site, Irati 3 Dam and Kayahwe 4**, majority of PAPs categories to be impacted will be PAPs losing farmland with isolated case of PAPs losing structures will be impacted **Irati 3 dam**. Photographs illustrates nature of farmland to be acquired from private individuals.

Farmland and Structures at Irati 3 Dam Reservoir Area to be Acquired

The severity of land acquisition impact will be rated as indicated below while **Table 8.14** on **Page 8-21** presents impact ranking adopted.

1. **Low to Medium**– Less than 200 persons impacted with no physical relocation of PAPs
2. **Medium Impact** – Less than 200 persons impacted with isolated cases of physical relocation of PAPs
3. **Medium to High** – more than 200 persons impacted with more cases of physical relocation of PAPs.

Table 8.14: Land Acquisition and Displacement Ranking

Impact Sources	**Impact Source Discussion**		**Mitigation Efficiency**
Land acquisition	Land acquisition and displacement of households from their farms within the dam reservoir		**Medium**
Reversibility of impact	no		
Affected Environment	**Households living within the reservoir.**		
Magnitude	***Extent***	Site – 1	
	Intensity	High-5	
	Duration	Long term - 2	
	Probability	High-5	
Significance	**Weighting**	(Extent+ Intensity +Duration + Probability) x WF (1+5+2+5) x5= 65 (Medium to High)	Medium to High

The Project activities associated with dam's construction have potential of triggering various social risks both at Project construction phase and operation phase. At the ESIA stage detailed social impacts will be assessed. Preliminary, **other social impacts** will be related to:

- ✓ Potential temporary disruption of access routes to water sources across the incised valleys.
- ✓ Potential temporal disruption of social-economic activities that rely on the river for communities downstream for instance small scale irrigation activities.
- ✓ Loss of crop fields, woodlots under agro-forestry and natural vegetation within the dam flood area,
- ✓ Labor influx impacts leading to associated strain on social services and other resources
- ✓ Gender Based Violence associated with workers working within the Project.
- ✓ Children abuse associated with vices such as early child pregnancies and child labor.
- ✓ Spread of HIV and other communicable diseases.

Mitigation Measures of Land Acquisition and Other Social Impacts

- ✓ Land acquisition and displacement impacts will be mitigated through preparation of a detailed Resettlement Action Plan (RAP)
- ✓ Provision of alternative routes and water points to community members to compensate the submerged water points and routes.
- ✓ Appropriate compensation of all loses including loss of livelihood suffered by PAPs.
- ✓ Development of a labor management plan, Children Protection Strategy, and HIV / Aids control and management strategy at Project construction period.

9.0 ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

9.1 Overview

This SESA Study for Integrated Water and Irrigation Master Plan for Murang'a County was conducted in line with the National Guidelines for SEA 2011. The SESA sought to ensure that the Plan meets the expected growth in both Domestic and Irrigation Water Demands within the County over the Medium Term (Year 2045) in line with aspirations of the Economic Pillar to Vision 2030.

From the assessment, numerous reports and documents, conducted numerous field investigations including stakeholder consultations with communities, workshops with technical managers, interviews with leaders and interests groups, the observation is that the identified strategies have potential to positively impact and transform local economies within Murang'a County.

However, SESA assessment has also identified some unforeseen and potentially significant negative impacts that will need to be addressed, as identified and discussed in **Table 9.1** on **Page 9-2.**

Table 9.1: Environment and Social Management Framework

Impact	Impact Severity	SEA Mitigation	Key Indicator	Institutions Involved	Implementation Time Frame
Impacts on terrestrial and aquatic flora	Score 52 (Medium)	✓ At the time of ESIA, a Biomass Survey will be undertaken to determine the quantity of woodlots likely to be destroyed, the report will propose appropriate offsets through re afforestation programs to be initiated within the Project. ✓ Encourage upstream community driven catchment conservation and management programs, such programs should be initiated through the Project in liaison with the Kenya Forest Services and local Forest Catchment Associations.	Vegetation cover footprint with the Project area	• Kenya Forest Services • Forest Conservation Associations (FCA) • Water Services Providers (MUWASCO, Kahuti) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA)	Medium Term
Downstream Environmental Flows.	Irati 3 Dam Score 85 (High) Maragua B dam, Irati 3 Dam and Kayahwe 4 Dam Score 52 (Medium)	✓ Maintain at least steady base environment flow of the stream to sustain ecological and social requirements downstream based on the ecological flow values calculated. ✓ Irati River at RGS 4BE08 is fully exploited with only 2,590m3/day Q95 available, therefore, there will be a demand for full downstream Reserve Flows required until development of future storage options. ✓ Ensure compliance with water resource regulation at all times, this will be achieved through weirs and offtakes that will be able to provide variable yields depending on the volume of flow ✓ Provide mandatory buffer area for conservation of the river line and dam ecosystem through the review of riparian land ownership,	Fish population following fish survey within respective rivers Number of water related conflict associated with downstream users	• Water Resources Authority (WRA) • Water Resources Users Associations (WRA) • Water Services Providers (MUWASCO, Kahuti) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA)	Medium Term

Impact	Impact Severity	SEA Mitigation	Key Indicator	Institutions Involved	Implementation Time Frame
Impacts on terrestrial and aquatic fauna (fish and avian)	All rivers (Thika, Irati & Maragua) score 76 (Medium to High)	✓ Provided fish passes for upstream-migrating fish. ✓ For downstream migrating fish -screening and bypass, improved water gates, spillway designs should allow free movement of fish. ✓ Collection of wild fish and propagation for particular species. ✓ Through Water Resources Authority (WRA) and Water Resources users Association s (WRUAs) regulate abstractions within the river basin ✓ Initiate tree planting programs with the entire project	Fish population following fish survey within respective rivers and avian survey	• Kenya Wildlife Services (KWS) • Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Athi Water Works Development Agency • National Environment Management Authority (NEMA	Medium Term
Sedimentation and Siltation Impacts within river channels	All rivers (Irati, Thika & Maragua) sites Score 52 (Medium)	✓ A water pan (silt trap) may be established downstream of the dam which will act as a soil trap to hold the excessive silt during construction. ✓ The steep slopes surrounding the dam construction should be stabilized, compacted and strengthen to reduce on erosion and potential landslides as a result of deep cutting, drainage channels should be installed only when necessary, ✓ Encourage re-afforestation and improved farming systems upstream of the dam	Turbidity Survey / silt load survey within the rivers to establish sedimentation levels	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, Kahuti) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA	Medium Term
Water Quality Impacts	All rivers (Irati, Thika & Maragua) sites Score 52 (Medium)	✓ Define a buffer zone for reservoir protection against siltation, waste deposit, pesticide use. ✓ Encourage re-afforestation and improved farming systems upstream of the dams ✓ Identification of point sources of water pollution from upstream farms for the purpose of management.	Water Quality Survey to assessment physical and chemical water characteristics with the rivers	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, Kahuti)	Medium Term

Impact	Impact Severity	SEA Mitigation	Key Indicator	Institutions Involved	Implementation Time Frame
		✓ Institute a water quality monitoring system and maintaining appropriate records on water quality, ✓ Best management practices will be utilized during site clearing and construction to minimize erosion and sedimentation		• National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA	
Dam Safety Impacts	All rivers (Irati, Thika & Maragua) sites Score 72 (Medium to High)	✓ Review the dam design and dam construction by independent panel of experts ✓ Prepare and implement relevant plans (plan for construction supervision and quality assurance, an instrumentation plan, an operation and maintenance plan), ✓ Ensure frequent maintenance of the dam structures ✓ Ensure soil structure around the sites (Intake, dam and Water treatment sites) is protected	Dam Safety and Incidence Survey reports	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, Kahuti) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA	Medium Term
Land Acquisition, Displacement and other Social Impacts	All rivers (Irati, Thika & Maragua) sites Score 65 (Medium to High)	✓ Land acquisition and displacement impacts will be mitigated through preparation of a detailed Resettlement Action Plan (RAP) ✓ Provision of alternative routes and water points to community members to compensate the submerged water points and routes. ✓ Appropriate compensation of all loses including loss of livelihood suffered by PAPs. ✓ Development of a labor management plan, Children Protection Strategy, and HIV / Aids control and management strategy at Project construction period	Resettlement Process and social incidences reported	• Water Services Providers (MUWASCO, Kahuti) • Athi Water Works Development Agency • National Environment Management Authority (NEMA • National Lands Commission (NLC) • Surveys of Kenya	Long-term

10.0 FINDINGS AND RECOMMENDATIONS

10.1 Findings of the SESA

The strategies for Water Resource Development for Murang'a County have been developed within Thika, Sabasaba, Maragua and Mathioya River Catchment. Therefore, the catchment was the focus of the SESA study which covered impacts related physical, biological, socio economic and cultural environment as detailed in **section 8.3** on **Page 8-6** of this report. The SESA Assessment identified likely environment and social risks, applicable policy, legal and institutional provisions as summarized in **Table 10.1** below.

Table 10.1: Environment and Social Impacts Linked to Applicable Policy, Legal and Institutional Provisions

Impact	Applicable Policy and Laws	Institutions Involved
Impacts on terrestrial and aquatic flora	(i) EMCA 1999, Cap 387 including below listed regulations ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. ✓ The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160. (ii) Forest Conservation and Management Act 2016 World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources ✓ Operational Policy 4.04 – Natural Habitats	• Kenya Forest Services • Forest Conservation Associations (CFA) • Athi Water Works Development Agency • National Environment Management Authority (NEMA)
Downstream Environmental Flows.	(i) EMCA 1999, Cap 387 including below listed regulations ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. ✓ The Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160.	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, Kahuti) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA)

Impact	Applicable Policy and Laws	Institutions Involved
	(ii) Water Act 2016 World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ Operational Policy 4.04 – Natural Habitats	
Impacts on terrestrial and aquatic fauna (fish and avian)	(i) EMCA 1999, Cap 387 including regulations below ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. ✓ The Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160. (ii) Water Act 2016 (iii) Fisheries development and Management Act 2016 World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources ✓ Operational Policy 4.04 – Natural Habitats	• Kenya Wildlife Services (KWS) • Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Athi Water Works Development Agency • National Environment Management Authority (NEMA
Sedimentation and Siltation Impacts within river channels	(i) EMCA 1999, Cap 387 including below listed regulations ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009. World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, MUSWASCO, Kahuti among others) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA
Water Quality Impacts	(i) EMCA 1999, Cap 387 including regulations below (ii) Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009 (iii) The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120.	• Water Resources Authority (WRA) • Water Resources Users Associations (WRA) • Water Services Providers (MUWASCO, Kahuti among others) • National Irrigation Board (NIB) • Athi Water Works Development Agency

Impact	Applicable Policy and Laws	Institutions Involved
	World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ World Bank OP 4.10 on Physical Cultural Resources	• National Environment Management Authority (NEMA
Dam Safety Impacts	(i) EMCA 1999, Cap 387 including regulations below ✓ Environmental Management and Coordination (Wetlands, Riverbanks, Lakeshores and Sea Shore Management) Regulation, 2009 ✓ The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120. World Bank Policies ✓ World Bank OP 4.01 on Environmental Assessment ✓ Operational Policy OP 4.37 on Dam Safety	• Water Resources Authority (WRA) • Water Resources Users Associations (WRUAs) • Water Services Providers (MUWASCO, MUSWASCO Kahuti among others) • National Irrigation Board (NIB) • Athi Water Works Development Agency • National Environment Management Authority (NEMA
Land Acquisition, Displacement and other Social Impacts	Land Act 2016 World Bank Policies ✓ World Bank OP 4.12 on Involuntary Resettlement	• Water Services Providers (MUWASCO, MUSWASC, Kahuti among others) • Athi Water Works Development Agency • National Environment Management Authority (NEMA • National Lands Commission • Surveys of Kenya (SoK)

From the assessment above, it can be observed that identified environment and social impacts likely to be triggered by the proposed strategies require a coordinated approach among the relevant national or county agencies and line ministries. Therefore, an appropriate steering committee will be established by AWWDA to spearhead implementation of the provisions of the Masterplan.

10.2 Recommendation

To support timely and effective implementation of environmental and social mitigation for risk identified under this SESA, the Project will ensure adequate budget is provided to carry out site specific Environment and Social Impact Assessment (ESIA) and later implement the ESMPs developed for the Sub Projects under the Master Plan.

The SESA assessment also recommends training and capacity building of environment and social safeguards personnel within implementation agencies coordinated by AWWDA to allow adequate implementation of SESA recommendations. This SESA report provides an estimate of Ksh 10 million to be allowed in the Master Plan for training and capacity building of staff and personnel in the agencies identified above.

The actual cost of environment and social safeguards management for each sub-Project under the Master Plan will be determined during the detailed ESIAs prepared by independent consultants. However, a provisional budget of Ksh 50million should be provided for hiring of consultancy firms required for preparation of specific Environment and Social Impact Assessment (ESIA) and Resettlement Action Plans (RAPs).

The SESA therefore recommended that these projects be subjected to Environmental and Social Impact Assessments (ESIA) in order to:

(i) Identify all potentially project-specific significant adverse environmental and social impacts of the project and recommend measures for mitigation.
(ii) Gather baseline data to inform the assessment of impacts and to monitor changes to the environment as a result of each of the projects as well as evaluate the success of the mitigation measures implemented; and
(iii) Recommend measures to be used to avoid or reduce the anticipated negative impacts and enhance the positive impacts.

For each project the ESIA should be carried out in line with Kenyan regulations (EMCA 2009 amended in 2015) as well as international best practice as defined by the World Bank Social Safeguards Policies specifically the OP 4.01 on Environment Assessment.

It is also recommended that any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations (Land Act 2012) and World Bank Social Safeguards Policies specifically the OP 4.12 on Involuntary Resettlement.

APPENDICES

LIST OF APPENDICES

APPENDIX 1

SESA Scoping Report NEMA Approval Letter

nema
mazingira yetu | uhai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

Mobile lines: 0724 253 398, 0723 363 010, 0735 013 046
Telcom Wireless: 020 - 2101370, 020 - 2183718
Incident Lines: 0786 - 101100, 0741 - 101100

P.O. Box 67839-00200
Popo Road, Nairobi, Kenya
E-mail: dgnema@nema.go.ke
Website: www.nema.go.ke

NEMA/SEA/5/2/069

29th March, 2021

Chief Executive Officer,
Athi Works Development Agency
P.O Box 45283 - 00100
NAIROBI

RE: APPROVAL OF THE SCOPING REPORT FOR THE STRATEGIC ENVIRONMENT ASSESSMENT FOR THE PROPOSED INTEGRATED WATER AND IRRIGATION MASTER PLAN FOR MURANG'A COUNTY

The National Environment Management Authority (NEMA) has reviewed the scoping report that was submitted to the Authority on 01st February 2021.

In light of the provisions of section 57 A of the Environmental Management and Coordination Act (EMCA), Regulations 42 and 43 of the Environmental (Impact Assessment and Audit) Regulations, 2003 and the National Guidelines for Strategic Environmental Assessment 2012, the scoping report for the proposed Integrated Water and Irrigation Master Plan is hereby **APPROVED.**

As you prepare to undertake the SEA study, the Authority informs you that effective and sustained stakeholder's engagement and appropriate communication methods are vital for a successful SEA process.

Ensure that linkages between the Master Plan and other regional, National and local plans are taken into consideration. You are informed to engage the SEA experts who shall conduct the SEA process and prepare the draft SEA report for submission to NEMA. Ten (10) hard copies and one electronic copy of the draft SEA report (which should include a non-technical summary and the submission form) should be submitted.

ZEPHANIAH OUMA
FOR: DIRECTOR GENERAL

ATHI WATER WORKS DEVELOPMENT AGENCY
RECEIVED
01 APR 2021
TEL: 2724292/3
P.O. Box 45283 - 00100 NAIROBI

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APPENDIX 2

Sample Environment and Social Screening Checklist Done for Sites Identified for Development of the Dams Under the Plan

Kayahwe 4 Dam Site
site inspection
30-01-2019

Annexes: Environment and Social Screening Matrix

SECTION B: ENVIRONMENTAL ISSUES

Will the sub-project:	Yes	No
Create a risk of increased soil erosion?	☑	☐
Create a risk of increased deforestation?	☑	☐
Create a risk of increasing any other soil degradation	☑	☐
Affect soil salinity and alkalinity?	☐	☑
Divert the water resource from its natural course/location?	☑	☐
Cause pollution of aquatic ecosystems by sedimentation and agro-chemicals, oil spillage, effluents, etc.?	☑	☐
Introduce exotic plants or animals?	☐	☑
Involve drainage of wetlands or other permanently flooded areas?	☑	☐
Cause poor water drainage and increase the risk of water-related diseases such as malaria?	☑	☐
Reduce the quantity of water for the downstream users?	☑	☐
Result in the lowering of groundwater level or depletion of groundwater?	☐	☑
Create waste that could adversely affect local soils, vegetation, rivers and streams or groundwater?	☑	☐
Reduce various types of livestock production?	☑	☐
Affect any watershed?	☑	☐
Focus on biomass/bio-fuel energy generation?	☐	☑

SECTION C: SOCIO-ECONOMIC ISSUES

Will the sub-project:	Yes	No
Displace people from their current settlement?	☑	☐
Will the Project lead to forced evictions and displacement	☐	☑
Infringe on Human Rights Principles	☐	☑
Interfere with the normal health and safety of the worker/employee?	☐	☑
Reduce the employment opportunities for the surrounding communities?	☐	☑
Reduce settlement (no further area allocated to settlements)?	☐	☑
Reduce income for the local communities?	☐	☑
Increase insecurity due to introduction of the project?	☐	☑
Increase exposure of the community to communicable diseases such as HIV/AIDS?	☑	☐
Induce conflict?	☑	☐
Have machinery and/or equipment installed for value addition?	☐	☑
Introduce new practices and habits?	☐	☑
Lead to child delinquency (school drop-outs, child abuse, child labour, etc.?	☑	☐
Infringe on provision of ILO on labour and working conditions	✓	
Lead to gender disparity?	☑	☐
Lead to poor diets?	☐	☑
Lead to social evils (drug abuse, excessive alcohol consumption, crime, etc.)?	☐	☐ ✓

Section D: Natural Habitats

Will the sub-project:	Yes	No
Be located within or near environmentally sensitive areas (e.g. intact natural forests, mangroves, wetlands) or threatened species? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Adversely affect environmentally sensitive areas or critical habitats – wetlands, woodlots, natural forests, rivers, protected areas including national parks, reserves or local sanctuaries, etc.)? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Affect the indigenous biodiversity (flora and fauna)? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Cause any loss or degradation of any natural habitats, either directly (through project works) or indirectly? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Affect the aesthetic quality of the landscape?	☐	☑
Reduce people's access to the pasture, water, public services or other resources that they depend on?	☑	☐
Increase human-wildlife conflicts?	☐	☑
Use irrigation system in its implementation? *NB:If the answers to any of the above is 'yes', please include an ESMP with sub-project application.*	☑	☐

Section F: Vulnerable and Marginalized Groups meeting requirements for OP 4.10

Are there:	Yes	No
People who meet requirements for OP 4.10 living within the boundaries of, or near the project?	☐	☑
Members of these VMGs in the area who could benefit from the project?	☐	☑
VMGs livelihoods to be affected by the subproject?	☐	☑

If the answer to any of the above is 'yes', please consult the VMGF that has been prepared for the project.

Section G: Land Acquisition and Access to Resources

Will the sub-project:	Yes	No
Require that land (public or private) be acquired (temporarily or permanently) for its development?	☑	☐
Use land that is currently occupied or regularly used for productive purposes (e.g. gardening, farming, pasture, fishing locations, forests)	☑	☐
Displace individuals, families or businesses?	☑	☐
Result in temporary or permanent loss of crops, fruit trees and pasture land?	☑	☐
Adversely affect small communal cultural property such as funeral and burial sites, or sacred groves?	☑	☐
Result in involuntary restriction of access by people to legally designated parks and protected areas?	☐	☑
Be on monoculture cropping?	☐	☑

If the answer to any of the above is 'yes', please consult the mitigation measures in the ESMF, and if needed prepare a (Resettlement Action Plan) RAP.

Section H: Proposed action

(i) Summarize the above:	(ii) Guidance
☐ All the above answers are 'No'	• If all the above answers are 'No', there is no need for further action;
☑ There is at least one 'Yes'	• If there is at least one 'Yes', please describe your recommended course of action (see below).

(iii) Recommended Course of Action

If there is at least one 'Yes', which course of action do you recommend?

☑ The Environment and Social Specialist will provide detailed guidance on mitigation measures as outlined in the Scoping Report; and

☑ Specific advice is required from the Environment and Social Specialist and thetechnical team regarding sub-project specific EIA(s) and also in the following area(s)

[type here]

☑ All sub-project applications/proposals MUST include a completed Environment and Social Screening checklist. The Environment and Social Specialist will review the sub-project proposals and sign off;

☑ The proposals will then be submitted to the Project Technical Committee for clearance for implementation by communities in the proposed subprojects.

Expert Advice

☑ The National Government through the Department of Monuments and Sites of the National Museums of Kenya can assist in identifying and, mapping of monuments and archaeological sites; and

☒ Sub-project specific EIAs, if recommended, must be carried out by experts registered with NEMA and be followed by monitoring and review. During the process of conducting an EIA the proponent shall seek views of persons who may be affected by the sub-project. The WB policy set out in OP 4.01 requires consultation of sub-project affected groups and disclosure of EIA's conclusions. In seeking views of the public after the approval of the sub-project, the proponent shall avail the draft EIA report at a public place accessible to project-affected groups and local NGOs/CSOs.

Completed by: [type here]

Specific ESIA to be undertaken at design stage

Name: [type here]

Position / Community: [type here]

Date:	[type here]

Field Appraisal Officer (CDE): [type here]

Godwin Lidahuli Sakwa

Signature: [***]*** NEMA LEAD EXPERT NO 2492

30-01-2019

Date:	[type here]

Note:

Project category	Characteristics
A ✓	Full and extensive ESIA needed- irreversible environmental impacts; impacts not easy to pick or isolate and mitigation cost expensive; ESMP design not easily done; Must have the EIA done and future annual EAs instituted
B	Site specific environmental impacts envisaged; mitigation measures easy to pick, not costly and ESMP design readily done; need an ESIA and future EAs
C	Have minimal or occasionally NO adverse environmental impacts; exempted from further environmental processes save environmental audits

(1) IRATI 3 DAM SITE
Inception Date
30-01-2019

Annexes: Environment and Social Screening Matrix

SECTION B: ENVIRONMENTAL ISSUES

Will the sub-project:	Yes	No
Create a risk of increased soil erosion?	☑	☐
Create a risk of increased deforestation?	☑	☐
Create a risk of increasing any other soil degradation	☑	☐
Affect soil salinity and alkalinity?	☐	☑
Divert the water resource from its natural course/location?	☑	☐
Cause pollution of aquatic ecosystems by sedimentation and agro-chemicals, oil spillage, effluents, etc.?	☑	☐
Introduce exotic plants or animals?	☐	☑
Involve drainage of wetlands or other permanently flooded areas?	☐	☑
Cause poor water drainage and increase the risk of water-related diseases such as malaria?	☑	☐
Reduce the quantity of water for the downstream users?	☑	☐
Result in the lowering of groundwater level or depletion of groundwater?	☐	☑
Create waste that could adversely affect local soils, vegetation, rivers and streams or groundwater?	☑	☐
Reduce various types of livestock production?	☑	☐
Affect any watershed?	☑	☐
Focus on biomass/bio-fuel energy generation?	☐	☑

SECTION C: SOCIO-ECONOMIC ISSUES

Will the sub-project:	Yes	No
Displace people from their current settlement?	☑	☐
Will the Project lead to forced evictions and displacement	☐	☑
Infringe on Human Rights Principles	☐	☑
Interfere with the normal health and safety of the worker/employee?	☐	☑
Reduce the employment opportunities for the surrounding communities?	☐	☑
Reduce settlement (no further area allocated to settlements)?	☐	☑
Reduce income for the local communities?	☐	☑
Increase insecurity due to introduction of the project?	☐	☑
Increase exposure of the community to communicable diseases such as HIV/AIDS?	☑	☐
Induce conflict?	☑	☐
Have machinery and/or equipment installed for value addition?	☐	☑
Introduce new practices and habits?	☐	☑
Lead to child delinquency (school drop-outs, child abuse, child labour, etc.?	☑	☐
Infringe on provision of ILO on labour and working conditions	✓	
Lead to gender disparity?	☑	☐
Lead to poor diets?	☐	☑
Lead to social evils (drug abuse, excessive alcohol consumption, crime, etc.)?	☐	✓

Section D: Natural Habitats

Will the sub-project:	Yes	No
Be located within or near environmentally sensitive areas (e.g. intact natural forests, mangroves, wetlands) or threatened species? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Adversely affect environmentally sensitive areas or critical habitats – wetlands, woodlots, natural forests, rivers, protected areas including national parks, reserves or local sanctuaries, etc.)? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Affect the indigenous biodiversity (flora and fauna)? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Cause any loss or degradation of any natural habitats, either directly (through project works) or indirectly? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Affect the aesthetic quality of the landscape?	☐	☑
Reduce people's access to the pasture, water, public services or other resources that they depend on?	☑	☐
Increase human-wildlife conflicts?	☐	☑
Use irrigation system in its implementation? *NB:If the answers to any of the above is 'yes', please include an ESMP with sub-project application.*	☑	☐

Section F: Vulnerable and Marginalized Groups meeting requirements for OP 4.10

Are there:	Yes	No
People who meet requirements for OP 4.10 living within the boundaries of, or near the project?	☐	☑
Members of these VMGs in the area who could benefit from the project?	☐	☑
VMGs livelihoods to be affected by the subproject?	☐	☑

If the answer to any of the above is 'yes', please consult the VMGF that has been prepared for the project.

Section G: Land Acquisition and Access to Resources

Will the sub-project:	Yes	No
Require that land (public or private) be acquired (temporarily or permanently) for its development?	☑	☐
Use land that is currently occupied or regularly used for productive purposes (e.g. gardening, farming, pasture, fishing locations, forests)	☑	☐
Displace individuals, families or businesses?	☑	☐
Result in temporary or permanent loss of crops, fruit trees and pasture land?	☑	☐
Adversely affect small communal cultural property such as funeral and burial sites, or sacred groves?	☑	☐
Result in involuntary restriction of access by people to legally designated parks and protected areas?	☐	☑
Be on monoculture cropping?	☐	☑

If the answer to any of the above is 'yes', please consult the mitigation measures in the ESMF, and if needed prepare a (Resettlement Action Plan) RAP.

Section H: Proposed action

(i) Summarize the above:	(ii) Guidance
☐ All the above answers are 'No'	• If all the above answers are 'No', there is no need for further action;
☑ There is at least one 'Yes'	• If there is at least one 'Yes', please describe your recommended course of action (see below).

(iii) Recommended Course of Action

If there is at least one 'Yes', which course of action do you recommend?

☑ The Environment and Social Specialist will provide detailed guidance on mitigation measures as outlined in the Scoping Report; and

☑ Specific advice is required from the Environment and Social Specialist and thetechnical team regarding sub-project specific EIA(s) and also in the following area(s)

[type here]

☑ All sub-project applications/proposals MUST include a completed Environment and Social Screening checklist. The Environment and Social Specialist will review the sub-project proposals and sign off;

☑ The proposals will then be submitted to the Project Technical Committee for clearance for implementation by communities in the proposed subprojects.

Expert Advice

☑ The National Government through the Department of Monuments and Sites of the National Museums of Kenya can assist in identifying and, mapping of monuments and archaeological sites; and

☒ Sub-project specific EIAs, if recommended, must be carried out by experts registered with NEMA and be followed by monitoring and review. During the process of conducting an EIA the proponent shall seek views of persons who may be affected by the sub-project. The WB policy set out in OP 4.01 requires consultation of sub-project affected groups and disclosure of EIA's conclusions. In seeking views of the public after the approval of the sub-project, the proponent shall avail the draft EIA report at a public place accessible to project-affected groups and local NGOs/CSOs.

Completed by: [type here]

Specific ESIA to be undertaken at design stage

Name: [type here]

Position / Community: [type here]

Date:	[type here]

Field Appraisal Officer (CDE): [type here]

Godwin Lidahuli Sakwa

Signature: [ ]

NEMA LEAD EXPERT NO 2492

30-01-2019

Date:	[type here]

Note:

Project category	Characteristics
☑ A	Full and extensive ESIA needed- irreversible environmental impacts; impacts not easy to pick or isolate and mitigation cost expensive; ESMP design not easily done; Must have the EIA done and future annual EAs instituted
B	Site specific environmental impacts envisaged; mitigation measures easy to pick, not costly and ESMP design readily done; need an ESIA and future EAs
C	Have minimal or occasionally NO adverse environmental impacts; exempted from further environmental processes save environmental audits

Maragua B Dam site
Site inspection
30-01-2019

Annexes: Environment and Social Screening Matrix

SECTION B: ENVIRONMENTAL ISSUES

Will the sub-project:	Yes	No
Create a risk of increased soil erosion?	☑	☐
Create a risk of increased deforestation?	☑	☐
Create a risk of increasing any other soil degradation	☑	☐
Affect soil salinity and alkalinity?	☐	☑
Divert the water resource from its natural course/location?	☑	☐
Cause pollution of aquatic ecosystems by sedimentation and agro-chemicals, oil spillage, effluents, etc.?	☑	☐
Introduce exotic plants or animals?	☐	☑
Involve drainage of wetlands or other permanently flooded areas?	☑	☐
Cause poor water drainage and increase the risk of water-related diseases such as malaria?	☑	☐
Reduce the quantity of water for the downstream users?	☑	☐
Result in the lowering of groundwater level or depletion of groundwater?	☑	☑
Create waste that could adversely affect local soils, vegetation, rivers and streams or groundwater?	☑	☐
Reduce various types of livestock production?	☑	☐
Affect any watershed?	☑	☐
Focus on biomass/bio-fuel energy generation?	☐	☑

SECTION C: SOCIO-ECONOMIC ISSUES

Will the sub-project:	Yes	No
Displace people from their current settlement?	☑	☐
Will the Project lead to forced evictions and displacement	☐	☑
Infringe on Human Rights Principles	☐	☑
Interfere with the normal health and safety of the worker/employee?	☐	☑
Reduce the employment opportunities for the surrounding communities?	☐	☑
Reduce settlement (no further area allocated to settlements)?	☐	☑
Reduce income for the local communities?	☐	☑
Increase insecurity due to introduction of the project?	☐	☑
Increase exposure of the community to communicable diseases such as HIV/AIDS?	☑	☐
Induce conflict?	☑	☐
Have machinery and/or equipment installed for value addition?	☐	☑
Introduce new practices and habits?	☐	☑
Lead to child delinquency (school drop-outs, child abuse, child labour, etc.?	☑	☐
Infringe on provision of ILO on labour and working conditions	✓	
Lead to gender disparity?	☑	☐
Lead to poor diets?	☐	☑
Lead to social evils (drug abuse, excessive alcohol consumption, crime, etc.)?	☐	☑

Section D: Natural Habitats

Will the sub-project:	Yes	No
Be located within or near environmentally sensitive areas (e.g. intact natural forests, mangroves, wetlands) or threatened species? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Adversely affect environmentally sensitive areas or critical habitats – wetlands, woodlots, natural forests, rivers, protected areas including national parks, reserves or local sanctuaries, etc.)? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Affect the indigenous biodiversity (flora and fauna)? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Cause any loss or degradation of any natural habitats, either directly (through project works) or indirectly? *NB: If the answer is yes, the sub-project should not proceed.*	☐	☑
Affect the aesthetic quality of the landscape?	☐	☑
Reduce people's access to the pasture, water, public services or other resources that they depend on?	☑	☐
Increase human-wildlife conflicts?	☐	☑
Use irrigation system in its implementation? *NB:If the answers to any of the above is 'yes', please include an ESMP with sub-project application.*	☑	☐

Section F: Vulnerable and Marginalized Groups meeting requirements for OP 4.10

Are there:	Yes	No
People who meet requirements for OP 4.10 living within the boundaries of, or near the project?	☐	☑
Members of these VMGs in the area who could benefit from the project?	☐	☑
VMGs livelihoods to be affected by the subproject?	☐	☑

If the answer to any of the above is 'yes', please consult the VMGF that has been prepared for the project.

Section G: Land Acquisition and Access to Resources

Will the sub-project:	Yes	No
Require that land (public or private) be acquired (temporarily or permanently) for its development?	☑	☐
Use land that is currently occupied or regularly used for productive purposes (e.g. gardening, farming, pasture, fishing locations, forests)	☑	☐
Displace individuals, families or businesses?	☑	☐
Result in temporary or permanent loss of crops, fruit trees and pasture land?	☑	☐
Adversely affect small communal cultural property such as funeral and burial sites, or sacred groves?	☑	☐
Result in involuntary restriction of access by people to legally designated parks and protected areas?	☐	☑
Be on monoculture cropping?	☐	☑

If the answer to any of the above is 'yes', please consult the mitigation measures in the ESMF, and if needed prepare a (Resettlement Action Plan) RAP.

Section H: Proposed action

(i) Summarize the above:	(ii) Guidance
☐ All the above answers are 'No'	• If all the above answers are 'No', there is no need for further action;
☑ There is at least one 'Yes'	• If there is at least one 'Yes', please describe your recommended course of action (see below).

(iii) Recommended Course of Action

If there is at least one 'Yes', which course of action do you recommend?

☑ The Environment and Social Specialist will provide detailed guidance on mitigation measures as outlined in the Scoping Report; and

☑ Specific advice is required from the Environment and Social Specialist and thetechnical team regarding sub-project specific EIA(s) and also in the following area(s)

[type here]

☑ All sub-project applications/proposals MUST include a completed Environment and Social Screening checklist. The Environment and Social Specialist will review the sub-project proposals and sign off;

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☑ The National Government through the Department of Monuments and Sites of the National Museums of Kenya can assist in identifying and, mapping of monuments and archaeological sites; and

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Completed by: [type here]

Specific ESIA to be undertaken at design stage

Name: [type here]

Position / Community: [type here]

Date:	[type here]

Field Appraisal Officer (CDE): [type here]

Godwin Lidahuli Sakwa

Signature: [***]*** NEMA LEAD EXPERT NO 2492

30-01-2019

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Thika 3A Dam
Site Inspection
30-01-2019

Annexes: Environment and Social Screening Matrix

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Will the sub-project:	Yes	No
Create a risk of increased soil erosion?	☑	☐
Create a risk of increased deforestation?	☑	☐
Create a risk of increasing any other soil degradation	☑	☐
Affect soil salinity and alkalinity?	☐	☑
Divert the water resource from its natural course/location?	☑	☐
Cause pollution of aquatic ecosystems by sedimentation and agro-chemicals, oil spillage, effluents, etc.?	☑	☐
Introduce exotic plants or animals?	☐	☑
Involve drainage of wetlands or other permanently flooded areas?	☐	☑
Cause poor water drainage and increase the risk of water-related diseases such as malaria?	☐	☑
Reduce the quantity of water for the downstream users?	☑	☐
Result in the lowering of groundwater level or depletion of groundwater?	☐	☑
Create waste that could adversely affect local soils, vegetation, rivers and streams or groundwater?	☑	☐
Reduce various types of livestock production?	☑	☐
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Focus on biomass/bio-fuel energy generation?	☐	☑

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Will the sub-project:	Yes	No
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Will the Project lead to forced evictions and displacement	☐	☑
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Reduce the employment opportunities for the surrounding communities?	☐	☑
Reduce settlement (no further area allocated to settlements)?	☐	☑
Reduce income for the local communities?	☐	☑
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Infringe on provision of ILO on labour and working conditions	☑	
Lead to gender disparity?	☑	☐
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Affect the aesthetic quality of the landscape?	☐	☑
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Increase human-wildlife conflicts?	☐	☑
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Completed by: [type here]

Specific ESIA to be undertaken at design stage

Name: [type here]

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Date:	[type here]

Field Appraisal Officer (CDE): [type here]

Godwin Lidahuli Sakwa

Signature: [ ]

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APPENDIX 3

Stakeholder Consultations Minutes and List of Attendance During Preparation of the Masterplan

STAKEHOLDER CONSULTATIONS AT MASTERPLAN DEVELOPMENT

INTRODUCTORY MEETING TO MURANG'A COUNTY

DEVELOPMENT OF AN INTEGRATED WATER AND IRRIGATION MASTER PLAN FOR MURANG'A COUNTY

MINUTES OF INTRODUCTORY MEETING HELD ON 28TH FEBRUARY 2018 BETWEEN MURANG'A COUNTY GOVERNMENT REPRESENTATIVES, ATHI WATER SERVICES BOARD (AWSB) AND MANGAT I.B PATEL (MIBP) LTD CONSULTING ENGINEERS AT MURANG'A COUNTY GOVERNMENT OFFICES – MURANG'A TOWN

PRESENT:

	NAME		ORGANIZATION		DESIGNATION
1.	Wanderi Thuku	-	Murang'a County Government (MCG)	-	County Water Officer
2.	Samuel Mwangi	-	MCG	-	Personal Assistant to Member of the County Executive Committee (CEC) Water & Irrigation
3.	Eng. Kiprono Rop	-	Athi Water Services Board (AWSB)	-	Project Engineer
4.	Eunice Jemutai	-	Athi Water Services Board (AWSB)	-	Environmental Officer
5.	Eng. J.K Rutere	-	Northern Collector Tunnel – Phase 1 Independent Panel of Experts (IPE)	-	Chairman
6.	Loannis Karayokyris	-	IPE	-	Member
7.	Dr. Angela Mwenda	-	IPE		Environmental Expert
8.	Eng. R.S Rupra	-	Mangat I.B Patel (MIBP) Ltd Consulting Engineers	-	Deputy Team Leader
9.	Eng. Eric I. Muriithi	-	MIBP	-	Water Supply Engineer
10.	Nicholas Mahinda	-	MIBP	-	Water Supply Engineer

Attendance sheet for the meeting is given in **Annex 1** of these Minutes.

Item	Minutes	Action By:
1.	**Introductions** Samuel Mwangi, Murang'a County Government Representative, officially opened the meeting which was followed by self-introductions by all Participants. He welcomed the Consultant and Athi Water Services Board to the meeting.	
2.	**Consultant's Brief on the Study** The Consultant gave a brief of the Assignment Titled "Development of an Integrated Water and Irrigation Master Plan for Murang'a County" as follows:	
2.1	**Study Objectives**	

Item	Minutes	Action By:

The objectives of the Study are*:*

- ✓ *To develop an Integrated Water and Irrigation Master Plan for Murang'a County considering the recommendations of the 2012 Master Plan for developing new Water Sources for Nairobi and Satellite Towns. The Consultant will therefore be required to undertake a desk review of this Master Plan. Further, AWSB has commissioned a separate Consultancy to prepare a Status Report of the Master Plan for developing new Water Sources for Nairobi and Satellite Towns. The two Consultancy Assignments have to be coordinated in delivering their specific outputs.*
- ✓ *To consider and incorporate recommendations of other studies undertaken or being undertaken by other relevant authorities including Tana River Development Authority, National Irrigation Board (NIB), Murang'a County Government among others,*
- ✓ *To determine the total Irrigation Potential for Murang'a County,*
- ✓ *To prepare Water Demand (including Domestic and Irrigation) Estimates for Murang'a County up to the year 2042. The Demand should consider the immediate consumers in the adjacent Counties,*
- ✓ *To review and identify potential Water Source(s) for Murang'a County and recommend a strategy for their development considering Hydrological, Geo-technical, Social, Political, Economic and Environmental factors.*
- ✓ *To carry out a comprehensive analysis of Ground and Surface Water availability,*
- ✓ *To make recommendations for exploitation of the available Water Resources,*
- ✓ *To identify possible Dam Sites and recommend on the Storage Capacities*
- ✓ *To prepare strategic Environmental Impact Assessment Report including Social Impact Assessment, Hydrological, and Geo-Technical Study Reports.*
- ✓ *To prepare an Integrated Water and Irrigation Master Plan for Murang'a County.*

2.2 **Deliverables under the Assignment**

The Deliverables under the Assignment which is set to take **9 Months** as follows:

No.	Deliverable	Target Submission Date (M = Months after Commencement)	
D1	Inception Report	M + 1	15-Feb-18
D2	Water Resources Options Report	M + 3	15-Apr-18
D3	Overall Water Resources Development Strategy	M + 5	15-Jun-18
D4	Water Resources Development Stage 1 (5 Years) Works Pre-Design	M + 5	15-Jun-18
D5	Strategic Environmental and Social Impact Assessment (SESA)	M + 6	15-Jul-18
D6	Draft Integrated Water and Irrigation Development Master Plan	M + 8	15-Sep-18
D7	Final Integrated Water and Irrigation Development Master Plan	M + 9	15-Oct-18

The Consultant gave a highlight of the main areas he is focusing on in the initial stages which involves: reviews of previous studies conducted in the Study Area, getting plans that have been set for the Study Area by the Stakeholders,

<table>
<tr><th>Item</th><th>Minutes</th><th>Action By:</th></tr>
<tr><td></td><td>confirmation of the present water sources and water supply systems by the WSPs and community Schemes, Conducting Institutional reviews, etc.</td><td></td></tr>
<tr><td>3.0</td><td><u>Request for Data from Murang'a County Government</u>
• The Consultant reported that he is in the process of collecting Data from the Relevant Stakeholders in Murang'a County. The Consultant requested the following Data from the County Government:
<table><tr><th>Item</th><th>DATA</th><th>FORMAT</th></tr><tr><td>1.</td><td>Murang'a County Administrative Boundaries Plan; Sub-counties, Districts, Locations and Sub-Locations</td><td>Soft & hard copies</td></tr><tr><td>2.</td><td>Existing and Proposed Land Use Plan maps for Murang'a Municipality and Murang'a County</td><td>Soft & hard copies</td></tr><tr><td>3.</td><td>County Irrigation Development Strategic Plan year 2013</td><td>Soft & hard copies</td></tr><tr><td>4.</td><td>Previous Reports on Water Resources in Murang'a County</td><td>Soft & hard copies</td></tr><tr><td>5.</td><td>Any on-going Consultancy Work on Water & Irrigation by Athi Water Services Board, Tana Water Services Board and the County Government</td><td>Soft & hard copies</td></tr><tr><td>6.</td><td>Data on Irrigation Schemes in Murang'a County</td><td>Soft & hard copies</td></tr></table>• The County Government Representatives promised to provide the Data requested by the Consultant by 9th March 2018.
• AWSB also promised to provide information and Reports on on-going projects that they are undertaking in Murang'a County.
• Consultant further sought clarification from the County Government whether there are any parallel Studies currently been done to what the Consultant is undertaking. It was confirmed that the County Government has not commissioned any presently on-going Studies that may be relevant to Consultant's Assignment.</td><td>MCG

AWSB</td></tr>
<tr><td>4.0</td><td><u>Formation of a Technical Committee</u>
The Consultant requested AWSB to fast track the formation of a Technical Committee as per the requirements of the Terms of Reference which should include but not limited to the following Key Stakeholders:
<table><tr><td>• Ministry of Water and Irrigation (MWI)</td><td>• National Irrigation Board (NIB)</td></tr><tr><td>• Water Resources Management Authority (WRMA)</td><td>• Murang'a County Government</td></tr><tr><td>• Athi Water Services Board (AWSB)</td><td>• Tana Water Services Board (TWSB)</td></tr></table></td><td></td></tr>
</table>

Item	Minutes	Action By:
	• National Environmental Management Authority (NEMA) • Water Service Providers (WSPs) • Water Resources Users Association (WRUAs) • Consultant • Ministry of Energy AWSB Representative indicated that he would write formally to the Key Stakeholders to initiate the formation of the Technical Committee.	**AWSB**
5.0	**Closing of the Meeting** • The County Government expressed gratitude to AWSB for commissioning the Study considering the dire water situation in Murang'a County. • The County Government also thanked AWSB for the various projects they are undertaking to improve water supply in Murang'a County but requested AWSB to fast tract some of them especially Gatango and Mathioya Water Supply Projects which have been delayed for some time. • The County Government promised to work closely with AWSB and the Consultant to make sure the Study is a success and requested the list of information that the Consultant requires in order to mobilize the various departments to provide the data. • AWSB and the Consultant thanked the Murang'a County Government for the meeting and expressed hope for a continued cooperation to ensure success of the Assignment.	
6.0	**Informal Meeting with Governor Murang'a County** The Consultant met the Governor Murang'a County at Blue Post Hotel, Thika and briefed him of the Study that the Consultant is undertaking for Murang'a County from which the Governor expressed gratitude and promised to mobilize the various departments to avail all the information the Consultant requires so as to make the Study a success and benefit people of Murang'a County.	

Minutes by:
N. Mahinda, MIBP Ltd

Attendance Sheets

CONSULTANCY SERVICES FOR DEVELOPMENT OF AN INTEGRATED WATER AND IRRIGATION MASTER PLAN FOR MURANG'A COUNTY

MEETING HELD ON 28th FEBRUARY 2018 AT MURANG'A COUNTY GOVERNMENT OFFICES

SESSION ATTENDANCE RECORD

	NAME	ORGANISATION & DESIGNATION	PHONE No.	E-mail Address
1	KHADERI THUKU	COUNTY WATER OFFICER MURANGA COUNTY	0720627123	wanderi-pithon @ gmail. com.
2	Samuel Mungai	P.A CEC WATER	0726803826	gfm8247@gmail.com
3	Eng J.K. RUTERE	NCT1 - IPE CHAIRMAN.	0724609355	
4	IOANNIS KARAVOKYRI	IPE of NCT-1	+306945592383	ik@gk-consultants.gr
5	Dr. Angela Muvenda	NCT1 - IPE Environmental Expert	0722768525	andutsma@gmail.com
6	Eng KIPRONO ROP	AWSB - PE	0729601237	rkiprono@awsboard.go.ke
7	Eunice Semutai'	AWSB - Environmental Officer	0721772120	esemutai@awsboard.go.ke
8	Eng. Eric I. Muriithi	MIBP - Consultants	0722675385	emuriithi@mibpp.com
9	Eng R.S. RUPRA	MIBP - Consultants	0722875061	rsrupra@mibpp.com
10	Nicholas Mahinda	MIBP - Consultants	0725364437	nickiemahinda@gmail.com
11	Samuel Ngungi			gfm8247@gmail.com
12				
13				wanderi.pithon @ gmail.com
14				
15				

Workshop at Inception Stage

DEVELOPMENT OF AN INTEGRATED WATER AND IRRIGATION MASTER PLAN FOR MURANG'A COUNTY

MINUTES OF INCEPTION WORKSHOP HELD ON 6TH JUNE 2018 AT GOLDEN BREEZE PALM HOTEL – KENOL TOWN

PRESENT:

	NAME		ORGANIZATION
1.	Eng. Rop Kiprono	-	Athi Water Services Board (AWSB)
2.	Keziah Adhiambo	-	AWSB
3.	Lawal Kaleef	-	AWSB
4.	Eunice Jemutai	-	AWSB
5.	Collins K. Ngetich	-	AWSB
6.	Samuel Odhiambo	-	AWSB
7.	Hon. Peter K. Kihara	-	Member of Parliament Mathioya Constituency
8.	Hon. Mary Njoroge	-	Member of Parliament Maragua Constituency
9.	Hon. C. Muturi Kigano	-	Member of Parliament Kangema Constituency
10.	Jane Kamande	-	Hon. Sabina Chege's Office
11.	Stanely Karanja	-	Hon. Sabina Chege's Office
12.	Kimani Ndegwa	-	Maragua Constituency Office
13.	Jamleck Njoroge	-	Kigumo Constituency Office
14.	Isaac Chugu Mugan	-	Kigumo Constituency Office
15.	Mr. Mbote	-	Murang'a County Government
16.	Samuel Kariuki	-	Murang'a County Government
17.	Eng. Daniel Nganga	-	Managing Director – Murang'a Water and Sanitation Company
18.	Pauline Mathenge	-	Murang'a South Water and Sanitation Company
19.	Liikeri Njoroge	-	Managing Director – Gatanga Community Scheme
20.	Charles Muriuki	-	Gatamathi Water and Sanitation Company
21.	Marygoret Chira	-	General Manager - Kahuti Water and Sanitation Company
22.	Irene K. Ndavi	-	Tana and Athi Rivers Development Authority (TARDA)
23.	Eng. Henry Maina	-	TARDA
24.	Eng. Gicheru	-	National Irrigation Board (NIB)
25.	Bii Ernest	-	Kenya Tea Development Agency (KTDA)
26.	David Migoti	-	Kakuzi Ltd
27.	Obed Kariuki	-	Kenya Electricity Generating Company Limited (KENGEN)
28.	Edna C. Njeri Mwangi	-	National Environment Management Authority (NEMA)
29.	Daniel Mbugua	-	Del Monte Ltd
30.	Eng. R. S. Rupra	-	Mangat I.B Patel Consulting Engineers (MIBP) – Consultant
31.	Eng. E. I. Murithii	-	MIBP
32.	Nicholas Mahinda	-	MIBP
33.	Amos Karuge	-	MIBP
34.	Eng. Steven Ojiambo	-	MIBP
35.	Dr. Zacharia Kuria	-	MIBP

Signed Attendance Sheets are given in **Annex 1**.

The following Agenda was adopted for the Inception Workshop:

1. Opening Prayer and Introduction
2. Opening Remarks
3. Consultant's Presentation
4. Question and Answer Session
5. Way Forward and Closing of the Workshop

Item	Minutes	Action By:
1.	**Opening Prayer and Introduction** • The Meeting officially started at 10:45am with an opening prayer from one of the participants. • Eng. Rop Kiprono, AWSB, officially opened the meeting which was followed by self-introductions by all Participants. He welcomed all and invited all to participate and give their views freely after the presentation by the Consultant.	
2.	**Remarks by Hon. Mary Njoroge, MP for Maragua Constituency** • Hon. Mary Njoroge conveyed apologies from the Member of Parliament for Mathioya Constituency, Hon Peter Kihara who had arrived early for the Workshop but had to leave for other engagements. • She pointed out that communication to the Stakeholders for future meetings should be improved since not all stakeholders received the invitations and those who received the invitation, did not receive them on time. • She was grateful to AWSB for initiating the Preparation of Water and Irrigation Master Plan for Murang'a County since most of residents have no access to clean, safe and affordable water yet the County is the major source of water to Nairobi County. • She expressed her preference that the whole of Murang'a County should be under jurisdiction of AWSB unlike in the current situation where only Gatanga is under AWSB and the rest of the County under Tana Water Services Board (TWSB). • She also insisted that Murang'a County being the main source of water to Nairobi County, should benefit from the resource first before sharing with other Counties. • She expressed concern at delays in completion of various ongoing projects and requested AWSB to distribute award of works contracts amongst a larger number of contractors rather than just a few contractors so as to avoid delays in the implementation of the projects.	**AWSB**

Item	Minutes	Action By:
3.	**Remarks by AWSB** • AWSB Representative Eng. Rop Kiprono apologized for the delay in sending out invitations to the Workshop and promised to improve on future communication to stakeholders including invitations to meetings. • AWSB Representative assured the participants that all issues raised will be considered in the study and further Consultations with various Stakeholders will be carried to ensure their full participation. • AWSB Representative then invited the Consultant to make his presentation on the ongoing preparation of Water & Irrigation Master Plan for Murang'a County.	
4.	**Consultant's Presentation** The Consultant made a power point presentation which included presentation of the Inception Report and the current progress of the Study together with preliminary findings. A copy of the Presentation is attached in **Annex 2.0** of these Minutes. Photographs taken during the Workshop are attached in **Annex 3.0** of these Minutes. The presentation was made in the following eight sections: • Objectives, Deliverables and Area of Coverage of the Assignment • Data Collection and Review • Population and Water Demand Assessment (Domestic / Institutional / Commercial / Industrial / Livestock / UfW) • Surface Water Resources Assessment • Ground Water Resources Assessment • Irrigation Potential and Irrigation Water Demand • Updated Schedule of Deliverables • Formation of Technical Committee Highlights of the Presentation are given below. **i) Objectives, Deliverables and Area of Coverage of the Assignment** The Consultant highlighted the main Objective of the Assignment which is to develop a robust and flexible Water Resources Development Strategy that ensures security of supply to Murang'a County and meets the expected growth in water Demand for Domestic and Irrigation use over the 25-year horizon up to year 2042. The Consultant presented the various Deliverables under the Assignment which are as follows:	

Item	Minutes	Action By:

No.	Deliverable
D1	Inception Report
D2	Water Resources Options Report
D3	Overall Water Resources Development Strategy
D4	Water Resources Development Stage 1 (5 Years) Works Pre-Design
D5	Strategic Environmental and Social Impact Assessment (SESA)
D6	Draft Integrated Water and Irrigation Development Master Plan
D7	Final Integrated Water and Irrigation Development Master Plan

The Consultant explained that from the Terms of Reference from AWSB, the Area of Coverage is the whole of Murang'a County covering an Area of **2,558.8Km^2** which fall under the following Water Services Providers; Murang'a Water and Sanitation Company (MUWASCO), Murang'a South Water and Sanitation Company (MUSWASCO), Gatamathi Water and Sanitation Company, Kahuti Water and Sanitation Company and Gatanga Community Scheme.

The Consultant gave a highlight of the Existing Capacities from the WSPs which are as follows:

MUWASCO – 15,000m^3/day.
MUSWASCO – 25,000m^3/day.
GATAWASCO – 8,640m^3/day.
KAWASCO – 20,000m^3/day.
Gatanga – 6,700m^3/day.

ii) Data Collection and Review

The Consultant pointed out that various data have been collected from previous and ongoing studies for review as follows.

- **Maps** – County Administrative Boundaries, WSPs Areas of Jurisdiction, Survey of Kenya Topographical Maps
- **Census Reports** - 1969, 1979, 1989, 1999 & 2009
- **County Integrated Development Plan** – data on existing infrastructure and social amenities e.g., schools, hospitals etc.
- **Hydrological Data** – Rainfall Data, River Gauging Station Data
- **Borehole Data -** for boreholes registered with Ministry of Water and WRA
- **Irrigation Data –** Agro Ecological Zoning, Soils Mapping, etc.
- **Previous Studies / Projects Reports –** e.g., Feasibility Study and Master Plan for Developing New Water Sources for Nairobi and Satellite Towns (Egis/MIBP 2012), Murang'a North and Murang'a South Bulk Water Supply Project Design Reports, etc.

Item	Minutes	Action By:

iii) Population and Water Demand Assessment (Domestic / Institutional / Commercial / Industrial / Livestock / UfW)

The Consultant pointed out that historical population trends for the County have been analyzed as is shown below.

Year	Area (km^2)	Population	Population Density (Persons/km^2)	Intercensal Population Growth Rate
1969	2,529	445,310	176	-
1979	2,476	648,333	261	3.82%
1989	2,525	858,063	340	2.84%
1999	2,530	910,943	360	0.59%
2009	2,477	942,581	380	0.34%

The Consultant explained that the Study Area has been categorized into Urban Areas and Rural Areas. There are six urban centres in the County: Murang'a Town, Kenol/Makuyu Town, Maragua Town, Kabati urban centre, Kangari Urban centre and Kiria-ini urban centre.

The adopted Population Projection Rates for the different urban areas and rural areas are shown below.

Area	2009-2018	2019-2022	2023-2027	2028-2032	2033-2037	2038-2042
Murang'a Township	3.0%	2.5%	2.3%	2.0%	1.8%	1.5%
Maragua Town	2.0%	1.8%	1.6%	1.5%	1.3%	1.1%
Makuyu/Kenol Town	7.0%	5.5%	5.0%	4.0%	3.0%	2.5%
Kabati Urban Centre	2.0%	1.8%	1.5%	1.3%	1.2%	1.0%
Kangari Urban Centre	1.5%	1.3%	1.2%	1.0%	0.9%	0.8%
Kiria-ini Urban Centre	1.5%	1.3%	1.2%	1.0%	0.9%	0.8%
Other Areas	0.4%	0.27%	0.27%	0.27%	0.27%	0.27%

Preliminary population projections based on the adopted projection rates are shown below.

Area	2018	2022	2027	2032	2037	2042
Murang'a Township	35,860	39,583	44,349	48,965	53,534	57,671
Maragua Town	17,323	18,604	20,141	21,697	23,145	24,446
Makuyu/Kenol Town	47,587	58,952	75,239	91,539	106,119	120,064
Kabati Urban Centre	3,738	4,015	4,325	4,614	4,897	5,147
Kangari Urban Centre	3,213	3,383	3,591	3,774	3,947	4,108
Biriyani Urban Centre	2,885	3,038	3,224	3,389	3,544	3,688
Total Urban Population	**110,606**	**127,575**	**150,869**	**173,978**	**195,186**	**215,124**
Rural Areas	894,715	904,417	916,693	929,135	941,746	954,529
Total Population	**1,005,321**	**1,031,992**	**1,067,562**	**1,103,113**	**1,136,932**	**1,169,653**

Item	Minutes	Action By:

The Overall Water Demand was classified and estimated in the following categories:

- Domestic Demand
- Institutional Demand (Educational, Health and Administrative Institutions)
- Commercial and Industrial Demand
- Livestock Demand
- Unaccounted for Water (UfW)

Preliminary Water Demand Projections are given below.

Category	Year					
	2018	**2022**	**2027**	**2032**	**2037**	**2042**
Domestic	67,652	72,375	74,834	79,048	83,128	87,147
Institutional	7,092	7,224	7,392	7,558	7,725	7,886
Livestock	9,451	9,553	9,683	9,814	9,947	10,082
Commercial & Industrial	4,260	4,306	4,365	4,400	4,484	4,545
Total	**88,455**	**93,458**	**96,274**	**100,820**	**105,284**	**109,660**

iv) Surface Water Resources Assessment

The Consultant explained that Surface Water Assessment will involve assessment of Yields Available from the major rivers in Run-of-River and Impoundment configurations and will be done as follows.

- **Assessment of Rainfall Data -** where data for 15Nr Rainfall Stations has been obtained. The data is being complemented with Satellite-derived data to update it to 2017
- **Assessment of River Discharge Data -** where Records of 15Nr River Gauging Stations (RGS) have been obtained. Rainfall-Runoff Model to complement the existing (RGS) data on-going
- **Assessment of Current Abstractions and the Compensation Flow Requirements -** Data on existing Abstraction Permits being obtained from Water Resources Authority (WRA)
- **Identification of potential Dam Sites -** 41Nr Dam Sites have been Identified at initial stage, where 13Nr of the 41Nr will have further assessment.
- **Assessment of the Sedimentation Impacts at the Dam Sites and Implications on the Design of Structures**
- **Assessment of Impact on Downstream Use including Hydropower Generation**
- **Water Balance Assessment**

v) Ground Water Resources Assessment

The Consultant explained that the main objective of Ground Water Resources Assessment is to Evaluate the Groundwater Potential of Murang'a County. This will be done in two phases as follows.

Item	Minutes	Action By:
	Phase 1 • Desk study and data acquisition phase – Review of existing data • Preparation of Borehole Database for Murang'a County • Data Compilation and Analysis in GIS Platform • Zonation of areas of high groundwater potential for detailed geophysical investigations **Phase 2** • Hydrogeological and Geophysical Investigations at pre-selected sites from Phase I • Analysis of Hydrogeological and Geophysical data • Compilation, Analysis and Evaluation of gathered data and information • Ground Water Modelling The Consultant highlighted that the preliminary findings of Ground Water Potential has been categorized in to three zones with the following characteristics. **Zone 1: High Ground Water Potential** • Assuming a borehole was drilled within this zone to a depth of 200m with a pump installed at 180m (i.e., leaving 20 m water column) whereas the water rest level is retained at average of 46.5 m. It then follows that a 133.5 m water column would be available for pumping. Using average drawdown (0.45 m), average yield of 19.2 m^3/hr and only 20 m of the available 133.5 m water column such a borehole has a potential yield of **768 m^3/hr,** which suggests very high groundwater potential. **Zone 2: Moderate Ground Water Potential** • Assuming the borehole was drilled within this zone to a depth of 200m with a pump installed at 180m (i.e., leaving 20 m water column) whereas the water rest level is retained at 17.2m. It then follows that a 162.5m water column would be available for pumping. Using average drawdown (4.95 m), average yield of 30.68 m3/hr and only 20 m of the available 162.5m such a borehole has a potential yield of 123.95 m3/hr, which though moderate for this area connotes a high groundwater potential for volcanic terrains. **Zone 3: Low Ground Water Potential** • Assuming the borehole was drilled within this zone to a depth of 200m (to account for boreholes within the fault zone) with a pump installed at 180 m (i.e., leaving 20 m water column whereas the water rest level is retained at 24.9 m. It then follows that a 155.1 m water column would be available for pumping. Using average drawdown (52.9 m), average yield of 5.2 m^3/hr and drawdown of 100m such a borehole has a	

Item	Minutes	Action By:

potential yield of **9.82 m^3/hr**, which is considerably low for any large-scale groundwater development.

vi) Irrigation Potential and Irrigation Water Demand

The Consultant explained that the main Objective was to determine the Irrigation Potential and Irrigation Water Demand for the Study Area.

Methodology will be based on soil assessment of the study Area, GIS analysis of the Ecological Zones, slopes, land use and 1.5km from riverbanks, where provisional land suitable for irrigation will be calculated. Through net irrigation water requirements for crops and water resources for agriculture, a physical irrigation potential for the study area will be obtained.

The Consultant gave the preliminary findings as follows.

- Irrigable land in year 2042 is 93,800ha
- Annual Irrigation Water Demand (Year 2042) is 37Mm^3 Equivalent to 101,370m^3/day

The Consultant explained that development strategy of the 93,800ha available will be done in the next stage of the study.

vii) Updated Schedule of Deliverables

The Consultant presented the updated working schedule of the Deliverables under the assignment as follows.

No.	Deliverable	Target Submission Date
D1	Inception Report	21-Mar-18
D2	Water Resources Options Report	15-Jun-18
D3	Overall Water Resources Development Strategy	15-Jul-18
D4	Water Resources Development Stage 1 (5 Years) Works Pre-Design	15-Aug-18
D5	Strategic Environmental and Social Impact Assessment (SESA)	15-Sep-18
D6	Draft Integrated Water and Irrigation Development Master Plan	15-Sep-18
D7	Final Integrated Water and Irrigation Development Master Plan	15-Oct-18

viii) Formation of Technical Committee

This is discussed in section **4.0** of these Minutes

Item	Minutes	Action By:
5.	**Question and Answer Session**	

	Question/Comment	Response
Q1	Eng. Ng'ang'a, Managing Director Murang'a Water and Sanitation Company (MUWASCO), pointed out some clarifications on the Consultant's Presentation as follows: • Production Capacity is 15,000m^3/day not 19,000m^3/day • UfW is 28% not 45% • Supply Area is 90% not 70%	***The Consultant noted the clarifications regarding production capacity, UfW and he Supply Area.***
	He sought clarification on whether the Study will address the issue of high UfW experienced in the various Water Service Providers. He enquired whether the Study would address the issue of Sanitation which is now a priority in Towns like Murang'a.	***AWSB responded that the scope of the Study does not cover the issues of UfW and Sanitation, but they will be addressed in a separate Study.***
	He suggested that dams be proposed in the upstream of Maragua and Mathioya so as to have a big command area by gravity.	***The Consultant clarified that the proposed dam sites are not final but further assessment will be done to come up with the most suitable dam locations and their Development strategies.***
Q2	Charles Muriuki, General Manager Gatamathi Water and Sanitation Company (GATAWASCO), suggested that the Consultant presents the Administrative Units in Sub-County and Constituencies Level rather than Districts.	***Consultant noted the comment and said that it will be effected in the future presentations.***
Q3	Eng. Gicheru, National Irrigation Board (NIB) sought clarification on the amount of water per day for Irrigation.	***The Consultant responded by stating that the preliminary estimates for irrigation water demand is 101,370m^3/day in the year 2042.***
Q4	David Migoti from Kakuzi sought clarification on whether the existing dams and water pans especially in Kenol and Makuyu area will be rehabilitated.	***The Consultant responded that all existing Dams have been identified. However, considering the Demand bigger dams than those existing are required.***
Q5	Irene Ndavi, TARDA, reported to the meeting that there is an on-going study on Irrigation on 5,000 ha in lower part of Murang'a County and promised to share the findings with the Consultant. Eng. Maina, TARDA added that the Inception Report and Feasibility Report have been prepared but the Study stalled due to lack of funds. He also reported that from the Study 6000 ha had the potential for irrigation but due to water scarcity, only 3000 ha can be irrigated. He appreciated the Consultant's idea of Storage which is critical in the County. He also wanted to know the Consultant's work plan.	***The Consultant appreciated the information about the other on-going Study and requested for the reports so as to incorporate the findings from the 5,000ha Study into this Study.*** ***The Consultant further stated that literature review for relevant studies is still in progress and requested for any additional information that may be available.*** ***The Consultant presented to the participants the Work Plan.***

Item	Minutes			Action By:
		Question/Comment	**Response**	
	Q6	Mr Bii Ernest from KTDA sought clarification on whether the Consultant has considered climate change in the estimation of Irrigation Demand. He also sought clarification on whether Tea has been considered for Irrigation as a result of climate change experienced.	***The Consultant responded that Tea has not been considered in the Irrigation Water Demand since it falls in the high rainfall area. However due to the climate change, viability of irrigating Tea will be considered.***	
	Q7	Daniel Mbugua, Del Monte, sought clarification whether the existing plantations are being considered for irrigation Water Demand. He also commented that the Consultants Preliminary figure of 37Mm^3 presented as Irrigation Demand for Year 2037 seems to be low judging from experience he has on irrigation.	***The Consultant responded that the Irrigation Water Demand for the plantations has not been considered but will be considered in the next step of the Study.*** ***Regarding the preliminary irrigation Water Demand Estimate, it was pointed out that detailed criteria and basis will be given in the next Consultant's Report and Presentation of Water Resources Option Report***	
	Q8	Managing Director, Gatanga Community Water Scheme pointed out that Dams proposed along Chania River will benefit Kiambu County rather than Murang'a County.	***The Consultant responded that the proposals for dam locations are still in the preliminary stages and the final selection of dam sites will be done in the next phase of assessment including the service area of each Dam.***	
	Q9	Samuel Kariuki of the Murang'a County Government brought to attention of the meeting that there are similar studies been undertaken by the County and the findings should be incorporated in the Study. He also sought clarification on the interaction/ liaison between AWSB and Murang'a County Government regarding the ongoing Mater Plan.	***AWSB Representative responded that there have been efforts to communicate with Murang'a County Government, but no information has been forthcoming so far. He requested the County Representative to avail any available information on previous and on-going studies.*** ***AWSB stated that the Technical Committee that will be formed will improve the liaison between the stakeholders.***	
6.	**Formation of the Technical Committee** AWSB Representative brought to the attention of Stakeholders present that the Terms of Reference for this study require the formation of a Technical committee and the study being at critical stage it should be formed as soon as possible. It was suggested the Technical Committee be composed of representatives of: • Ministry of Water and Sanitation (MWS) - Chair • National Irrigation Board (NIB) • Water Resources Authority (WRA) • Athi Water Services Board (AWSB) - Secretary • Tana Water Services Board (TWSB) • Murang'a County Government • National Environmental Management Authority (NEMA) • Water Resources Users Association (WRUAs) • Ministry of Energy / Kengen • Water Services Providers (WSPs) • TARDA • Plantations (Del Monte Ltd, Kakuzi Ltd, etc.			

Item	Minutes	Action By:
	• Consultant AWSB told the meeting that they will formally write to the proposed member institutions to nominate their representatives after which after there will be another forum organized for the Technical Committee.	AWSB
7.	**Remarks by Hon. Muturi Kigano, Member of Parliament Kangema Constituency.** • Hon. Muturi Kigano pointed out that the notification for the meeting was short and suggested that it should be done earlier so as to involve all the Stakeholders and also the participation of all MPs. He assured the meeting that the Study has the support of all the MPs in the County. • He commended AWSB for initiating the study including Irrigation component stating that irrigation is key for food security in the County and also in Kenya. • He thanked all the participants and also for the chance given to make his remarks.	
8.	**Closing of the Workshop** There being no other business, the Workshop was closed at 1.30 pm.	

Minutes by:
N. Mahinda, MIBP Ltd

Signed Attendance Sheets

DEVELOPMENT OF AN INTEGRATED WATER AND IRRIGATION MASTERPLAN FOR MURANGA COUNTY

INCEPTION REPORT WORKSHOP HELD ON 6TH JUNE 2018 AT GOLDEN PALM HOTEL

ATTENDANCE REGISTER

No.	NAME	ORGANIZATION	CONTACTS	SIGNATURE
1	ENG. STEVEN OJIAMBO	MIBP ENGINEERS	SOJIAMBO@GMAIL.COM	[signature]
2	Nicholas Mahinda	MIBP CONSULTING ENGINEER	nickiemahinda@gmail.com	[signature]
3	Amos Karuge	MIBP ENGINEERS	akaruge@gmail.com	[signature]
4	A. ZACHARIA KURIA	MIBP CONSULTING ENGINEERS	Kuria2aacc@yahoo.com	[signature]
5	LIKERI NJOROGE	MURANGA WATER	gatawa@yahoo.com	[signature]
6	DAVID MIGOT	KAKUZI PLC	dmigot@kakuzi.co.ke	[signature]
7	Obed Konuki	Kerucien	okonuki@kerugen.co.ke	[signature]
8	Eng R.S. RUPRA	MIBP - consulting Eng	rsrupra@mibpp.com	[signature]
9	Eng. E.I. Murithi	MIBP	emurithi@mibpp.com	[signature]
10	Bii Ernest	KTDA-R-1	ebii@ktdateas.com	[signature]
11	Eng. Daniel Ngang'a	MUWASCO	kimahmahe@gmail.com	[signature]
12	ENG. Gichera	NIB	gicherukuria@yahoo.	[signature]
13	MARYGORET CHIRA	KAHUTI WATER & SANITATION CO.	cmarygoret@yahoo.com	[signature]
14	Stanley Karanja	HON SABINA CHEGE'S OFFICE	stano@gmail.com	[signature]
15	Samuel Odhiambo	Athi Water Services Board	sodhiambo@awsboard.go.ke	[signature]
19	Hon. Peter K. Kimani	M.C Mathioya	KimaniKihara@gmail.com	[signature]
20	JANE KAMANDE	HON SABINAS OFFICE	Janeeka940@gmail.co	[signature]

ATHI WATER

DEVELOPMENT OF AN INTEGRATED WATER AND IRRIGATION MASTERPLAN FOR MURANGA COUNTY

INCEPTION REPORT WORKSHOP HELD ON 6TH JUNE 2018 AT GOLDEN PALM HOTEL

ATTENDANCE REGISTER

No.	NAME	ORGANIZATION	CONTACTS	SIGNATURE
21	Pauline Mathenge	MWSWASCO	0729676403	
22	Daniel Mbugua	Del Monte	0724712202	
23	Eng Calmo	MWSB	0729601237	
24	IRENE K. NJAVI	TARDA	0722537828	
25	ENG. HENRY MAINA	TARDA	0722 297351	
26	Kimani Ndegwa	Maragua Constituency Office	0722102299	
27	Charles Muriuki	Gatamathi Water	0725382238	
28	EDNA C. NJERI MWANGI	NEMA	0708 925 836	
29	Collins Kiprono Ngetich	AWSB	0717734328	
30	Eunice Samurai	AWSB	0721772120	
31	CLLR MBOTE	MURANGA COUNTY LOVERNMENT	0726955517	
32	Samuel Kamuki	" " "	0720803325	
33	Irene Chege Mugo	Kigumo Constituency	0729501267	
34	Keziah Athiambo	AWSB	0720352697	
35	Lawal Kaleef	Athi water	0703657454 7	
36	Jamleck Njoroge	Kigumo Constituency	0722739425	
37	Hon C Muturi	Kigumo	0722860020	

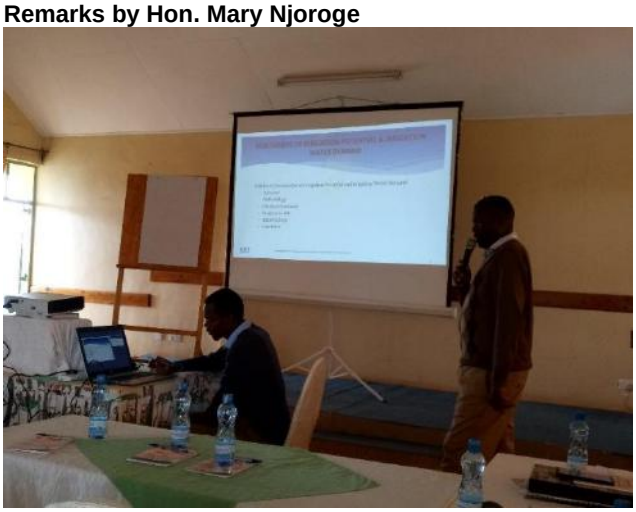
Consultant's Presentation

Session Photographs

AWSB Representative Opening the Meeting

Remarks by Hon. Mary Njoroge

Consultants Presentation



Consultants Presentation

Some of the Stakeholders present at the Workshop

Question and Answer session

Question and Answers session

Remarks by Hon. Muturi Kigano

Stakeholder Consultations at SESA Stage outcome of Key Informant Interviews

Key Informants Interviews at SESA Assessment

Name/Position	Date of Consultation	Discussions
KWS consultations	20th June 2019	KWS has established an effective system that allow for inter institutional collaboration in wildlife management and conservation, such institutions include National Management and Coordination Act (NEMA), Water Resources Management Authority (WRMA), Kenya Forest Service (KFS) and various state committees including County Environment Committee, County Lands Committee, County Wildlife Conservation and Management Committee as detailed below. Critical areas of concern will be interaction of the proposed projects (intake works and raw water transmission lines) with already mapped out wildlife migration corridor. Also, project interaction with wildlife species listed under IUCN red list protected by CITES such as elephants and black rhinos
WRA Consultations (at Head Office)	13th June 2019	• The project must ensure that environment flow releases (EFR) are maintained throughout for all the identified rivers. • EFR is crucial for sustaining downstream ecosystems including human population who depend on the rivers downs stream • Ensure all works are comply to Water Regulations which require water abstraction permits are granted prior to construction of such works
Gatanga Community Water	18th June 2019	• The interview was responded to by the MD of the WSP, On the irrigation schemes and areas being chosen, he raised concerns about conflicts that might arise if the process isn't clearly carried out. • The consultant advised that the process would be all inclusive and that all the farmers and landowners would be consulted before the process commences. • In one of the proposed dams, he said he would prefer if its solely used for domestic purposes instead of irrigation due to contamination of the water during irrigation • Lastly, he also advised that Athi Water Services Board should focus more on helping the Water Service Providers to deal with non-revenue water resulting from dilapidated transmission and distribution mains.
Kenya Forest Services – Gatare Station	22nd June 2019	• The interview was responded to by Head of KFS Gatare Stations. • Keys concerns were that the Plan should be implemented harmoniously as provided by the Forest Conservation and Management Act 2016. • That forest consents should be acquired prior to undertaking any works within the forest, such works include intake weirs or raw water mains • Locations of Water Treatment Plant at the edge of the forest within Nyayo tea zone land should be approved by KFS since the Land belongs to KFS and not Nyayo tea Zone. • The current moratorium within gazette forest is still in force.

Name/Position	Date of Consultation	Discussions
County Chief Officer Water and Irrigation	19th June 2019	• Mr. Josephat Rukenya- He also welcomed the team to Murang'a County, and that his office would provide all the necessary information needed. • The Chief Officer appreciated all the proposed projects that would help the county in getting to supply its people with treated water for domestic used and also water for irrigation. • He proposed that the small capacity dams be given priority due to cost and time of completion. • In relation to that, he also added some locations that he thought would be appropriate to be studied for a dam location. These was in Mathioya and Maishathe • He also raised the issue of motorcycle riders causing problems in the area and that maybe the works to be provided by the dam would help out. • Further consultations with the relevant stakeholders would be needed in future so as to ensure that no one is left out by the process.

APPENDIX 4

EIA / EA Practicing License

FORM 7 (r.15(2))

nema
mazingira yetu | uhai wetu | wajibu wetu

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/13777

Application Reference No: NEMA/EIA/EL/18256

M/S **GODWIN LIDAHULI SAKWA**
(individual or firm) of address

P.O. Box 18075-00500, NAIROBI

is licensed to practice in the

capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert**
registration number **2492**

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

Issued Date: **1/20/2021** Expiry Date: **12/31/2021**

Signature.....

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001: 2008 Certified


EIK Environment INSTITUTE OF KENYA

Certificate of Membership

This is to certify that

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An Institute Founded in the year 2014 to extend and disseminate

Environmental knowledge and promote the

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INSTITUTE OF KENYA ENVIRONMENT

Herbert Tama Mwachiro
Chairman

12/01/2021
Date

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