REPUBLIC OF KENYA

Kenya National Highways Authority

Quality Highways, Better Connections

CONSULTANCY SERVICES FOR FEASIBILITY STUDY, ENVIRONMENTAL AND SOCIAL IMPACT STUDY, PRELIMINARY AND DETAILED ENGINEERING DESIGN FOR DUALLING OFMUTHAIGA – KIAMBU – NDUMBERI ROAD (B32) CONTRACT NO. KENHA/CS/HPD/2611/2018)

Ridgeways commercial Centre

Karura Forest Headquarters - Km1+270

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

STUDY REPORT

SUBMITTED BY:
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APRIL 2020

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EXECUTIVE SUMMARY

Background of the project

The Government of Kenya through the Kenya National Highways Authority KeNHA has proposed development of Muthaiga-Kiambu-Ndumberi Rd (B32) into a dual carriage (B52/C558). The road commences at Pangani and Muthaiga interchanges along Thika road and proceeds through Kiambu town ending at Ndumberi. The road covers 25 Kms which includes by-passes, loops and accesses. Major loop roads within townships or market centres, potential bypasses and interchanges have been factored along the road.

The ESIA for the proposed project was undertaken simultaneously with the feasibility study before project implementation. Environmental and social impacts were identified and mitigation measures for anticipated impacts were proposed. The project road is in Nairobi and Kiambu counties and specifically North of Nairobi and South of Kiambu respectively. Nairobi County has a cool climate resulting from its high altitude. The mean annual rainfall is 786.5 mm while Kiambu County experiences bi-modal type of rainfall.

The rocks of the Nairobi area mainly comprise a succession of lavas and pyroclastic of Cainozoic age overlying a foundation of folded Precambrian schists and gneisses of the Mozambique Belt. There are several rivers and perennial streams crossing the road such as Gitathuru, Karura, Ruaka, Kigwa, Gatharaini and Riara. The socio-economic settings have several businesses such as; shopping Malls, car yards, petrol stations, restaurants and hotels, kiosks, churches, flower vendors, agricultural produce markets.

Brief project description

The project road is located in Nairobi and Kiambu Counties of Kenya. The total road length measures approximately 25km (including bypasses, loops and accesses). The main road alignment commences at Pangani and Muthaiga Interchanges along Thika Road (A2) and proceeds through Kiambu ending at Ndumberi. There are two proposed Bypass Roads as follows; the Eastern bypass- starts at Riabai on Kiambu - Ngewa (B30) Road while the Western bypass starts at Ndumberi Githunguri (C210) Road through

Sasini coffee estate and terminates at Kiriguini B on Ndumberi - Githunguri (C210) Road. The design of a spur road connecting Muthaiga -Kiambu -Ndumberi (B32) Road at KIST to Kamiti Kiambu Road is part of the project.

Purpose and objectives of the project

The purpose was to ensure that the above project once constructed will ease the traffic congestion along the road and other adjoining roads, improve the infrastructure for the two counties to spur economic growth, open up Kiambu County to peri urban status and ease movement of agricultural produce. The project road will be implemented in an environmentally and socially sustainable approach. KeNHA engaged the services of a competent Consultant to conduct an Environmental & Social Impact Assessment (ESIA) for the proposed project. The ESIA for the proposed project was undertaken simultaneously with the feasibility study before project implementation. Environmental and social impacts were identified and mitigation measures for anticipated impacts were proposed.

The prime objective of this Consultancy services was to carry out Feasibility Studies, Preliminary Environmental and Social Impact Study and Detailed Engineering Design of for the construction of Dualling of Muthaiga – Kiambu – Ndumberi (B32) Road.

Summary legislations Relevant to the Project

i. Environmental Management and Coordination Act (EMCA), 1999 and the subsequent regulations such as:-

- Environmental (Impact Assessment and Audit) Regulations, 2003 Legal Notice No. 101.
- The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121.
- The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120.
- The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61
- The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160

- The Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations, 2006 Legal Notice No. 131
- The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73.
- The Forests Act, 2005
- Forest Conservation and Management Act, 2016.
- The Water Act, 2016
- Land Act No. 6 OF 2012 (Revised, 2016)
- Traffic Act, 2016
- Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971
- Occupational Safety and Health Act, 2007
- Any other relevant documents

Brief description of Environmental and Socio-economic Baseline Conditions of the Project Area

The project road is in Nairobi and Kiambu counties and specifically North of Nairobi and South of Kiambu respectively. Nairobi County has a fairly cool climate resulting from its high altitude and it experiences bi-modal type of rainfall. The mean annual rainfall is 786.5 mm. The rocks of Nairobi area mainly comprise a succession of lavas and pyroclastic of Cainozoic age overlying a foundation of folded Precambrian schists and gneisses of the Mozambique Belt. For the period between late Precambrian and Tertiary times no geological record exists in central Kenya except that the area is known to have undergone pen planation on more than one occasion. The project road traverses a series of trachyte and tuff rock rheology that encompass light-coloured, very fine-grained extrusive igneous rock that is composed chiefly of alkali feldspar with minor amounts of dark-coloured minerals such as biotite, amphibole, or pyroxene. The main soils types in Nairobi County are the gray clays, black clays, red clays, reddish brown clays and brown clays (Daniel Ichang'i). In addition, Kiambu County is covered by three broad categories of soils which are: high level upland soils, plateau soils and volcanic footbridges soils.

The current vegetation along the project corridor has a mix of both planted and indigenous trees with Karura forest having a pristine canopy of trees. Trees such as Eucalyptus, Grevilea, jacaranda trees, Lantana Camara, Persian lilac, Croton Megalocapus, pine, bamboo, Thika palm, Nandi flame, and Wild strawberries are also visible. Other vegetation types include Napier grass, coffee, and crops such as arrow roots, maize, bananas, and horticultural produce. There are several flower nurseries. The rivers crossing the project road are Gitathuru, Karura, Rui-ruaka, Kigwa, Gatharaini and Riara. The vegetation growing along the riparian zone are grasses, sedges, and rushes.

The socio-economic settings is characterised by businesses such as, shopping Malls, car yards, petrol stations, restaurants and hotels, kiosks, churches, flower vendors, agricultural produce markets etc.

Brief description of the anticipated environmental and socio-economic impacts and proposed mitigation measures

The findings of the Environmental Impact Assessment show that the proposed Muthaiga-Kiambu-Ndumberi road has positive impacts that outweigh the potential negative impacts. Some of the main positives impacts identified include; employment opportunities improved standards of living, security, access to schools and health facilities, aesthetics, ease traffic congestion and improve transport of goods and services, growth of towns and shopping centers along the project road among others.

Among the potential negative impacts identified are noise pollution, dust emissions, solid waste generation, increased water demand, increased energy consumption, generation of exhaust emissions, accidents and hazards during construction, possible exposure of workers to diseases and increased storm water drainage. Increased sedimentation in water resources such as Karura, Rwaka, Riara, Gatathuru, Kigwa and Gatharaini rivers will mainly be prevented by use of silt traps and locating stockpiles away from the rivers. Increased wildlife mortality especially primates will be mitigated by construction of monkey bridges at designated crossing points for monkeys and use of road signs and speed limits.

Other proposed mitigation measures include; planting of trees and vegetation to control soil erosion and improve visual aesthetics, use of Protective equipment/gears, training of construction workers on Environmental Health and Safety issues, create awareness on disease transmission such as HIV/AIDS and STI, traffic marshalls, use of signage and markings to avoid and minimize accidents, use water to control dust as well as improve diversions to motorable tracks. Riparian Zones will be preserved or have minimal disturbance to protect the aquatic ecosystem and reduce pollution into the rivers. With proper implementation of the provided mitigation measures, these impacts can be avoided and/or minimized. Due process of addressing the project affected persons through compensation will be followed.

Brief description of the alternatives and parameters considered in choosing the best alternative

The “No Project Alternative” assumes that the activity does not go ahead, implying a continuation of the current situation or the status quo. However, this was not

considered since the screening and scoping exercise indicated that there were more positive impacts and the negative impacts will be avoided, minimized or compensated. There were five alternative/routes to diffuse traffic and five bypass options which were considered. The selected route for the main project road from Muthaiga to Ndumberi follows the existing road alignment. However, preliminary route assessment done to identify possible Kiambu Town bypasses resulted to several proposals. On further assessment and restricting the length of the project road to 25kms as specified in the TOR, two road alignments were selected to serve as Kiambu Town bypasses.

Routes that would reasonably diffuse traffic and make travel through town centre less attractive were more favourable as bypasses. Existing road alignments were more favourable than new roads due to extents of land acquisition. Routes that passes through built up environment and have restricted road reserves were not economically feasible. The following were selected as the best alternatives.

- Eastern Bypass. a) Githunguri Road through Sasini Coffee Farm to Ndumberi-Limuru Road, b) Limuru Road- Sasini Coffee- Kiratina Road and c) Kiratina Road – Kanunga.
- Western Bypass- Riabai Road Junction-Kiriguini B Road Part of Kiambu Town Eastern Bypass
- KIST - Kamiti Road.
- Kirigiti Junction –Old Kiambu Road Section – A Link Road
- Boma/Kiambu Road Junction to Old Kiambu Road Link Road(spur)

Outcomes of public participation

Several issues were raised during the public participation process such as traffic congestion where it was felt that more lanes and bypasses should be used, diversions to be used to reduce accidents and traffic jams. The stakeholders suggested the design of the road to accommodate acceleration and deceleration lanes and pedestrian lanes. There was need for clarification as to whether sewer lines, storm water and surface run off, service lines were incorporated in the design. There was a proposal to include a monkey bridge between Karura Forest and the opposite side of the road. The recorded mortality of monkeys along Kiambu road for the last six years justifies the need of a monkey bridge to mitigate loss of the primates. The conservation of the riparian ecosystem was also raised and that Karura Forest should

not be acquired for the construction of the road. However, the sensitivity of the Directorate of Criminal Investigation (DCI) installations had to be considered in moving the road design towards Karura Forest. Several proposals of other feeder roads were raised such as Thindigua to Windsor Roundabout, Paradise Lost to Two rivers, Kugeria Mushroom, Edenville to Boma road, and several other loop roads within Kiambu town.

Other issues raised were that locals should be given priority in employment during construction of the road and that project affected persons should be compensated at the current rates and they should be given adequate notice to vacate affected areas. The issue of congestion at Pangani was raised and that trees and vegetation should be planted immediately to improve the visual and aesthetics of the road and to control soil erosion. Solid waste disposal and collection was also raised, and that solar power should be used for lighting. Participants were elated about the improvement of the road because it will ease congestion and accelerate development along the project route.

Monitoring plan

Environmental monitoring is an essential component of project implementation. An Environmental Social Management and Monitoring Plan (ESMMP) provides mechanism of monitoring environmental impacts of a project during its execution in order to reduce their negative effects and to introduce standards of good practice to be adopted for all project works. The EMP facilitates and ensures the follow-up of the implementation of the proposed mitigation measures proposed in the ESMMP. The parameters of the proposed dualing of Muthaiga-Kiambu-Ndumberi road project that were identified for monitoring include: water quality, air quality, solid waste generation, Occupational Health and Safety risks, wildlife/ human accidents, HIV/AIDS incidences and emerging diseases such as COVID 19, soil erosion, storm water drainage, livelihood and environmental risks.

Conclusions and recommendations

The findings of the Environmental and Social Impact Assessment show that the proposed Muthaiga-Kiambu-Ndumberi road has positive impacts that outweigh the potential negative impacts. Some of the main positives impacts identified include;

employment opportunities improved standards of living, security, access to schools and health facilities, aesthetics, ease traffic congestion and improve transport of goods and services, growth of towns along the project road among others. Among the potential negative impacts identified; noise pollution, dust emissions, solid waste generation, increased water demand, increased energy consumption, generation of exhaust emissions, accidents and hazards during construction and operation, possible exposure of workers to diseases, increased storm water among others which can however be sufficiently mitigated. Increased sedimentation in water resources such as Karura, Rwaka, Riara, Gatathuru, Kigwa and Gatharaini rivers will mainly be prevented by use of silt traps and locating stockpiles away from the rivers.

Increased wildlife mortality during construction and operation of the dualled road will be mitigated construction of monkey bridges, appropriate signage and speed limits as conservation areas of wildlife. With proper implementation of the provided mitigation measures, these impacts can be avoided or minimized. Due process of addressing the project affected persons through compensation will be followed. The proponent of the proposed project shall be committed to putting in place several measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project.

It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the Environmental Social Management and Monitoring Plan as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects in Kenya. There should emphasis to comply with the 10 Equator Principles and IFC World Bank Guidelines.

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ABBREVIATIONS

AASHTO American Association of State Highway and Transportation Officials

AADT Annual Average Daily Traffic

ACK Anglican Church of Kenya

AFDB African Development Bank Group

ASALS Arid and Semi-Arid Lands

BRT Bus Rapid Transport

CIDP County Integrated Development Plan

CSR Corporate Social Responsibility

CBO Community Based Organization

CBR California Bearing Ratio

CDF Constituency Development Fund

CEDAW Convention on Elimination of all forms of Discrimination against Women

CEC County Executive Committee

CFA Community Forest Association

CFC Chlorofluorocarbons

CFU Colony-forming Unit

DDV Daily Design Volume

DHV Design Hourly Volume

DTM Digital Terrain Model

DOD Department of Defense

EC Electrical Conductivity

E coli	Escherichia coli
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ERP	Emergency Response Plan
ESMS	Environmental and Social Management Systems
FKF	Friends of Karura Forest
GHG	Green House Gases
GII	Gender Inequality Index
HIV	Human Immunodeficiency Virus
IFC	International Fund Corporation
ILO	International Labour Organization
ISD	Intermediate Sight Distance
KeNHA	Kenya National Highways Authority
KDF	Kenya Defence Forces
KFS	Kenya Forestry Service
KIST	Kiambu Institute of Science and Technology
KIWASCO	Kiambu Water and Sewerage Works Company
LATF	Local Authority Transfer Funds
LHS	Left Hand Side
MTP	Medium Term Plan

NEMA National Environmental Management Authority

NIS National Intelligence Service

NMT Non-Motorized Transport

NTU Nephelometric Turbidity Units

OCS Officer Commanding Station

OCPD Officer Commanding Police Division

OSHA Occupational Safety and Health Act

PAPs Project Affected Persons

PCU Passenger Car unit

pH Potential of Hydrogen

PPEs Personal Protective Equipment's

PPM Public Participation Meeting

PPP Public Private Partnership

PWDs Persons with Disabilities

RAP Resettlement Action Plan

RHS Right Hand Side

RTI Respiratory Tract Infections

3Rs Reduce, Recycle, Reuse

SDG Sustainable Development Goals

SACCO Savings and Credit Cooperative

STDs Sexually Transmitted Diseases

SSD Stopping Sight Distance

SSWP	Safe System of Works
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UNFCC	United Nations Framework on Convention on Climate Change
WIBA	Work Injury Benefits Act
WHO	World Health Organization
WRA	Water Resource Authority
WSP	Water Service Providers
WWTW	Waste Water Treatment Works

CHAPTER ONE: INTRODUCTION

1.0 Introduction

The dualling of Muthaiga-Kiambu-Ndumberi road (B32) will have several benefits to the immediate users and the wider community of Nairobi and Kiambu Counties. The traffic snarl ups that have been experienced for a long time, the lost man hours, the high fuel costs, Green House Gas (GHG) emissions and the spill over of vehicles to other roads are some of the main problems experienced by the road users. There are positive and negative impacts that will occur during the road construction and commissioning.

However, the positive impacts such as easy transportation, increased property, and land values, employment opportunities, community development, and economic improvement among others will be enhanced. Additionally, the negative impacts such as air and noise pollution, essential services disconnection, loss of land, demolition of structures, deforestation or loss of tree and vegetation coverage, interruptions to vehicular and pedestrian movement among others will be mitigated through avoidance, minimization of the impacts or through compensation. The project affected persons (PAPs) will be compensated as per the National Land Commission regulations. The stakeholders have high anticipation of using the newly improved highway.

1.1 Road Developer

1.1.1 Physical Address

Client	Consultant
Kenya National Highways Authority, Barabara Plaza, Jomo Kenyatta International Airport, off Mazao Road, P. O. Box 49712-00100, Nairobi, Kenya	APEC Consortium Ltd in Jv with Span Engineers, Mapera Court. Langata Road P.O. Box 3786-00100 Nairobi, Kenya

1.2 Project Location

The project road is located in Nairobi and Kiambu Counties of Kenya. It measures approximately 25 (including bypasses, loops and accesses) kilometres and commences at Pangani and Muthaiga Interchanges along Thika road and proceeds through Kiambu ending at Ndumberi. The study incorporated design for all access roads to Government institutions including but not limited to schools, colleges, District headquarters and other Government offices. Major loop roads within townships or market centres and potential bypasses along the road were also included. Design of bypass roads for Kiambu town was undertaken. Also, the design of interchanges was incorporated where necessary. The socio-economic settings indicated several businesses such as shopping Malls, car yards, petrol stations, restaurants and hotels, kiosks, churches, flower vendors, agricultural produce markets etc.

The residential estates along the project road include Muthaiga North, Ridgeways, Horse Shoe, Runda Evergreen, Fourways, Runda Palms, Runda Paradise, Runda Gardens, Paradise Lost, Mhasibu SACCO, Mbugua Kibathi, Kencom Estate, Edenville and other planned estates. Other facilities are; Brook house Schools, Sabis International School, Regis, St. Mary's Girls Schhol, Wadi Degla Sports Club, Our Lady of Rosary Catholic Church, PCEA Evergreen and Kasarini Churches, Elysia Hotel, Kigwa Conference Center and Ridgeview Gardens.

1.3 Project Background, Overview, Justification and Objectives

1.3.1 Project Background

The Government of Kenya through the Kenya National Highways Authority KeNHA has proposed the development of Muthaiga-Kiambu-Ndumberi Rd (B32) into a dual carriage (B52/C558). The road commences at Pangani and Muthaiga interchanges along Thika road and proceeds through Kiambu town ending at Ndumberi. The traffic flow profiles revealed that hourly traffic flows peak between 1600 – 1700 hrs with the highest two directional hourly flow of about 1,824 vehicles being recorded along the Thika Road – Northern Bypass section. The lowest two directional hourly traffic flows were recorded between 0600 – 0700 hrs along the Kiambu Town - Ndumberi Town section recording about 172 vehicles per hour.

1.3.2. Overview of the Project

The project road is located in Nairobi and Kiambu Counties of Kenya (Fig.1). The total road length measures approximately 25km which includes passes, loops and accesses. The main road alignment commences at Pangani and Muthaiga interchanges along Thika Road (A2) and proceeds through Kiambu ending at Ndumberi. The design has incorporated design for all access roads to Government institutions including but not limited to schools, colleges, District headquarters and other Government offices. Major loop roads within townships or market centers and potential bypasses along the road have been included. Design of bypass roads for Kiambu town is mandatory and has been included to ease congestion in Kiambu town. Furthermore, design of interchanges where necessary has been factored in the design.

The road traverses an urban and peri-urban development set up which is densely populated. It however passes through an ecologically salient Karura Forest and serves important installations, institutions and developments including Muthaiga Golf Club, National Intelligence Service (NIS), Directorate of Criminal Investigations (DCI), Kiambu Institute of Technology(KIST), Police Stations, Hospitals and Health Centres, Schools and Shopping Malls. It cuts right across Kiambu Town and proceeds in a North westerly direction to Ndumberi. Two Bypass Roads to Kiambu Town have been proposed as follows:

- Eastern bypass- starts at Riabai on Kiambu -Ngewa (B30) Road and moves North wards and terminates at Kiriguini B on Ndumberi - Githunguri (C210) Road.
- The other bypass is on the western side of Kiambu town and starts at Ndumberi Githunguri (C210) Road and cuts through Sasini coffee estate, cuts across Ndumberi – Limuru (B32) Road near Sasini Coffee Factory and terminates at Kiratina on Kiambu- Kanunga- Raini (C205) Road.

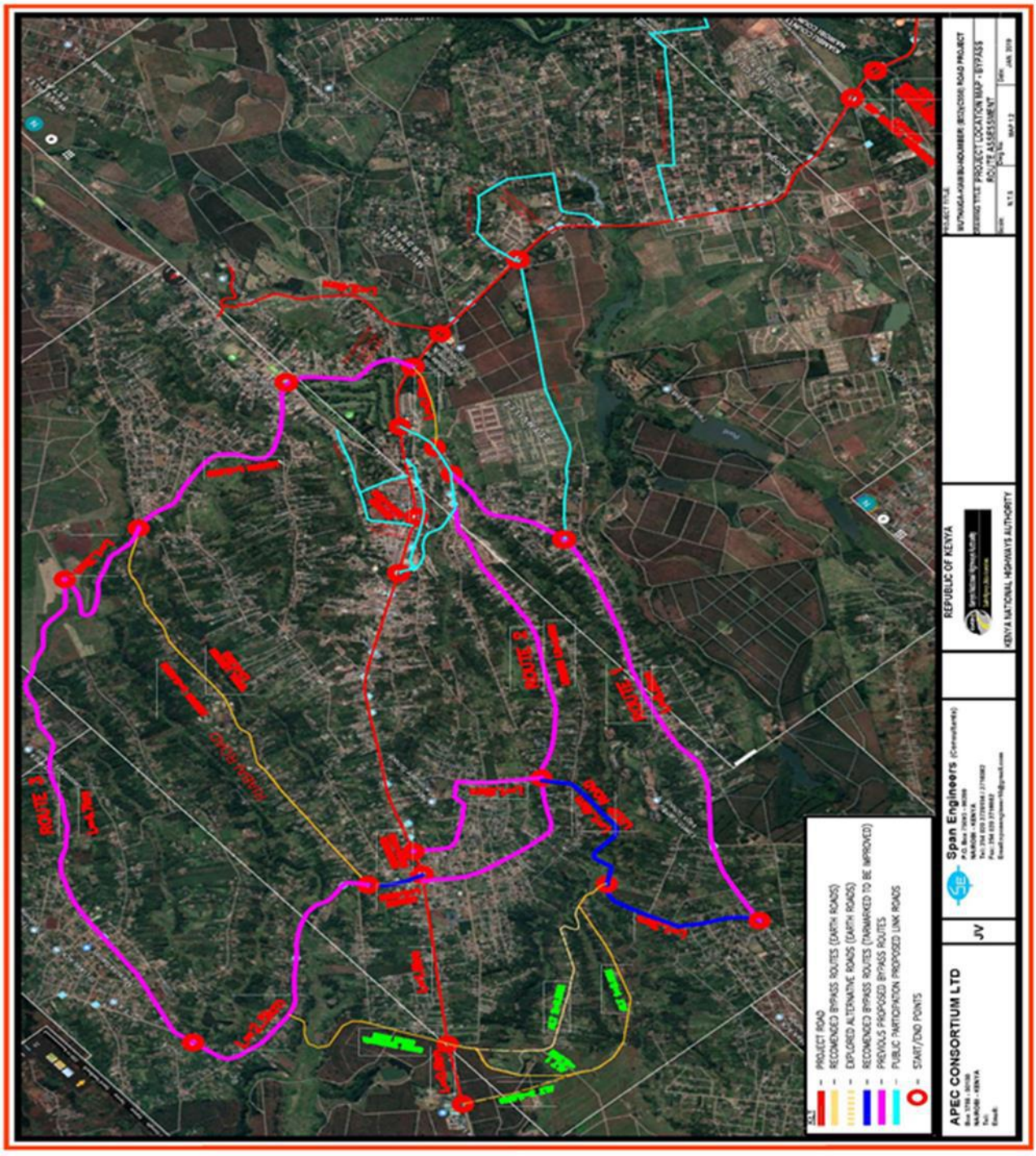

Figure 1: Muthaiga-Kiambu-Ndumberi Project Location

Further, the design of a spur road connecting Muthaiga -Kiambu -Ndumberi (B32) Road to Kamiti Kiambu Road at KIST is part of the project. The project will entail:

- Upgrading of Muthaiga-Kiambu-Ndumberi (B32) Road from a single carriageway to a dual carriageway.

- Construction of two lane single carriageway for two way traffic for bypasses
- Dualling of KIST- Kamiti Road Spur.
- Provision of adequate service lanes (two lanes on either side – Muthaiga- end of Kiambu Town)
- Provision of new and expansion/widening of existing junctions.
- Provision of NMT facilities- 3m wide NMT lane on either side of the road.
- Provision of bus-bays on service roads.
- Provision of footbridges at designated locations.
- Provision of street lighting
- Provision of space for future development of Bus Rapid Transit (BRT).
- Provision of adequate highway structures including overpass Bridges at interchanges and turning points and retaining walls for retaining earth and requisite construction materials and layers.
- Provision of a dedicated overpass at Muthaiga Golf Club.
- Provision of service ducts – Longitudinal and transverse along the road alignment.
- Provision for adequate drainage facilities including Bridges, Box Culverts and pipe culverts.
- Provision for Highway Signs and Road Markings.
- Provision of road furniture including guardrails, crush barriers, marker posts, road kerbs and bumps etc.
- Conservation of the environment measures including dust reduction, planting of trees and landscaping.

Refer to Appendix I for detailed inventory of the road components, Appendix 2 for typical X- sections, Appendix 3 Preliminary Design Inventory, Appendix 4 is highways and drainage structures.

1.3.2 Project Purpose and Objectives

The objectives of the assignment was to provide the Government of Kenya through the Kenya National Highways Authority (KeNHA) with sufficient information from studies, investigations, enquiries and designs presented in form of drawings, bills of

quantities and reports to enable upgrading of Muthaiga-Kiambu-Ndumberi (B32) Road from a single carriageway to a dual carriageway and expand/widen the existing junctions, provide NMT facilities and make provision for BRT. Further, to provide for adequate drainage facilities and at the same time conserve the environment, mitigate against disruptions to normal life of the population while at the same time ensure cost effectiveness, functional and aesthetically pleasing road. Consequently, the prime objective of this Consultancy services was to carry out Feasibility Studies, Preliminary Environmental and Social Impact Study and Detailed Engineering Design, and preparation of Tender Documents for the construction of Dualling of Muthaiga – Kiambu – Ndumberi (B32) Road.

The purpose was to ensure that the above project once constructed will ease the traffic congestion along the road and other adjoining roads, improve the infrastructure for the two counties to spur economic growth, open up Kiambu County to peri urban status, easy movement of agricultural produce.

The project road will be implemented in an environmentally and socially sustainable approach. The ESIA for the proposed project was undertaken simultaneously with the feasibility study before project implementation. Environmental and social impacts were identified and mitigation measures were proposed for anticipated impacts. The measures should be implemented using the Environmental and Social Management Plan (ESMP)and Environmental and Social Management Monitoring plans (ESMMP). The project Affected Persons (PAPs) were identified, valuation of affected properties undertaken and the Resettlement Action Plan (RAP) prepared for compensation. Other management plans that have been proposed are the Environmental Health and Safety (EHS), Borrow pit/Quarry Rehabilitation plan, Vehicle/Traffic Management plan, Waste Management plan, Camp design/Installation plan, Spills Prevention and Response plan, Emergency Response plan, Environmental awareness plan, and decommissioning plans for camps and other installations.

1.3.4 Project Justification/Rationale

Infrastructure is an important enabler for sustained economic growth. Accordingly, the MTP 2008-2012 was to accelerate and consolidate gains made in the Economic

Recovery Strategy on infrastructure development, with a focus on quality, aesthetics, and functionality of the infrastructure services. The MTP targets were to increase investments in the road network, water and sanitation services, Rail, Sea, Air transport and Energy supply services. Effective and reliable infrastructure was considered critical in lowering the cost of doing business and increasing competitiveness of the country.

Consequently, under the MTP, measures to reduce the impact of infrastructure and cost of doing business were to be targeted for implementation. The target for the Second MTP was to gradually close Kenya's "infrastructure deficit" while building on the achievements of the first MTP.

The strategies for successful improvement of infrastructure both at national and county governments included: strengthening of the institutional framework for infrastructure development; operationalizing the Public Private Partnership (PPP) legislation to encourage private investment in public projects; establishing a Kenya Development Bank to provide finances to the private sector for investment in infrastructure development; regular maintenance of infrastructure facilities; raising the efficiency and quality of infrastructure as well as increasing the rate of implementation of infrastructure projects.

Moreover, Kiambu road has had major transport problems due to the increase in population residing in the county or are involved in various businesses in Kiambu town. Other factors that have contributed to congestion along the road is the spill over from Thika Superhighway which has major traffic snarl ups due to the bottle neck at Muthaiga - Pangani interchange and several bumps from Safari Park that interfere with the smooth traffic flows. Dualling of Muthaiga – Kiambu – Ndumberi road is economically viable and well overdue since if effected, the project road area will be decongested, vehicles operating costs reduced and mobility enhanced/eased between Muthaiga/Nairobi and Kiambu/Ndumberi towns and their environs.

1.4 Purpose of ESIA

The role of ESIA process was to assess the environmental and social impacts associated with the design, construction, and operation of the planned dual carriage way. ESIA has proposed practical and effective mitigation measures to prevent or reduce any potential negative impacts of the construction and operation of the planned road. In addition, environmental and social impact management plans were developed to safeguard best environmental and social performance. The ESIA experts who undertook the assessment are as indicated in table1.1.

Table 1.1 ESIA Expert Roles, Qualifications and Experience

Name	Role	Qualifications	Experience (years)
1.Dr. Margaret Wachu Gichuhi	EIA Lead Expert	PhD	>15 years
2. Moses Odhiambo Kololo	Associate EIA Expert	BSc. Environmental Science	7 years
3. Stanley Kanyua	Civil Engineer	Bsc Civil Engineering	5 years
4. Tedd Njeru	Civil Engineer	Bsc Civil Engineering	5 Years
5. George Kimeu	Geospatial Analyst	Bsc in Geospatial Information	9 Years
6. Felistas Gitau	Sociologist	Bachelor of Arts in Social Science	10 Years

1.5 Objectives of ESIA

The main objective was to provide decision makers in the Government of Kenya, with sufficient information to construct the dual carriage road from Muthaiga-Kiambu road interchange to Ndumberi, Kiambu County.

1.5.1 Specific Objectives

- To identify **all potential** significant adverse environmental and social impacts of the proposed project (Muthaiga-Kiambu-Ndumberi Road).
- To **verify compliance** with the National Environmental and social regulations and industry's standards as well as with the Banks safeguards policies and Environmental and Social Assessment Procedures.

- To **generate baseline data** for monitoring and evaluation of how well the mitigation measures will be implemented during the project cycle.
- To **recommend** cost effective measures to be implemented to mitigate against the expected impacts
- To **provide opportunity for consultation** of all stakeholders, including communities to be affected by the project as well as Civil Society Organizations in order to obtain their input during the ESIA process.
- To **provide opportunity** to stakeholders to participate in the identification of mitigation measures for the adverse environmental and social impacts of the project
- To prepare an Environmental and Social Impact Assessment report and accompanying Environmental and Social Management Plan **(ESMP**) compliant to the Environmental management and Coordination Act (1999) and detailing findings and recommendations
- Identify **Mitigation Measures** and develop an Environmental Management and Monitoring Plan
- Identify the Project Affected Persons **(PAPs)** and provide a framework for the Resettlement Action Plan (RAP).

The specific objectives were achieved through the identification of potential environmental and social impacts, generating the baseline data, involving the stakeholders through public participation meetings, identifying project affected persons and preparing a Resettlement Action Plan (RAP), identifying mitigation measures for adverse impacts and preparing an ESMP and ESMMP and other management plans. The output was the compilation of the ESIA and RAP reports to be used by the contractor during project implementation.

1.6 Terms of Reference (TORs)

According to the Terms of Reference, the Muthaiga-Kiambu-Ndumberi ESIA involved screening and scoping of the project area in line with the tasks summarized as follows:

- Description of the baseline environment
- Detailed Description of the Proposed Project

- Legislative and Regulatory Framework
- Identification and prediction of potential environmental and social impacts
- Occupational Safety & Health (OSH) concerns
- Public Consultations
- Identification of feasible mitigation measures
- Identification of feasible Alternatives
- Development of a comprehensive Environmental and Social Management Plan (ESMP).
- Development of Environmental and Social Monitoring and Management Plan (ESMMP)
- Compilation and submission of the ESIA and RAP study reports

1.7 Structure Of Report

The ESIA report includes the following which is also indicative of the depth of the scope:

i. Title Page
ii. Executive Summary: This has a concise description of the proposed project; environmental setting, highlights key findings and recommended mitigation and monitoring procedures.
iii. Chapter One: Introduction
iv. Chapter Two: Project Description
v. Chapter Three: Environmental and Social Impact Methodology
vi. Chapter Four: Policy, Legal and Regulatory Framework
vii. Chapter Five: Baseline Environmental and Social Parameters
viii. Chapter Six: Analysis of Project Alternatives
ix. Chapter Seven: Environmental and Social Impact Assessment
x. Chapter Eight: Environmental, Social and other Management Plans
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CHAPTER TWO: PROJECT DESCRIPTION

2.1 Introduction

The Government of the Republic of Kenya has earmarked funds through the Development Vote for use in the feasibility study, environmental and social impact study, and preliminary and detailed engineering design for dualling of Muthaiga-Kiambu-Ndunberi (B32) Road. APEC Consortium Ltd in JV with Span Engineers were commissioned by the Kenya National Roads Authority (KeNHA) to carry out the above detailed assignment. The notification of award of the consultancy was communicated by the Director General (KeNHA) through letter **Ref: KeNHA/1908/2018 dated 22nd June 2018.**

The project design assignment effectively commencement on 22nd October 2018. The assignments execution period was to be twelve months. The scope of Consultancy Services included: Economic Feasibility Studies, Technical and Engineering Studies, Environmental and Social Studies, Field investigations, Engineering designs and preparation of tender documents. The design has provided space for future development of Bus Rapid Transit (BRT) system along the main road as necessary and NMT facilities, junctions and service roads and has provided for accommodation of current and future services within the road reserve.

2.2 Project Location

The project road is in Nairobi and Kiambu Counties of Kenya (Fig. 1). The total road length measures approximately 25km (including bypasses, loops, and accesses). The main road alignment commences at Pangani and Muthaiga Interchanges along Thika Road (A2) and proceeds through Kiambu ending at Ndumberi. The road traverses an urban and peri-urban development setup which is densely populated.

It however passes through ecologically prime Karura Forest and serves important installations, institutions and developments including NIS Headquarters at Karura, Kiambu Institute of Technology, Police Stations, Schools and Shopping Malls. It cuts

right across Kiambu Town and proceeds in a North westerly direction to Ndumberi shopping center.

The two proposed Bypass roads for Kiambu Town are;

- Eastern bypass- starts at Riabai on Kiambu -Ngewa (B30) Road and moves North wards and terminates at Kiriguini B on Ndumberi - Githunguri (C210) Road.
- The other bypass is on the western side of Kiambu town and starts at Ndumberi Githunguri (C210) Road and cuts through Sasini coffee estate, cuts across Ndumberi – Limuru (B32) Road near Sasini Coffee Factory and terminates at Kiratina on Kiambu- Kanunga- Raini (C205) Road.

Further, the design of a spur road connecting Muthaiga - Kiambu -Ndumberi (B32) Road to Kamiti- Kiambu Road at KIST junction is part of the project.

2.3 Overview of Road Construction

The project entailed the design that will;

- Upgrade Muthaiga-Kiambu-Ndumberi (B32) Road from a single carriageway to a dual carriageway.
- Involve the construction of two lane single carriageway for two way traffic for bypasses
- Dualling of KIST- Kamiti Road Spur.
- Provision of adequate service lanes (two lanes on either side – Muthaiga- end of Kiambu Town)
- Provision of new and expansion/widening of existing junctions.
- Provision of NMT facilities- 3m wide NMT lane on either side of the road.
- Provision of bus-bays on service roads.
- Provision of footbridges at designated locations.
- Provision of street lighting
- Provision of space for future development of Bus Rapid Transit (BRT).
- Provision of adequate highway structures including overpass Bridges at interchanges and turning points and retaining walls for retaining earth and requisite construction materials and layers.

- Provision of a dedicated overpass at Muthaiga Golf Club.
- Provision of service ducts – Longitudinal and transverse along the road alignment.
- Provision for adequate drainage facilities including Bridges, Box Culverts and pipe culverts.
- Provision for Highway Signs and Road Markings.
- Provision of road furniture including guardrails, crush barriers, marker posts, road kerbs bumps etc.
- Conservation of the environment and implementation of mitigation measures including dust reduction, planting of trees and landscaping.

2.3.1 Geometric Design

The Project Road is currently two-lane carriageway carrying traffic in both directions and classified as Class B road according to the latest Road Classification by the Kenya Roads Board. The project road has a 60m road reserve from Muthaiga to Kirigiti Junction and thereafter the reserve narrows down to 25-30m as it passes through Kiambu town to Ndumberi. The road traverses through a level to a rolling terrain, table 2.1

Table 2.1 Project Road Reserve

Item	Road section name	Available road reserve	Recommended road reserve
1	Muthaiga – Kirigiti Junction	60 m	60
2	Kirigiti – Kiambu Town	25-30 m	60
3	Kiambu Town - Ndumberi	30 m	60
Kiambu Town Bypass Roads			
4	Kamiti Road	60 m	60
5	Riabai Road (Bypass)	12 m	20m (extra to be acquired)
6	Kiambu Eastern Bypass through Boma Road and lower Sasini Coffee Farm	12 m	20m (extra to be acquired)

The general design concept requires minimal land acquisition and improvements of the roads will be confined within the road reserve. However, land may be acquired in

the difficult sections as shown in the land acquisition drawings. The considered improvement proposals have been conceived and developed under the following two sets of standards;

i. The desirable standards in the design criteria would be adopted
ii. The minimum standards which are adopted for difficult stretches where application of the desirable standards would lead to exorbitant costs.

Accordingly, the design standards for geometric elements were adopted under "desirable" and "minimum" categories and are consistent with and fall within the parameters recommended in related standards of the Roads Design Manuals of the Ministry of Roads and other internationally recognized manual.

2.3.1.1 Design Standards

The geometric design of the project road has been prepared in accordance with the following design standards: -

i) KeNHA Guidelines
ii) Road Design Manual Part 1; Geometric Design Manual of Rural Roads by Ministry of Works, Roads Department. January 1979.
iii) A policy on Geometric Design of Highways and Streets 2001 Fourth Edition- AASHTO
iv) Highway Capacity Manual 2000 ,4th Edition

2.3.1.2 Classification and Function of the Road

The functional class of Muthaiga - Kiambu- Ndumberi road is Class B, which is a national trunk road, providing connectivity between Thika Road A2 and Nairobi – Nakuru Highway Road A8 according to the new road classifications by the Kenya Roads Board. The project road also links Kiambu County administrative centres to international trunk roads namely Thika Road A2 and Nairobi - Nakuru Road A104 in the south and north respectively.

The project road can also be classified as a peri-urban road that also links important residential, market and social economic centres within the project area to major centres that include Nairobi City, Limuru, Kabete, Githunguri, Thika, Gatundu and Nakuru. For this type of road, high design speeds may be desirable on economic considerations, but the speeds should consider the safety of the road user. The level

of access to the project road by roadside developments along the road was dictated by the road functional class i.e. Class B which ranges from full to partial for desirable and reduced level of access respectfully.

2.3.1.3 Traffic Volumes Expected to Use the Road

Currently the project is characterized by heavy traffic especially during the peak hours. The Traffic study established that the project road was at LOS E, and thus improving it to a dual carriage way with controlled level of access would certainly increase the road capacity thus attracting growth in the project area.

Moderate design speeds of 70kph were therefore acceptable for the main carriage way and design speeds of 50kph on the service roads for traffic safety as required by the Traffic Act.

2.3.1.4 Design Speeds achieved along the Project Road

The Main Carriageway was designed with a general design speeds of 70kph in view of the requirements by the manuals for a rolling terrain topography in addition to the utilization of the available 60m road reserve and minimizing land acquisition. There were some few sections with reduced speeds of 60kph due to the nature of the terrain and the available road reserve. Service roads were designed to speeds of 50kph. The design speeds achieved along Muthaiga – Kiambu - Ndumberi Project Road for the Main Carriageway are shown in table 2.2 below.

Table 2.2. Main Carriageway Design Speeds along Muthaiga – Kiambu - Ndumberi Project Road

Chainage (Km)	Design Speed Achieved (Kph)	Factor Controlling Design Speed	Remarks
0+000 - 10+000	70	Horizontal radius of 250m	Muthaiga - B30 Road at Kirigiti Junction
10+000 - 11+950	50	Town Centre/Urban Area	Kiambu Town
11+950 - 16+400	50	Built up environment/urban	Kiambu Town - Ndumberi – Sasin

		area	Coffee Factory

2.3.2 Cross-sectional Elements

2.3.2.1 Lane Width

The width of a basic traffic lane was taken as 3.5 m on the main Carriageway. Thus, for 2 lane carriageways, the carriageway widths are to be 7.0 m. A 0.5 m to 1.5m wide edge strip is provided along the median kerb to provide compensation for kerb shyness.

2.3.2.2 Cross-fall

Each carriageway will have uni-directional cross fall. The cross fall for the pavement was taken as 2.5%.

2.3.3 Median

Dual carriageways should have raised central medians which mainly serve to separate the opposing traffic and enable better and safer traffic operations. General range of median width varies from 1.2 to 2.4 m. 9 m median has been adopted on the project road from Muthaiga to Kirigiti junction where the road reserve is adequate with a width of 60m. This is to allow future Bus Rapid Transit (BRT) provision. This will be enough for 2-way single carriageway BRT operation which requires 7.0m space with a 1m shoulder and separation Kerb on either side of the Carriageway. The width requirements for the BRT at the proposed BRT stations varies to from 20m.

2.3.4 Standards of Interchanges

The requirement of providing interchanges/grade separated junctions was investigated based on the junction capacity requirements and the proposals were developed from AASHTO/BS standards and discussed with the client. The standards proposed in Kenyan Design Manual for Rural Highways, Design Standards of Local Government, Urban Road standards of Nairobi City Council" and Geometric Design Standards for Urban Streets of AASHTO were followed.

2.3.5 Standards of Intersections

The standards proposed in Kenyan Design Manual for Rural Highways, Design Standards of Local Government, Urban Road standards of Nairobi City Council" and Geometric Design Standards for Urban Streets of AASHTO were followed.

2.3.6 Horizontal Alignment

2.3.6.1 Design Standards

The horizontal alignment of the project road were designed to the highest standards consistent with the site topography while taking into account the need to optimize on the road user benefits, construction costs and conservation of the environment. The alignments were designed to follow the already acquired road reserve to minimize land acquisition and property demolition costs except at a few locations where realignment has been done to improve the geometry of the existing curves.

A summary of the horizontal alignment standards for roads specified in the Road Design Manual Part 1 and other internationally recognized standards for various design speeds are shown in Table below. These standards have been adhered to as much as possible in the design of the project road. A summary of the horizontal alignment standards adopted in the design are shown in table 2.3 as shown below.

Table 2.3. Adopted Horizontal Design Standards

Design Element	**Design Speed, V_D (km/h)**				
	50	60	70	80	90
Minimum Horizontal Radius (m)	100	160	250	350	450
Minimum Stopping Sight Distance (m)	60	75	95	105	125
Normal Passing Sight Distance (m)	250	325	400	475	525
Passing Sight Distance (m)	175	225	275	325	350
Minimum "A" Factor for Minimum Horizontal Radius (m)	74	100	123	150	179
Horizontal Radii without Transition (m)	>2000	>2000	>2000	>2000	>2000
Horizontal Radii without Super-elevation (m)	>4000	>4000	>4000	>4000	>4000
Maximum Rate of Change of Super-elevation (%)	1.25	1.0	0.75	0.5	0.5
Minimum Rate of Change of Super-elevation (%)	0.3	0.3	0.3	0.3	0.3
Maximum Super-elevation (%)	6.0	6.0	6.0	6.0	6.0

The critical factor considered in the horizontal alignment design of the project road was the minimum curve radii specified in the Road Design Manual Part 1 for various design speeds. The minimum sight distances for stopping and passing, maximum super elevation and rate of change of super elevation, lengths of transition spirals for

effecting the super elevation and super elevation runoffs and clothoid "A value" recommended in the Design Manual have been achieved.

The minimum curve radii adopted for the main carriageway was 250m for the design speed of 70 KPM which was achieved throughout the project road. Transition curves have been applied at all circular curves with radius less than 2000m to accommodate the super-elevation run-off, provide good aesthetics and ensure comfort to the motorists during changes in of direction of travel. In all cases the adopted clothoid parameter "A" exceeded the specified minimum value.

2.3.6.2 Choice of Alignment

There were three alignment options identified to be presented to the Client. In these options, the BRT road reserve was designed to be in the middle of the carriage way due to foreseeable benefits namely;

- Once the BRT is fully operational, challenges that would occur at grade separated junctions will be minimised.
- The reserved BRT section will be protected from possible encroachments and future construction will have minimal obstruction to traffic.
- The BRT reserve can also be used for addition of extra lanes to improve the road capacity for future implementation.

These were the three alignment options, merits and demerits;

Option I

Two Lane dual carriageway with 9m wide median future BRT in the middle, One or two lanes for the service roads at the sides. Roads generally at grade and utilizes the river valleys local circulation of the traffic. Proposed BRT stations are also at Grade.

Merits

- No excessive cuts
- No visual separation of activities on either side of the carriageway
- Utilizes the topography for circulation of traffic at the river valleys with less earthwork's requirements

Demerits

- Requires physical barriers to bar pedestrians from crossing at undesignated places
- Local traffic on the service road has sometimes has to travel far to circulate

Option II

The Two Lane dual carriageway with 9m wide median future BRT at the centre, two or single Lanes for the service roads at the sides. The Main carriageway and BRT are under cut at the ridges with the service roads at grade. This is to allow at grade traffic on the service roads to circulate at overpass structures built across the main carriageway and BRT at the ridges. This will also be complemented by other structures at the river valleys. Most of the proposed BRT stations will be undercut thus, pedestrian bridges necessary to crossover and direct them to the depressed station under the cut.

Merits

- Reduced gradients on the Main Carriageway
- Does not require physical barriers to bar crossing of pedestrians at undesignated places
- Circulation of local traffic on the service roads is convenient, traffic does not necessarily go far to circulate

Demerits

- Extra earth works due to extra cuts at the ridge to accommodate headroom for the main carriageway and BRT
- Earth retaining structures required
- Widening of the BRT corridor to accommodate stations results to more
- BRT station Pedestrian access footbridge structures are complex and expensive due to the headroom requirements over the service. Accessing subsurface located stations will come with added costs on the ramps/staircases due to extra height and space to be covered by the structures
- At Ridgeways where the Main Carriageway and BRT corridor is elevated to allow for local traffic circulation, there is a lot of visual intrusion

Option III

This is the optimization of options I and II. After considerations of the merits and demerits of options I and II, all the positive elements have been combined in this option, thus forming a superior option of the three and thus forming the basis of the highways report.

Merits

- Results to balanced earthworks

Demerits

- May result to having too many grade separations structures near each other

2.3.6.3 Values of Critical Parameters of Horizontal Alignment

The values of the critical horizontal alignment design parameters of the project road are shown below: -

- Minimum horizontal radius = 250m
- Minimum sight distance = 100m
- Minimum "A" factor for minimum horizontal radius (m) = 94.87
- Maximum super-elevation = 6%

2.3.7 Vertical Alignment

2.3.7.1 Design Standards

Design of the vertical profile was carried out along the proposed centreline of horizontal alignment. The digital terrain model (DTM) was generated from topographic survey maps, which contains the x, y, z co-ordinates of each cardinal point. After verifying the existing DTM, the profile of the existing road at proposed centreline was generated using the civil 3D software. Subsequently, the vertical profile of the proposed road was made. In general, both carriageways are designed at the same level, except for super-elevated stretches. Proper schemes were taken to counter drainage at these locations.

The project road is on a level to rolling terrain with the existing road having gradients between 0.5% and 6.5%. The design aimed at smoothening the gradients by limiting

maximum gradients on the main carriageway to 4.0% and extreme cases 5.5% to maintain a design speed of 70 Kph.

The Service roads were designed for speeds of 40-50kph and with maximum gradients of 7%. The alignment was also raised at the proposed flyover locations and lowered at proposed underpass locations to get the necessary vertical clearances.

Crest curves have been designed considering K values corresponding to intermediate sight distances (ISD) and design speed. Sag curves were designed considering K values corresponding to stopping sight distances (SSD) and design speed. The vertical curve lengths provided fulfil the minimum requirements with respect to the design speed of 70 km/hr. The minimum lengths of the vertical curve considered was 236 m and min K value 30 for the main carriageway. This was considered to improve longitudinal drainage.

Longitudinal profile of service roads, footpaths, and drains were generally designed with respect to the main line carriageway profile apart from the section with grade separated junctions. However, the status of abutting property (including level and location) have been given due consideration while designing the same. For at-grade intersections and at other cross road locations, profiles were developed in such a manner that manoeuvring from/to cross roads does not create any hazards from a sight distance point of view or discomfort to motorists. Details of the proposed longitudinal section of the main carriageways, grade separated junctions and service roads are provided in the Book of Drawings.

2.3.7.2 2.3.7.2. Values of the Critical Parameters of Vertical Alignments

The values of the critical vertical alignment parameters of the project road are shown below.

Minimum vertical curve length at sag	200m
Minimum vertical curve length at crest	200m
Minimum K value for stooping at sag	30
Minimum K value for stooping at crest	52
Maximum gradient	5.1%
Minimum gradient	0.5%

Maximum fill along the road	10.0m
Maximum cut along the road	**9.0m**

2.3.8 Road Cross-section

2.3.8.1 Choice of Road Cross-Section and Design Standards

The choice of the road cross-sectional elements depends on several factors, the most important being the following: -

- The traffic volumes the road will have to accommodate.
- The selected design speeds.
- The road function, i.e. the predominant type of traffic that the road serves, e.g. "long distance" verses "access", or "heavy goods" versus "passenger cars". The road classification gives an indication of the road function.

The standard road cross-sections for rural roads recommended in the Road Design Manual Part 1 and their selection criteria based on the 10th year AADT or DHV (Daily Design Volume) are shown in table 2.4.

Table 2.4. Recommended Cross-Section Types for Two-Lane Rural Road

AADT or DHV in Year 10 (PCU)	**Cross-Section Type**
AADT < 150	V, VI, VII, OR VIII
150 < AADT < 500	IV, V OR VIII
500 < AADT < 2000	III OR IV
1000< AADT < 4000 or 250 < DHV <500	II OR III
AADT > 4000 or DHV>500	II

Source: Road Design Manual Part I - Table 4.2.2

Major elements of the road cross-section (including lane width) have been standardized in line with the Road Design Manual of Kenya. These are presented in Table 4.6. Based on the above criteria for geometric improvement requirements, typical cross-sections were developed. Refer to Appendix 1 for typical X- sections, Appendix 2 for detailed inventory of the road components and Appendix 3 for highways and drainage structures.

CHAPTER THREE: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT METHODOLOGY

3.1 Approach taken in ESIA

The ESIA approach with respect to the proposed road construction was as follows:

i. Scaling and work evaluation (determination of geographical and other boundaries; preliminary assessment)
ii. Detailed assessment based on: project design and technologies vis-à-vis environment, social, cultural and economic considerations of the project area; evaluation of pre-existing environmental, social, cultural and economic conditions, pressures and impacts; identification and evaluation of potential environmental, social, cultural and economic impacts that may arise from the proposed project; public consultations to explain what the proposed project is all about and to receive their views, perceptions, concerns and local expert knowledge and advice with respect to the proposed project;
iii. Determination/evaluation of the significance of the potential project impacts and recommendation of mitigation measures.
iv. Development of an Environmental and Social Management Plan and Monitoring Programme; and decommissioning of some project facilities
v. Preparation of the ESIA Project Report.
vi. Preparation of the RAP Report

3.2 Collection of Baseline Data

3.2.1 Overview of Methods

3.2.1.1 ESIA Methodology and Information Sources

The generalized framework of the ESIA is as shown in the flow chart below **(fig.2)**

The ESIA Flow Chart

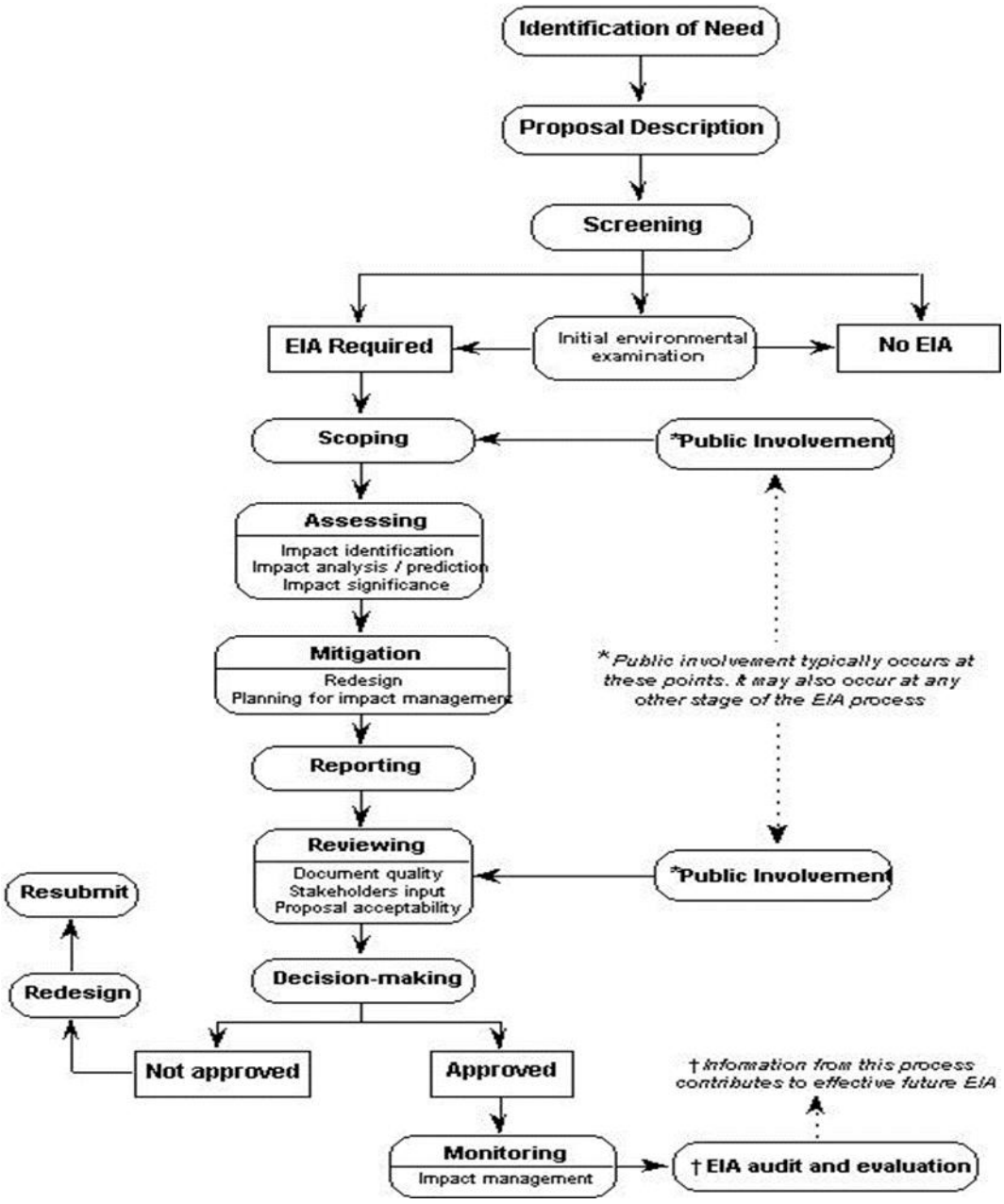

Figure 2. ESIA Flow Chart

3.4.1.2. Reconnaissance visits

A reconnaissance site visit with KeNHA was undertaken on October 2018. Other subsequent visits with the Engineering design and ESIA teams commenced to collect environmental and social baseline information along the project route.

3.4.1.3. Desk Review on Key Documents.

This was undertaken to lay the ground work for the study. The documents reviewed included but were not limited to the following.

- Defining the legal, institutional and policy framework of the proposed project.
- Environmental Management and Coordination Act (EMCA), 1999 and the subsequent regulations such as:-
    - Environmental (Impact Assessment and Audit) Regulations, 2003 Legal Notice No. 101.
    - The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121.
    - The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120.
    - The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61.
    - The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160.
    - The Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations, 2006 Legal Notice No. 131;
    - The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73.
    - The Forests Act, 2005
    - Forest Conservation and Management Act, 2016.
    - The Water Act, 2016
    - Land Act No. 6 OF 2012 (Revised, 2016)
    - Traffic Act, 2016
    - Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971
    - Occupational Safety and Health Act, 2007

3.4.1.4. Questionnaires and Checklists

The screening and scoping checklists were used to identify the likely significant positive and adverse environmental impacts of the dual carriage road. Assessment of secondary data also provided an insight into the expected impacts.

3.4.1.5. Focus Group Discussions (FGDs) and Public Involvement

The groups were divided into the following focal areas.

- Muthaiga Golf Club
- Directorate of Criminal Investigations (DCI)
- Ridgeways - Our Lady of Rosary Catholic Church
- PCEA Evergreen Church - Runda
- Thindigwa – ACK Church Hall
- Kiambu Institute of Science and Technology (KIST)
- Kiambu Town-Municipality
- Kirigiti Chief's Camp Play Ground
- Ndumberi Play Ground

3.2.1.2 Consultants' Observations

Field level observations was also used to supplement interviews and public consultative process. This was to ensure that all ESIA impacts and issues are validated and documented to enable sustainable project implementation.

3.2.1.3 Analysing the Potential Impacts of the Proposed Project

Impact analysis was undertaken to identify, predict and evaluate the characteristics of the main potential impacts. This stage had three overlapping phases.

i. Identification — to specify the impacts associated with each phase of the project and the activities undertaken.
ii. Prediction — to forecast the nature, magnitude, extent, and duration of the main impacts; and
iii. Evaluation — to determine the significance of residual impacts i.e. after considering how mitigation will reduce a predicted impact.

3.2.1.4 Mitigation Measures, Environmental and Social Impact Management and Monitoring Plan

The objectives of impact management were to:

- Ensure that mitigation measures are implemented.
- Establish systems and procedures for this purpose
- Monitor the effectiveness of mitigation measures; and
- Take any necessary action when unforeseen impacts occur.
- This was achieved by developing an Environmental and Social Impact Management Plan (ESMP) and Environmental Social Impact Management and Monitoring Plan (ESMMP) to be used by the proponent during project implementation, commissioning, monitoring and for future Environmental Audits.

3.2.2 Physiography and Geology

Data collection entailed observation and review of secondary data. Secondary data was reviewed to provide information for the soil types in Nairobi and Kiambu Counties. Nairobi County is underlain by tertiary volcanic; the main soils types in the area are the gray clays, black clays, red clays, reddish brown clays, and brown clays (Daniel Ichang'i). In addition, Kiambu County is covered by three broad categories of soils which are: high level upland soils, plateau soils and volcanic footbridges soils. These soils are of varying fertility levels with soils from high-level uplands, which are from volcanic rocks, being very fertile.

3.2.3 Soils

3.2.3.1 Alignment Soils Investigations

Primary data for soil investigations entailed the use of trial holes which were dug at 500 m intervals approximately 15 m from either side of the centre line of the existing paved road for the entire lengths of the proposed new alignments for dualling Muthaiga – Kiambu – Ndumberi road leaving the existing road for future design of Bus Rapid Transit (BRT) systems. Trial holes were dug to depths slightly more 1m deep. Each trial hole was logged, the material encountered described followed by taking a sample from each hole 1m vertically in order to represent full depth of alignment soils after removing top soil. All samples were submitted to Mass Labs Ltd where they were subjected to the following tests: Particle size distribution (Grading), Atterberg

Limits (Plasticity), Compaction (T99) and the California Bearing Ratio (CBR) tests after 4 days.

In general, CBR test results for Muthaiga – Kiambu – Ndumberi road vary from 7 % to 12 % Except at km 0+000, km 3+710 and km 6+210 which have yielded extraordinarily high CBRs of 24%, 16% & 25% respectively. The high CBR values do not represent the trend of CBRs along the project road, thus in order to balance the subgrade strength of the road including avoiding over designing the road, the high CBR test results have been ignored in the analysis of the CBR test results. In general, therefore the CBR test results of dualling of Muthaiga- Kiambu – Ndumberi road range from 7 % to 12 5 with mean value of 9 %.

Therefore, the subgrade strength of Muthaiga- Kiambu – Ndumberi road falls under soil class S2. Alignment soils CBR test results for Kiambu Northern and Southern bypasses range between 6 – 13 % and 7 – 14 % with mean values of 10 % & 11 % respectively and for Sasini Coffee Farm project, the CBR test results vary from 7 % - 10 % with a mean value of 9 %.

Secondary data was reviewed to provide information for the soil types in Nairobi and Kiambu Counties. Nairobi County is underlain by tertiary volcanic; the main soils types are the grey clays, black clays, red clays, reddish brown clays, and brown clays (Daniel Ichang'i). In addition, Kiambu County is covered by three broad categories of soils which are: high level upland soils, plateau soils and volcanic footbridges soils. The soils are of varying fertility levels with those from high-level uplands from volcanic rocks being very fertile. The soil fertility is conducive for livestock keeping and growth of various cash crops and food crops such as tea, coffee, horticultural products, pyrethrum, vegetables, maize, beans, peas and potatoes. These soils are mostly in Gatundu South, Gatundu North, Githunguri, Kiambu, Kiambaa, Lari, Kikuyu, Kabete and Limuru Constituencies. Low fertility soils are mainly found in the middle zone and the eastern part of the county which form part of the semi-arid areas. The soils are sandy or clay and can support drought resistant crops such as soya beans and sunflower as well as ranching.

These soils are mostly found in parts of Juja, Thika Town, Ruiru, Kabete, Limuru, Gatundu North and Gatundu South Constituencies. Most parts of the county are covered by soils from volcanic footbridges. These are well drained with moderate fertility. They are red to dark brown friable clays, which are suited for cash crops like coffee, tea, and pyrethrum. However, parts of Thika Town, Ruiru, Juja and Lari constituencies are covered by shallow soils, which are poorly drained, and these areas are characterized by low rainfall, which severely limits agricultural development.

3.2.4 Climate

Data on climate was assessed by using rainfall data at the Kabete Agro met Station for the period 1971-2017. Refer to Table 2-1 and Fig. 2-2-1 below.

3.2.4.1 Rainfall

Kabete Agro met Station I.D. 9136208 for the period 1971-2017 Monthly extreme rainfall 24-Hr totals in mm as shown in table 3.1.

Table 3.1. Kabete Agro met Station

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1971	N/R	N/R	N/R	73.6	55.7	6.6	15.7	4.3	5.2	15.2	14.7	40.6
1972	9.6	23.7	44.5	9.6	26.6	97.8	5.1	2.6	20.3	56.7	23.5	9.3
1973	35.6	38.6	5.4	102	18.6	20.8	2	4.5	23.2	6.5	24.6	12.2
1974	2.5	4	32.2	25	N/R	20	35.6	13.1	15.1	24.8	14.2	48.5
1975	8.9	1.7	9	57	43.5	3.5	5.3	2.6	22.5	23.2	59	31.4
1976	97.9	14.8	12.3	33	37.7	5.3	4.5	1.1	20	6	23	51
1977	31.3	38	21	84.9	77.2	29.3	7.5	24.5	6.5	11	35.7	37.8
1978	45.4	11.3	90	70.5	17	3.9	10	20.2	1.8	33.8	29.9	28.9
1979	20.3	82.6	32.8	29.8	38.5	14.7	13.7	4	7.6	12.5	31.3	50
1980	71.1	81.8	31.3	55.9	79.6	14.6	1.3	10.8	22.9	15.3	53.2	20.4
1981	21.4	3.9	48.1	128.3	58.7	3.8	18.7	13.2	31.8	101	8.3	32.1
1982	0.5	11.4	21.8	66.1	61.4	6.2	19.8	3.9	27.7	133	30.3	65
1983	3.3	51.8	47.9	48	11.4	35.3	12.7	10.8	3.7	22.6	9.8	108.8
1984	1.6	0.7	126.3	28	4.1	99.2	130.5	87.5	5.7	37.3	23	33.9
1985	0	23.6	49.7	35.1	15.8	11.4	22.2	1.8	22.3	9.7	23.5	23.2
1986	4.1	0.2	13.9	41	87.7	7.6	3.5	1	2.9	11.2	77	32
1987	22.1	80	7.6	164	73.5	37.1	5.4	5.6	12.2	3.8	58.9	10.7
1988	48.8	10.4	70.8	63.8	53.6	26.9	13.6	19	20.2	6.9	30.6	28.7
1989	43	16.1	30.9	48.2	158.2	24.6	10.5	5.9	42.5	20.8	23.7	42.9
1990	35.7	28.1	55.5	89.6	90	3.1	15	13.5	22.6	25.5	78.8	23.2
1991	23.2	0.4	40.2	52.4	45.7	6.4	9.4	14.5	1.3	5.2	66.5	16.2

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1992	3.9	46.8	2.6	60.5	133.4	5.1	14.7	1.6	11.6	21	33	32.4
1993	42.3	22.3	29.5	19.7	16.4	31	1.9	2	0	9.6	50.1	80.1
1994	4.4	16.7	17.5	48	20.4	20.5	9.2	24.5	0.3	27.2	53.1	21.6
1995	7.8	40.8	45.8	85.8	76	32.6	9.8	18.3	15.5	30.8	26.5	27.5
1996	7.4	24.5	36.7	29.1	16.2	12.1	10.1	23.4	22.3	1.3	34.8	1.7
1997	2.7	0	18.7	101	23.3	8.5	12.1	61.5	0	44.7	44.7	68.7
1998	77	30.7	27	30.6	85.7	35	19.8	10.2	30.8	47	14.9	7.5
1999	13.8	0.6	32	41.5	14.8	1.4	7.6	12	21.6	10	107.6	87.2
2000	5.4	0	14.8	83	31.3	22.8	1	4.2	34	8.1	53	38
2001	103	1.4	47.8	33	37	54	8.2	19	19.5	76.1	58.8	5.1
2002	25.8	28.3	33	77	18.5	1.6	3	2.3	18.5	19.4	33.9	58
2003	25.5	4.1	28.9	53	25.5	20.9	1.6	32.4	14	24.1	23.6	8
2004	129.4	12	29.7	74.6	118.8	4.3	5.1	0.1	8.4	35.6	26.2	25.5
2005	46.3	42.2	57.5	75.8	64.5	13.6	6.5	1.6	23	13.6	28.4	0.5
2006	9.4	18.7	85	43.5	52.6	2.5	2	15.3	14.5	N/R	72.8	77.5
2007	24.5	44.5	12.2	102	85.5	37	9.6	16.1	37.4	9.8	12.3	20
2008	25.7	133.5	48.5	30.5	6.7	3	25.2	3.4	36.2	22.5	62.5	3.8
2009	25.7	8.5	33.3	16.8	57.2	15.8	6.8	0.6	4.1	31	40.9	46.6
2010	63.8	18.8	53.8	38.8	75.4	21.2	1	9	13.7	25.8	30.6	24
2011	4.2	30.5	61.6	24.4	25.2	16	10.3	11.6	16.2	51.5	30.4	82
2012	0	9	2.5	40.9	55.5	15.5	15.2	21.5	3.2	137.1	58.9	77.4
2013	16.6	0	81.7	83	31	11	4.1	16	15.2	5.5	37	33.8
2014	30.2	27.4	49	26.6	34.1	35.7	3.9	11.2	13.7	90.6	15.2	47
2015	27.7	44	12.8	75.2	68.4	51.9	11.2	3	25.4	28.6	79.8	37.8
2016	37	61.4	33.1	79.7	104	12.3	0.1	35.3	13	7.8	13.3	11.1
2017	7.8	16	9.1	18.1	52.9	26	0.6	23	17.6	7.8	25.2	43.1

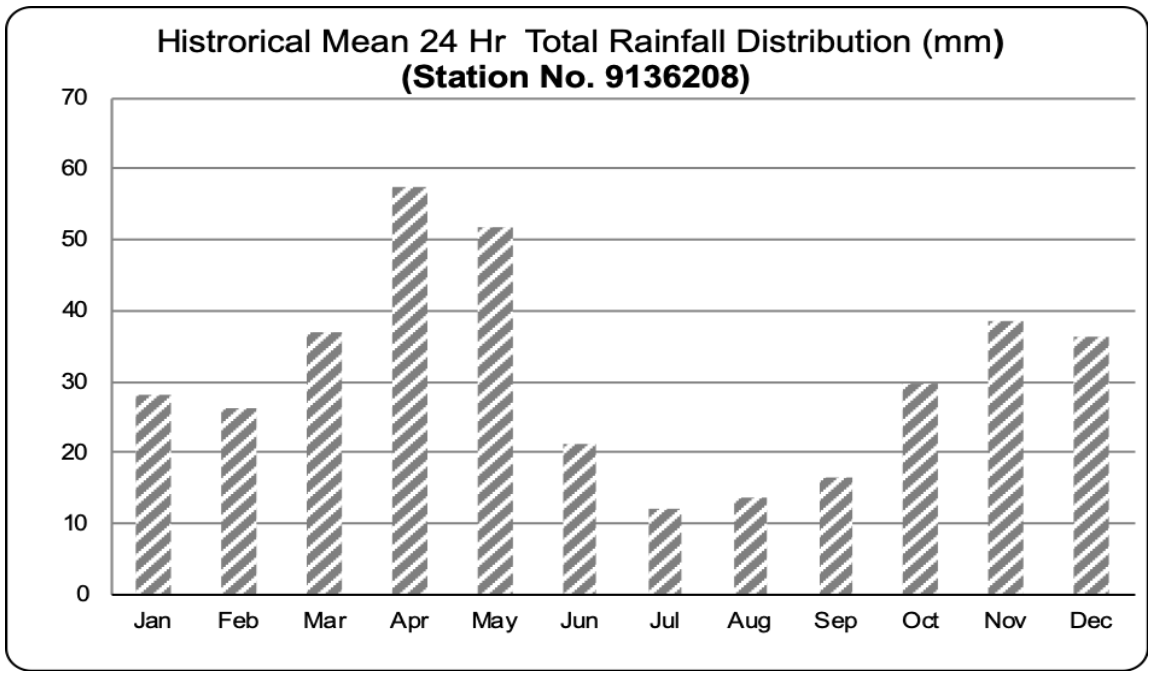

Figure 3.1. Mean 24-Hr Average Rainfall at Kabete station.

3.2.5 Air Quality

The methodology outline for this exercise incorporated the following aspects:

- Identification of sampling points in accordance with the SOR
- On-site data collection of the sampling points
- Deployment of the air quality measuring equipment for data logging at site
- Downloading of data for analysis

On-site data was collected from identified sampling points and was documented on a data collection sheet. Three sampling sites were identified as Muthaiga Interchange, Four-ways Junction and Kiambu Town along the property boundary. All activities currently taking place along the road reserve and in the neighbouring plots were taken into consideration. Data entry entailed details of the location, coordinates, date and run time and any additional information of the sampling points. Photographs of the were also to show the exact location of the sampling sites.

3.2.6 Surface and Groundwater Resources/ Water Quality

Primary and secondary data collection methods were used to assess the surface and ground water resources. Water quality was assessed by testing the Physical, Chemical, and Biological parameters of water samples at the crossing points of the

proposed road and the rivers. These rivers were Gitathuru, Karura, Rui-ruaka, Kigwa, Gatharaini, Riara and a natural spring at KIST. The high rainfall experienced in the project area contributes to high river flows in the lower reaches. The local surface drainage and hydrology is also influenced by the varying soil type, ranging from well drained red coffee soil to few pockets of black cotton soil.

The road corridor faces notable challenges including silted drainage culverts, urban development's abutting the road corridor resulting in minimized outfalls, inadequate drainage and road side ponding. The natural drainage patterns are also impeded, like the Gitathuru River that appears to have been realigned in its due course. The proposed road drains at the locations as indicated in the table 3.2 below.

Table 3.2. Major Rivers and Streams

No.	Name of River	Chainage
1	Gitathuru river	Km 0+683
2	Karura river	Km 1+783
3	Rui-ruaka river	Km 3+064.53
4	Perenial Stream	Km 5+360
5	Kigwa river	Km 6+544
6	Gatharaini river	Km 7+840
7	Riara river	Km 9+820
By-passes		
1	Karumu River	
2.	Riara River- Upstream	
3.	Riara River tributary /Stream #1	
4.	Kiu River tributary/Stream #1	
5.	Kiu River tributary River/Stream #2	
6.	Kiu River	

Water quality grab samples of 500 ML were collected from rivers Gitathuru, Karura, Ruaka, Kigwa, Gatharaini, Riara and KIST springs. The parameters tested were Ph, Turbidity, Electrical Conductivity(EC), Total nitrate, Total Dissolved Solids, Fluoride, Lead, Copper, Zinc, Permanganate value(PV) and E Coli. The Physical parameters indicated that the turbidity of Rivers Ruaka, Gitathuru and Riara were found to be 28.6 (NTU), 22.1 (NTU) and 18.4 (NTU) respectively. These values were more than the permissible upper limit of 15 (NTU) as per the WHO. The other samples were within the acceptable level of 15 (NTU). This implies that water from the three rivers should be passed through filtration process to lower the turbidity before consumption. Mitigation measures should be put in place to reduce turbidity during construction. The electrical conductivity in all the samples was within acceptable limit because all values were below 1000. The PH of Thindigua River was 6.29 which is slightly below the recommended level of 6.5-8.5. The rest of the samples' pH was within range.

3.4.6.1. Fluoride and Copper

The concentration of Fluorides was below 1.5 Mg/L in all the tested samples while water from rivers Thindigua and Gatharaini had concentrations of Copper that was slightly higher than the permissible concentration of 0.005 Mg/L. The copper concentration of Thindigua River and Gatharaini River was 0.0088 Mg/L and 0.0058 Mg/L respectively.

3.4.6.2. Coliforms

All seven samples exhibited presence of coliform which indicated that these rivers had some form of contact with animal or human waste. The rivers passing through forested areas had the least contamination. These are Karura and Gitathuru whose results were 10 CFU/ml and 20 CFU/ml, respectively.

3.4.6.3. Total nitrate.

The concentration of total nitrate of Thindigua River was 71.9mg/l which was above the recommended level of 50mg/l. The other river samples were within the recommended total nitrate concentration.

3.4.6.4. Lead.

All the samples tested showed presence of lead. For examples Thindugua River had 0.2271 Mg/L the same as the KIST Springs. The KIST springs could have been contaminated by wastes from the workshops in its vicinity.

3.4.6.4. Zinc

All the samples tested had amount of zinc that was within the allowable upper limit for water for human consumption.

3.4.6.5. Turbidity

The turbidity levels of Rivers Ruaka, Gitathuru and Riara were above acceptable levels which could be due to farming activities upstream leading to soil erosion. The upstream of these rivers has shopping centers, towns and agricultural activities which could contribute to point and non-point pollution. The results of the seven sampled water sources are as indicated in table 3.3. Below.

Table 3.3. Water Quality Tests of Seven Sampling Points along Kiambu Road

Parameters	SAMPLE LEVEL							Acceptable Level.	Remarks
	River Kegwa	River Ruaka	River Gitathuru	KIST Springs	River Karura	River Riara	River Gatharaini		
pH	6.29	6.72	6.82	6..61	7.01	6.22	6.35	6.5-8.5	
Turbidity(NTU)	1.2	28.6	22.1	7.6	15	18.4	5.1	15	
Electrical conductivity (µs/cm)	345	151.1	416	190.4	253	148.6	184.7	500	
Total nitrate(mg/L)	71.9	38.85	31.74	42.67	26.27	30.61	33.09	NIL	
Total dissolved solids.(mg/l)	221	96.7	266	122	162	69.5	118	1000	
Fluoride (mg/l)	0.65	0.73	0.62	0.98	0.61	0.28	0.94	1.5	
Lead(mg/L)	0.2271	0.1975	0.2228	0.2271	0.1764	0.1975	0.2017	-	

Parameters	SAMPLE LEVEL							Acceptable Level.	Remarks
	River Kegwa	River Ruaka	River Gitathuru	KIST Springs	River Karura	River Riara	River Gatharaini		
Copper (mg/L)	0.0088	0.0035	0.0012	0.0047	0.0023	0.0035	0.0058	-	
Zinc(mg/L)	0.0735	0.1120	0.2250	0.0775	0.2073	0.2210	0.1065	-	
Permanganate value(PV)	12.64	9.48	15.8	9.48	25.28	18.96	22.12	500	
E Coli(CFU per mL)	5×10	6×10	2×10	3.4×10^2	1×10	2.4×10^2	4.3×10^2	NIL	

3.2.7 Terrestrial/ Aquatic Environment

Secondary data on terrestrial and aquatic environment was reviewed.

3.2.8 Land Resources

Secondary data on land resources reviewed.

3.2.9 Visual Aesthetics

Observation and primary data collection were used. Secondary data on Visual aesthetics was assessed and reviewed. Visual Quality is a description of the relationship between viewers and their environment and a composite of their perceived sense of natural harmony, cultural, order, and design Integrity (or Project Coherence).The Visual quality of highways incorporates, road surfaces & alignment, roadside environment & beyond, bridges and structures, appurtenances, and highway-related facilities.

The Muthaiga- Kiambu-Ndumberi road has the following design elements; paving, bridges, intersections, interchanges, retaining walls, grading, signing, landscaping, laybys, BRT and NMT facilities. The benefits of trees in landscaping include environmental benefits such as visual appeal, improved air quality, managing storm-water and erosion control, stabilization of watersheds, protection of wildlife habitats and promoting biodiversity, lowering the wind speed and helping young/new trees grow, cooling effect and land reclamation. Moreover, the economic benefits include

increase in property values and enhanced business performance while cultural benefits give a sense of place.

The public participation input indicated that there was need for restoration of road side vegetation and preservation of habitat species in Karura Forest and Riparian areas. This could be done by selecting tree species and shrubs that should not obstruct the traffic and yet create a beautiful scenery. High branching trees should be given preference over trees that tend to branch close to the ground. Examples are Nandi Flame, Polyscias kikuyuensis (Mutati), Thika palm, Albizia gummifera (the peacock flower tree), Markhamia lutea (siala, lusiola, muu) and Grevilea. Grasses absorb heat, reduces noise, prevents erosion, filters the air and water, and provides recreation.

All the vegetation planted will also sequester carbon monoxide and other GHGs that impact negatively on the ozone layer and hence leading to global warming. The traditional ground cover plant species such as the Kikuyu grass (Pennisetum clandestinum) which could quickly cover the ground, especially under optimum moisture and soil fertility conditions can be given preference. *Panicum* (panic grass) which are often large, annual, or perennial grasses, growing to 1–3 m tall can also be considered. Landscaping and soil control measures such as use of gabions should be done concurrently with road construction to eliminate ugly scars on the landscape and to mitigate on soil erosion and sedimentation of rivers. For aesthetics purposes above ground utility lines should be placed underground. Solar powered street lighting should be put in place while well-lit pedestrian walkways should be considered to promote security. Waste disposal facilities should be placed at laybys and BRT stations. After decommissioning of the road, the maintenance of the vegetation and the road should be factored in by the client.

3.2.10 Noise and Vibrations

The equipment that was used for measuring the ambient noise levels in this exercise was the Casella CEL-63x Environmental & Occupational Noise Meter. This instrument uses the latest digital signal processing technology to provide a full range of functions, including integrating and real-time octave and 1/3-octave band analysis. It

uses a colour screen to show a range of information, including operating menus and messages, warnings, and the results of measurements. The following procedure was followed during deployment of the noise metre level to a given sampling point:

i. Identification of a suitable area to mount the noise meter
ii. Once the area has been identified, the equipment is assembled by fitting the windshield to the microphone.
iii. The instrument requires three AA batteries, which can run for approximately 12 hours.
iv. To switch on the instrument, the on/off key was pressed. The initialization screen was displayed for approximately 10 seconds, and then the measurement screen was displayed in the STOP mode (with red bars at the top and the bottom of the screen).
v. The Menu Key was pressed to access the settings, memory, and instrument status.
vi. Once the settings had been set, the next step was to take the measurements.
vii. The Run/Stop key was pressed to start making measurements. Here, the screen displayed green bars at the top and bottom.
viii. The Play symbol is displayed at the top left-hand corner of the screen, and the Pause symbol is displayed at the bottom left-hand corner of the screen. The left-hand soft key is the Pause/Run control and toggles between these two modes when operated.
ix. The instrument is left to run for 24 hours as required.
x. To stop the run, the Run/Stop key was pressed. A screen was displayed asking you to confirm the action - press yes to end the run.
xi. The instrument was then disconnected from the battery and stored away for use for the next sampling point after battery has been fully charged.
xii. The instrument was calibrated weekly using a calibrator provided by the manufacturer.

3.2.11 Solid and Liquid Wastes

Secondary data was reviewed.

3.2.11.1 Public Consultations and Socioeconomics

The Government of Kenya through the implementing agency Kenya National Highways Authority (KeNHA) is preparing documentation for Dualling of Muthaiga-Ndumberi-

Kiambu Road (B32) which traverses through Nairobi and Kiambu Counties, respectively.

KeNHA has engaged the services of APEC Consortium Ltd in joint venture with Span Engineers to prepare a Feasibility Study, Environmental and Social Impact Assessment (ESIA), Resettlement Action Plan (RAP), Preliminary and Detailed Engineering Design and Preparation of Tender Documents for Dualling of Muthaiga-Ndumberi-Kiambu Road (B32) road.

As part of the preparation process, Kenya National Highways Authority planned and advertised for public consultation /stakeholders' consultative meetings in conformity to the provisions of the Constitution of Kenya and Environmental Management and Coordination Act (EMCA) Cap 387.

The purpose of the meetings was to provide project affected persons and other stakeholders with the opportunity to give their views and concerns for adoption in the design, Plate 1 and 2, identification of impacts and preparation of sustainable mitigation measures for the project are as shown in table 3.4.

Table 3.4. Public Consultation Meetings

DATE	VENUE	TIME
18th June 2019	Our Lady of Rosary Catholic Church, Ridgeways	10.00 am
19th June, 2019	ACK Church Hall, /Thindigua	10.00 am
20th June, 2019	Kirigiti Chief's Hall	10.00 am
21st June, 2019	Kiambu Municipal Hall	10.00 am
24th June , 2019	Ndumberi Chief's Ground	10.00 am
27th June, 2019	Directorate of Criminal Investigations	10.00am
27th June, 2019	Muthaiga Golf Club	5 Pm
28th June, 2019	Kiambu Institute of Science and Technology (KIST)	10.00am
16th July, 2019	PCEA Evergreen Church, Runda	10.00 am

Plate 1:PPM at Ridgeways

Plate 2:PPM at Muthaiga Golf Club

3.2.11.2 Health and Public Safety

Secondary data was used.

Nairobi County has three public hospitals namely; Mbagathi District Hospital, Mutuini Hospital and Mama Lucy Hospital, and one maternity hospital -Pumwani Maternity Hospital. Several large hospitals are under private ownership. Some of them (Nairobi Hospital and Aga Khan Hospital) offer premium care not only to the County but also to the East Africa region. Nairobi City County hosts three facilities owned by the National government (Kenyatta National Hospital, the largest referral hospital in the country; Mathare Hospital - a specialty hospital for mental health care; and the National Spinal Injury Hospital that specializes in rehabilitative care and spinal injuries. Together, these hospitals contribute significantly to healthcare delivery in the County. The Armed Forces Memorial Hospital is managed by the Department of Defence (DoD) that provides healthcare services to members of the Kenya Defence Forces (KDF) and their families. (Source: Nairobi City County Health Sector Strategic and Investment Plan, 2013/2014–2018/2019, (Revised 2017).

Security is a key governance issue as it relates to individual safety and their property. There is high insecurity and level of crimes in the County especially terrorist attacks in East Leigh and organized crime in informal settlement areas. Unemployment is the main cause of insecurity in the County. Insecurity discourages investment because it

increases the cost of conducting business. Investors would have to put in more resources to enhance the security of their property and their lives.
Additionally, they have to hire private guards and take insurance cover, all these are at the expense of investment in productive activities. Security challenges that undermine the living and business environment will be confronted through decentralization fire, security and emergency services and establishment of a rapid response team.

Kiambu County Health Office is located in Thika Town. The department is charged with the responsibilities of overseeing health related issues in terms of management, supervisory duties. The citizens are served by the following health facilities classified in the following tiers: Tier 5- Inter-county facility (1), Tier 4 -Hospitals (13), Tier 3 - Health Centres (24), Tier 2 -Dispensaries (70). The Department of Health – Kiambu County is responsible for promotion, regulation, and provision of health care services to the people of Kiambu County and Kenya in general. The public Safety in the County is maintained through security, law and order as shown by the total number of police stations, posts and patrol bases (72) distributed as shown by the table 3.5.below.

Table 3.5. Police Stations, Posts and Patrol Bases per Sub County

S/No	Sub county	No of Police Station/Police Post/Patrol Base
1.	Kiambu sub county	12
2.	Thika	6
3.	Gatundu North	4
4.	Gatundu South	6
5.	Juja	7
6.	Ruiru	5
7.	Githunguri	4
8.	Kiambaa	5
9.	Kabete	3
10.	Kikuyu	7
11.	Limuru	7
12.	Lari	6

Source: County Government of Kiambu, County Integrated Development Plan 2018-2022.

All stations have Community Policing Committees which hold meetings regularly and officers from both National and County Governments are invited during such meetings to give their input. There are three prisons in the county located within the following sub counties; Ruiru, Kiambu and Thika.

3.2.11.3 Key informant Interviews

Preliminary meetings were planned and letters to stakeholders dispatched. The key informants from the Administration from National Government County Commissioners, Assistant County Commissioners, District Commissioners, District Officers, Chiefs, Assistant Chiefs, and village elders. On the side of security, the Officer Commanding Police Station (OCPD) and the Officer Commanding Station (OCS) were involved. The County Government was represented by the Governor's office representatives such as CEC Lands, CEC transport CEC Environment and CEC Sociologist. Other Key informants were Muthaiga Golf Club, DCI and all stakeholders along Kiambu road.

3.3 Development of the Environmental and Social Management Plan (ESMP)

3.3.1 Introduction

The purpose of the ESMP is to identify mitigation measures to avoid, minimize, and compensate for adverse environmental and social impacts. The expected and predicted impacts that may occur during construction, operation and commissioning phase of the proposed road are categorized into; Impacts on biophysical environment, Health and safety impacts, and Social-economic impacts as shown in the table 3.6 below.

Table 3.6. Type of Expected Impacts and Classification

Predictable	**Improved land Value, Loss/demolition of Property and livelihoods, Solid waste increase, Noise and vibration increase, Loss of vegetation, increase in surface runoff, Improved human movement** **Air pollution**

Temporary	Occupational, Hazards, Noise, Dust, Solid waste, Roadside informal Business, Social ills (decay), Sediment movement Air pollution from dust
Permanent	Enhanced Immigration, Improved land value, Improved housing, Improved business along the road route, Social ills, Motor vehicle accidents, improved human movement, Air pollution, Wild animals' accidents, Increased GHGs
Long term/short term	Change of landscape aesthetic beauty, change of land uses, improved social amenities, Wild animal movement within Karura forest , water pools after the rains, climate change impacts
Direct impacts	Land consumption, removal of vegetation, and severance of farmland. An example of this is removing gravel material from a borrow pit for use in earthworks when making the road
Indirect impacts	Degradation of surface water quality by erosion of land cleared for a new road, urban growth near a new road, and increased deforestation of Karura forest because of influx of people and easier transportation of logs because of the new expanded road

3.3.2 Impact Assessment, Rating Scales and Scoring

The potential impacts associated with the proposed development have been assessed as presented in the table below. Precautionary principle was used to establish the significance of impacts and their management and mitigation table 3.7. Appendix 5.

Table 3.7. Impact Assessment, Rating Scales and Scoring

S/N	Severity of the impact	Rating	Scoring
1.	Insignificant / non-harmful/less beneficial	-1/+1	Very Low
2.	Small/ Potentially harmful / Potentially beneficial	-2/+2	Low
3.	Significant / slightly harmful / significantly beneficial	-3/+3	Medium
4.	Great/ harmful / beneficial	-4/+4	High
5.	Disastrous/ extremely harmful / extremely beneficial	-5/+5	Very high
	Spatial Scope of the Impact		
6.	Activity specific	-1/+1	Very Low
7.	Right of way specific	-2/+2	Low
8.	Within Project area 5km radius	-3/+3	Medium
9.	Regional	-4/+4	High

S/N	Severity of the impact	Rating	Scoring
10.	National	-5/+5	Very high
	Duration of Impact		
11.	one day to one month	-1/+1	Very Low
12.	one month to one years	-2/+2	Low
13.	Within Project construction period	-3/+3	Medium
14.	Within the Project life	-4/+4	High
15.	At decommissioning	-5/+5	Very high

Example of Cumulative Impact Scoring: 1. +3, +2, +5, +4, +4, +1=+4 (the weight that occurs more is adopted) 2. +2, +2, +5, +4, +4, +1=+3 (if two scores or more tie, then an average of the scores shall be adopted)

3.3.3 Positive Environmental and Social Impacts during Construction and Operational Phase

The likely positive environmental and social impacts during construction phase of the proposed road project include: -

- **Creation of employment opportunities**- This will be in form of skilled and unskilled staff such as civil engineers, material laboratory experts, surveyors, EHS officers, Architects, quantity surveyors, mechanical and plumbing engineers and quality control experts among others. These jobs will be sources of income for several individuals and households and hence is expected to boost the GDP and improve their living standards. This positive impact has a high impact scoring of +4. The impact scoring, rating and mitigation measures for all impacts are in appendix 5.
- **Increased business opportunities**- in form of temporary businesses such as food vendors. Local businessmen will also benefit by supplying construction materials for the proposed road. This impact also scores high with a rating of +4.
- **Contribution of revenue to the County and National Governments**

  Both the County and National Governments will benefit from the improvement and dualling of Muthaiga-Kiambu-Ndumberi road through levies and taxes that will be imposed on the contractors. In addition, increased business opportunities will add to the revenue base of both the County and National Governments. This is also high positive impact with a rating of +4.

- **Revitalizing of existing Centres/Towns along the road route**

  There is possibility of re-vitalization of six Shopping Centres/Towns such as Ridgeways, Kiambu road - Northern bypass intersection, Thindigwa, Kiambu, Ndumberi, Riabai, Kirigiti and Kiratina existing along the route of the proposed road. This could be through economic appraisals of the local people during the construction works and other business opportunities. The impact scoring and rating is +4 which a high positive impact is.

- **Increased Security**

The general security of the area will be improved along the stretch of the road. Cases of burglary and carjacking will significantly reduce as security will be provided by the Administration Police throughout the project route and in contactors campsite and worksites. The security personnel response time will be enhanced further due to the improved road and therefore enhancing the security status of the entire neighbourhood. Increased security has a high impact score of+4.

3.3.4 Likely negative environmental impacts during Construction

The negative impacts include the following:

- **Noise pollution and Excessive Vibrations**

The source of noise pollution during construction phase will be from transport vehicles, construction machinery, metal grinding and cutting equipment, among others. Excavations and quarrying activities will also cause noise vibrations. However, the proponent will take appropriate steps to minimize noise pollution through provision of appropriate protective equipment to construction workers, planning and minimizing the frequency of transport of construction materials, ensuring that all construction equipment are well maintained and noise screens.

Noise and Excessive Vibration Pollution (Control) Regulations, 2009 gives highlights of the required noise levels as this was a concern raised during the consultation process. NEMA, WHO and ILO & ICGIH Noise specification standards were used in the categorization of the different sampling points used in this exercise as shown in table 3.8.

Table 3.8: Noise Exposure Standards Applied to Kiambu Road sampling Sites

Sampling site	LAeq (dB(A)	NEMA	WHO	ILO and ACGIH
Sampling site 1: Muthaiga site. Morning	63.8			
Midday	62.1			
Evening	70.4	55.0	70	60
Sampling site 2. Bypass junction. Morning	70.5			
Midday	70.1			
Evening	70.9	55.0	70	60
Sampling site 3. Kiambu town. morning	70.2			
Midday	69.5			
Evening	70.3	55.0	70	60

All sites were outdoor (road side) and measurements were taken during a duration of 2-4 hours sampling. Noise pollution survey shows that the values recorded for all sites were above the NEMA, WHO, and ILO maximum permissible levels. The only site where the levels recorded were below the WHO level was site 1(Muthaiga site) for morning and midday sampling periods.

- **Air pollution by air emissions and dust**

Potential air pollution (carbon, hydrocarbons, and particulate matter) caused by emissions from construction equipment, earth movers and excavators and other site vehicles transport materials to site. Also, dust will be emitted from earth works, concrete and cement batching plants in campsites, demolitions, and transport of materials trucks and vehicles accessing the construction areas and camp sites as well as material piling (sand and aggregate). Odour from temporary disruption of accumulated solid waste materials at locations of construction will also be expected. Such impacts may affect the immediate residential houses and commercial premises

and may fail to meet 140g/cm3 as recommended in the NEMA Air Quality Regulations 2009. Diversions of traffic during the construction phase will also contribute to high emission of dust.

Peak carbon monoxide levels were all above the NEMA limit levels for ambient air. All the sampling sites had heavy traffic loading during the peak hours. Site1, Muthaiga site recorded the highest level of 15.8 ppm, higher than three times the NEMA limit level for 8 hrs. All sites recorded high levels for carbon monoxide during the morning (6.30 -10.00am) and evening (16.00-20.00pm) sampling periods, values higher than the NEMA limit levels for 1hr (8.6ppm) but lower values during the midday sampling period (11.00-14.00pm). The average carbon monoxide levels for all sampling sites were all below the NEMA limits for 8hr and 1hr for ambient air.

Peak nitrous oxides levels were all above the NEMA limit levels (0.05ppm) which was the case for all sampling sites for average nitrous oxide levels (except site 3 during the morning sampling period). The average nitrous oxide levels were all lower than the peak nitrous oxide values recorded.

Peak levels of sulphur oxide levels were all above NEMA ambient limit values (for 24hr, average levels 0.05ppm), while the average levels were all below the NEMA limit levels for ambient air.

Levels of volatile organic compounds, non- methane hydrocarbons and hydrogen sulphide were all below the detection limit for the sensors for all sites. The levels of volatile organic compounds, non-methane hydrocarbons, and hydrogen sulphide were below detection limit. There are no activities along Kiambu road generating these gases, e.g. chemical industrial activities, solid waste dump sites or petroleum handling facilities.

Maximum levels of particulate matter of diameter less than 10 micron (PM_{10}) were high and above 1000 $\mu g/m^3$ for all sites. The average PM_{10} recorded were below the NEMA limit levels except for site 2 (Kiambu road-bypass junction) during the morning sampling. The proponent/contractor should ensure that dust levels at the site are minimized as much as possible through sprinkling water in areas being excavated and

along the tracks used by the transport trucks within the site and diversions. This impact has a medium score of-2.

- **Increased generation of solid waste**

Through the consultation process, members of the public raised concerns over possibility of generation of large volumes of solid wastes during the construction phase. Solid waste materials will be generated from various packaging materials and other construction materials, others which could be hazardous to the receiving environment. Significant quantities of rock and soil materials will be generated from earth moving during construction activities. The contractor shall comply with recommendations provided in the ESMP and implement the Solid Waste Management Plan. The plan shall incorporate the three (3R) Principles of Solid Waste Management; Reduce (Source Reduction), Recycle and Reuse. This impact has a medium score of -3.

- **Increased Discharge of Wastewater, Sewage and Degradation of Water Quality**

Increased generation of wastewaters and sewage during the construction phase of the project is expected. This will be due to the presence of construction camp sites and influx of people in the project area. Possible oil spillage during the construction phase, disposal practices of used oil, oil filters during the normal maintenance of machinery could also find their way to the nearby rivers. In addition, possible washing of the new bituminous layer of the new road when it rains could lead to pollution of the nearby rivers which is the source of water for the local residents and ground water aquifers. Quarterly water quality testing to ascertain pollution levels should be undertaken in the nearby rivers along the project route. Analysis of the water quality should be based on the NEMA and WHO standards. The impact has a medium score -3.

- **Water abstraction and consumption**

The project is likely to draw water from boreholes and from rivers along the road route. Drilling of a borehole along the road corridor for use to reduce over reliance on water from the rivers and this may require approval from the Water Resources Authority (WRA), and an EIA license from NEMA. These are required for each borehole that may be drilled. It is important to acquire all the relevant licenses prior to drilling. The siting of construction water sources should be carefully considered to

ensure that there is water for the construction works and for downstream users. As part of the planning it should be clear how the resource shall be managed and handed back to the community as a part of CSR of the project. The impact has a medium score -3.

- **Climate change and potential Impacts on road project**

Over the recent years there are frequent droughts, floods, and other extreme weather events in some parts of the country including Central Kenya where the project is located. An increase in rainfall and given the number of rivers passing across several rivers renders the need for the road design to cater for floods and accommodation of high flow across all the rivers and especially river Riara which has a dam upstream. The impact has a medium score -3.

- **Interfering with Drainage and Hydrology**

The Project construction will involve earthworks and excavation that could interfere with local drainage in towns and centres along the project area. This has a potential to divert the surface runoff towards homes and private plots or even accumulate along the sides of the road preventing direct flow to river channels. The increased water abstraction may modify the hydrological characteristics of these water bodies though not significantly in the larger project area. Earthworks activities will result in the generation of some spoil materials.

Moreover, if not handled properly the soils could lead to sedimentation of the nearby water sources which will interfere with the habitats and hence flora and fauna downstream. Borrow pits for extraction of road construction materials (ballast, soil, etc) may provide localized areas for surface water infiltration with the possibility of recharging groundwater aquifers. Additionally, water collecting in such open pits may also harbour waterborne diseases vectors such as mosquitoes. The impact has a medium score -3.

- **Increased soil erosion risk and soil quality degradation**

The construction of the proposed road will involve creation of large impervious surface that restricts the infiltration of rainwater. This could lead to high generation of surface runoff on bare steep slopes that could lead to rill and sheet erosion. The rest of the water will flow from the road into drainage ditches. This can undermine the stability of the road including associated facilities such as bridges. Sediment and erosion from construction activities and storm water runoff may also increase turbidity of surface waters. It is highly recommended that the contractor should ensure mechanisms are put in place to control soil erosion and to ensure monitoring

of soil erosion is continuous. The nature of slope where the road passes is generally of a gradual elevation and hence the impact on soil erosion is expected to be minimal. The impact has a medium score -3.

- **Loss of Vegetation Cover and Biodiversity**

During the construction phase of the project, there will be clearance of vegetation along the project route in some areas to pave way for the road. It is also expected that vegetation will be cleared during construction of campsite, borrow pits and contractors' quarry. This will lead to the negative impacts to the environment such as reduction of rainwater infiltration to the water table. Karura forest forms a critical habitat along the project route since part of the road reserve is within the forest. There will be clearance/disturbance of indigenous trees in the forest and riparian vegetation along river crossings. In addition, the contractor may install a material batching plant within the campsite and work stations that will impact on air quality and smothering of vegetation around the camp sites. The impact has a high score -4.

- **Extraction and construction material sourcing**

Construction materials such as hard core, sand, soil and rough stone will be obtained from quarries, borrow pits and river beds. These are natural resources which should be regulated to allow natural regeneration. The sites should be rehabilitated and restored to maintain visual quality and mitigate against accidents and water borne diseases. Six new materials sites were located. Trail holes were set up at 30m grids, digging was done to depths where suitable materials were exhausted followed by taking samples on each trial hole after removing overburden. Logging and description of encountered materials were also carried out. Site plan for each materials site was sketched. Location of each materials site has been shown on the map presented in appendix B in the Final Materials Report. All samples taken were subjected to the tests listed below.

  - Grading
  - Plasticity
  - Compaction (AASHTO T180)
  - CBR after 4 days' soak for untreated materials
  - CBR after 7 days' cure plus 7 days' soak for cement and lime improved materials.

Hard stone samples were taken from three existing sites namely DM Enterprises (Mlolongo- Katani Area), Silverstone quarry (Mlolongo- Katani Area) and Aristocrat (Nairobi). All the three samples from different sources have failed to comply with grading requirement for 0/40 mm aggregates. Sand samples were taken from three suppliers namely Strurples, Kahawa West and Giomato.

Sand samples from Masinga Dam Strurples has the lowest silt and organic matter contents whereas the sample from Giomato has the highest silt content. In view of the above scenario, sand from Strurples was recommended to be used for the construction of the project roads. Water for road construction shall be obtained from any of the following rivers: Getathuru, Ruaka, Kegwa, Gatharaini and Riara. The impact has a medium score -3.

- **Resettlement and land acquisition impacts**

Land for the construction of the road that is not part of the corridor will be acquired from private land owners along the road. This has an impact of loss of land and livelihoods for private property owners. The RAP assessment identified approximately 48 households (PAPs) likely to be affected along the project route. The project proponent should fully compensate the affected persons along the project route so that they can purchase land elsewhere. This shall be addressed through RAP. Provision of World Bank Operational Policy 4.12 on Involuntary Resettlement will be the main framework that will be adopted in preparing the resettlement action plan (RAP) document for the project affected persons and their assets. The impact has a high score -4.

- **Possible land and water contamination**

Land contamination may occur from oil spills; tar and other chemicals used might find their way to productive land, agriculturally productive land or to underground or surface water. Contaminated lands may involve surficial soils or subsurface soils that, through leaching and transport, may affect groundwater, surface water, and adjacent sites. Where subsurface contaminant sources include volatile substances, soil vapor may also become a transport and exposure medium and create potential for contaminant infiltration of indoor air spaces of buildings. Contaminated land is a

concern because of the potential risks to human health and ecology (e.g. Risk of cancer or other human health effects, loss of ecology) and the liability that it may pose to the polluter or affected nearby properties. This has a medium impact of -3.

- **Loss of Businesses along the road reserve**

Many businesses will be disrupted, and some lost along the project route. It was noted that squatters have established small-scale businesses on the road reserves such as flower vendors, kiosks, and car wash yards. These squatters will be given notice to vacate the road reserve to pave way for the road construction. Some hotel owners and food vendors who depend on illegal settlers operating businesses on the road reserves expressed concern that there would be loss of livelihood. The loss of livelihood will be addressed in the RAP report however the proposed improvement and dualling of the road will ensure safety and minimal disturbance of the businesses. This a low impact since much of the road will pass through the road reserve with little impacts on business. The impact has a low score -2.

- **Spread of communicable diseases and HIV/AIDS infection**

The Project will attract new people to the area, and this could lead to the spread of HIV/AIDS and/ or other sexually transmitted diseases (STDs). This influx could result to new cases of HIV and AIDS and new comers could be at a higher risk. The project proponent/contractor will need to work jointly with the Kiambu County government and National Government Public Health Agencies in order to come up with a comprehensive STD, HIV and AIDs control program during the construction and operational phases of the project. Other infectious diseases such as Covid-19 should also be introduced during the awareness campaign. The impact has a low score -2.

- **Disturbance to Wildlife**

The most common wildlife to be affected will be monkeys from Karura forest since movement to both sides of the road will lead to high mortality rates through road accidents. The contractor should provide monkey crossing bridges for ease of movement for the primates. There will also be visual and auditory disturbance to wildlife due to the presence of machinery, construction workers, and associated equipment. Maintenance and calibration could reduce the high noise levels. The impact has a low score -2.

- **Delays in transportation and possible accidents**

During construction phase, the road traffic will be controlled and, in some cases, complete road closure will be necessary especially at river crossings. This will entail disruption to traffic flows resulting in delay to transport of people and goods. There will be also delays caused by diversion during construction. The contractor should communicate possible delays in advance of affected sections of the road through the local media and newspapers and implement the traffic management plan. The impact has a medium score -3.

- **Social-Political Disputes**

There is a likelihood of political and social conflicts related to the compensation of people along the road reserve in in the project route. Politicians or local leaders may also incite local communities on the terms of compensation or any other unrealistic request from the contractor hence resulting in protracted disputes between the contractors and the local communities. The impact has a medium score -3.

- **Gender and equality biases**

Gender and equality issues in road projects may arise because of preferential/bias treatment of persons based on their sex roles, ethnicity, status, religion, race, age, beliefs and disability among other attributes. The proponent/contractor should put measures in place to address issues of gender equality and avoid discrimination among all Kenyans that involved in the project implementation. Special focus should be on Special Interest Groups such as; women, youth, children, persons with disabilities (PWDs), the elderly, the minority and marginalized groups or communities. The proponent should expected to roll out programs and activities in various sectors including health, education, housing, employment and social support and justice, among others. The overall aim is to reduce gender inequalities and the discrimination against all interest groups during the project cycle. The impact has a very low score -1.5.

- **Occupational Health and Safety Risks**

The Occupational health and safety issues associated with the construction of the proposed road project will include the physical hazards, chemical hazards and biological hazards. Exposure to physical hazards from the use of equipment, trips and

fall hazards, rock falls/slides in steep areas. Chemical hazards in road construction activities will principally be associated with exposures to dust during construction, exhaust emissions from heavy equipment and motor vehicles during all construction activities. Construction workers are likely to have injuries and hazards as the construction works such as trenching and excavations unavoidably expose workers to occupational health and safety risks. Biological agents represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. It is also highly recommended that the contractor conforms to requirements of OSHA, 2007. The impact has a medium score -3.

- **Community Health and Safety**

Community health and safety issues will emerge during the construction of roads particularly at large construction sites. The impacts include dust, noise, and vibration from construction vehicle transit, life and fire safety and communicable diseases associated with the influx of temporary construction labour. Significant community health and safety risks associated with the proposed road project will include pedestrian safety, motorists' safety, traffic safety, and emergency preparedness.

Children will generally be the most vulnerable due to lack of experience and knowledge of traffic related hazards, their behaviour while at play, and their size and stature making them less visible to motorists. The road passes near several schools and most students use the roads to cross. Collisions and accidents are expected to occur in search kind of project these can involve a single or multiple vehicles, pedestrians, or motor cyclists or even tankers and oil spills. Many factors contribute to traffic accidents. Probable causes of road accidents are associated with the behaviour of the driver or the quality of the vehicle, while others are linked to the road design, or construction and maintenance issues.

These are impacts anticipated to occur even in the operational phase of the project. The contractor liaison officer together with the community representative should come up with grievances committees to address any issues affecting the communities. The impact has a medium score -3.

- **Decommissioning Phase**

Some of the anticipated impacts during the decommissioning phase of the proposed project include both positive and negative impacts. Positive impacts are:

- **Rehabilitation and restoration of the site to its original status**

  Upon decommissioning of the project, rehabilitation of the project sites will be carried out to restore them the original status. This will apply to campsites, borrow pits and quarries. This will include landscaping and re-vegetation of slopes and other bare surfaces of the road corridor to improve visual quality of the new road. The proponent will be expected to decommission all sites as guided by NEMA.

- **Employment Opportunities**

Several temporary employment opportunities will be created for the demolition staff.

- **Recovery of recyclable materials**

  Materials used to construct bridges and the associated facilities in campsite can be re-used or recycled for use in other projects.

The negative Environmental and Social Impacts are:-

- **Dust emission**

  Large quantities of dust will be generated during decommissioning works. This will affect the workers as well as the local community.

- **Noise and Vibration**

  The decommissioning works will lead to significant deterioration of the acoustic environment along the project site and corridor and the local community.

- **Solid Waste Material**

  It is expected that large amounts of solid waste material arising during demolition will include tar, concrete, metal, stone, wood, glass, metal, paper, plastic, equipment, paints, adhesives, sealants and fasteners etc. The proper disposal of these materials should be carried out.

- **Occupational Health and Safety Hazards**

  Occupational Health and Safety hazards such as falling objects, open borrow pits, sharp objects lying around, and dust may all be a health risk to construction workers. Risk of accidents and incidents will be heightened

during the demolition activities as workers will be in direct contact with heavy machinery and equipment. The use of PPEs' should be enforced.

CHAPTER FOUR : POLICY, LEGAL AND REGULATORY FRAMEWORK

4.1 Introduction

The Republic of Kenya has policies, legal and administrative framework for environmental management. The Government's policy on road transport is to provide efficient and reliable road network to spur socio-economic development and improve security. This ESIA report has been prepared for consideration for approval by the National Environment Management Authority (NEMA) in accordance with the Sec. 58 (4) of the Environmental Management and Coordination Act No. 8 of 1999 (Rev. 2015) as well as Regulation 11 of Legal Notice No. 101 of 2003 (Rev. 2016) in which the proposed project has been identified to subjected to EIA. National Environment Management Authority (NEMA) is responsible for ensuring that environmental impact assessments (EIAs) are carried out for new projects and environmental audits on existing facilities as part of its coordination obligation.

On the international platform, there are various applicable frameworks and requirements to ensure sustainability is achieved in any project development for instance, IFC performance standards, AFDB operational safeguards and World Bank operational policy instruments, Multilateral Environmental Agreements on Environmental management, among others. It is a requirement by NEMA, AFDB and the World Bank that a clear management plan and action plan that describe and prioritize the actions required implementing mitigation measures are put in place.

The government of Kenya has established regulations to facilitate the process on ESIAs and environmental audits. The regulations are contained in Kenya Gazette Supplement No. 56, legislative, Supplement No.31, Legal Notice No.101 of 13th June 2003 and Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2016. In Kenya, it is a legal requirement that any proposed project of the scale described in this report should undergo an Environmental and Social Impact Assessment. These requirements are stipulated in the Environmental Management and Coordination Act (EMCA, Rev 2015) and EIA/EA amendment Regulations 2003. This section outlines the Policy, Legal and Institutional framework pertaining to the proposed development of Muthaiga-Kiambu-Ndumberi Rd (B32) into a dual carriage (B52/C558). The requirement for an EIA license as obligated by section 58 of the

Environmental Management and Coordination Act (EMCA), amended 2015 and environmental Impacts Assessment and Audit Amendment Regulation 2016 which stipulates that developer must seek an Environmental Impact Assessment (EIA) permit or license granted under this Act requires the proponent to undertake EIA study to be in conformity with the act before the implementation of the proposed project. The purpose of EIA is to identify potential positive and negative environmental impacts associated with the proposed project and provide recommendations on how to take advantage of the positive impacts on one hand and how to mitigate the negative environmental impacts on the other hand.

4.2.The Constitution of Kenya 2010

The Constitution of Kenya has taken on board various issues that are related to environmental management. Article 42 of the Bill of Rights contained in the Constitution provides that 'every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures'. Chapter five of the Constitution is dedicated to land and the environment. The constitution requires that land be used and managed in a manner that is equitable, efficient, productive and sustainable. Part 2 of Chapter 5 of the constitution is dedicated to Environment and Natural Resources.

Article 69 in Part 2 provides that the state shall provide encourages efforts towards sustainable of natural resources, increasing of the national forest cover public participation in the management, protection and conservation of the environment, protection of genetic resources and biodiversity, environmental impact assessment, environmental audit and monitoring of the environment, etc. The proposed project should comply with the constitutional requirements in as far as equitable sharing of the resources between various stakeholders is concerned on matters of sustainability of livelihoods and biological resources public participation Resettlement Action Plan among others.

4.3 The Policy Framework

4.3.1. National Policy Framework

The broad objectives of the National Environmental Policy in Kenya are:

- To ensure optimal use of natural resources while improving environmental quality.
- To conserve natural resources such that the resources meet the needs of the present without jeopardizing future generations in enjoying the same.
- To develop awareness that inculcates environmental stewardship among the citizenship of the country.
- To integrate environmental conservation and socio-economic aspects in the development process.
- To ensure that national environmental goals contribute to international obligations on environmental management and social integrity.
- To achieve the above policy objectives, it is a policy directive that appropriate reviews and evaluations of all forms of developmental project plans and operations are carried out to ensure compliance with the environmental policy and legal frameworks. The following section provides details on the relevant policies in the country.

4.3.2. The Land Policy (2007)

The Land Policy in Kenya is guided by the environmental management principles which are aimed at restoring the environmental integrity through introduction of incentives and encouragement of use of technology and scientific methods for soil conservation, among others. The policy further requires fragile ecosystems to be managed and protected by developing a comprehensive land use policy bearing in mind the needs of the surrounding communities. The policy also requires zoning of catchment areas to protect them from degradation and establishment of participatory mechanisms for sustainable management of fragile ecosystems. The policy also addresses land management particularly in Section 3.4.3.2 on ecosystem protection (including wetlands) and calls for the protection of watersheds, lakes, drainage basins and wetlands.

4.3.3. Gender Policy 2011

The overall goal of this framework is to mainstream gender concerns in the national development process in order to improve the social, legal/civic, economic and cultural conditions of women, men, girls and boys in Kenya. An important priority is to ensure that all ministerial strategies and their performance frameworks integrate gender equality objectives and indicators and identify actions for tackling inequality. In addition, each program will develop integrated gender equality strategies at the initiative level in priority areas. Within selected interventions, the policy will also scale-up specific initiatives to advance gender equality.

4.3.4.HIV and AIDS Policy 2009

The proposed project is to be implemented along different towns and shopping centres with growing population which have high freelance cases of HIV and Aids. This policy shall provide a framework to both the project proponent and contractor to address issues related to HIV and Aids. In Summary the policy provides a mechanism for:

- Setting Minimum Internal Requirements (MIR) for managing HIV and AIDS
- Establishing and promoting program to ensure non-discrimination and non-stigmatization of the infected;
- Contributing to national efforts to minimize the spread and mitigate against the impact of HIV and AIDS;
- Ensuring adequate allocation of resources to HIV and AIDS interventions;
- Guiding human resource managers and employees on their rights and obligations regarding HIV and AIDS.

4.4. Kenya Legislation and Regulations

4.4.1 Legislative framework

4.4.1.1 The National Land Commission Act, 2012

The Act establishes the National Land Commission. The National Land Commission (the “Commission") has wide powers in the management and administration of public, private and community land. In order to carry out its functions effectively, the Commission is required to devolve the administration of land. Consequently, the

Commission, when fully functional will have offices and land management boards at the county level. The project proponent will comply with the Act by ensuring that the proposed acquisition of public and private land (either for realignment/expansion of road or acquisition for private land for borrow pits and campsite) for the proposed development of Muthaiga-Kiambu-Ndumberi Rd (B32) into a dual carriage B52/C558 will be carried out in line with the provisions of this law.

4.4.1.2 The Water Act 2016

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

Part III, section 11, of the Water Act 2016 provides for regulation of the management and use of water resources. Following on this, sub-section 12 allows the Water Resources Authority (WRA) to demand from any person or institution, specified information, documents, samples or materials on water resources. Under these rules, specific records may require to be kept by a facility operator and the information thereof furnished to the Authority.

The contractor shall ensure proper water use, management, and conservation. In the event of borehole drilling WRA shall be consulted by the project hydro geologists for the purpose of attaining permits for borehole sinking.

4.4.1.3 Wildlife Conservation and Management Act, (2013).

The new law is aimed at improving the protection, conservation, sustainable use and management of the country's wildlife resources. The Act also sets out important principles that include:

- Effective public participation in the management of wildlife resources, thereby setting a basis for the strengthening of community based natural resources management.
- Use of the ecosystem approach in the management of wildlife
- Equitable sharing of benefits accruing from wildlife resources by Kenyans

- Sustainable utilization
- Recognition and encouragement of wildlife conservation and management as a form of land use on public, community and private land.

4.4.1.4 The Land Registration Act, No.5 of 2012

This was an Act of Parliament to revise, consolidate and rationalize the registration of titles to land, to give effect to the principles and objective of devolved government in land registration, and for related purposes. Section 26 of the Act states that Certificate of Title to be held as conclusive evidence of proprietorship, except;

- On the ground of fraud or misrepresentation to which the person is proved to be a party
- Where the Certificate of Title has been acquired illegally, un-procedurally or through a corrupt scheme.

The project proponent will comply with the Act by verifying the land ownership status before acquiring private land for the proposed development of Muthaiga-Kiambu-Ndumberi Rd (B32) into a dual carriage B52/C558.

4.4.1.5 The Lands Act, 2012

The new laws require all land in Kenya, whether private, public or community land, to be registered. The new laws therefore make provision for the registration of community land, which is the predominant land tenure system in the project area. However, substantive provisions on the administration and management of community land will be enacted by 2015 as required by the Constitution. The process of compulsory acquisition of land is now more transparent and will be managed by the Commission. In addition, the process requires that the award of compensation (determination of amount payable) will be made prior to the Government taking possession of the land. The Commission is expected to promulgate rules to regulate the assessment of just compensation.

4.4.1.6 The Kenya Roads Act – (Cap 399) No. 2 of 2007

An Act of Parliament that provides for the establishment of the Kenya National Highways Authority, the Kenya Urban Roads Authority and the Kenya Rural Roads Authority with clear and separate mandates. Part II of the Act establishes the various Roads Authorities in Kenya and outlines their functions.

Section 8 and 9 of the Act provides for the dedication, conservation or alignment of public travel lines including construction of access roads adjacent to lands from the nearest part of a public road. Section 10 and 11 allows for notices to be served on the adjacent land owners seeking permission to construct the respective roads. Already public meetings were held during public consultations and notifications to this effect issued.

Section 23 of the Act outlines procedures for acquisition of land for the purpose of the Authority's development while Section 24 (1) allows any authorized employee of an Authority to enter upon any land and survey such land or any portion thereof for the purposes of the Authority's development activities. Section 24 (2) provides that where any damage to land is caused by reason of the exercise of the powers conferred by this section, the owner or occupier of the land shall be entitled to compensation therefore in accordance with this Act. By undertaking this project, the project proponent is exercising his mandate and, therefore, has the powers and duties to construct, upgrade, rehabilitate and maintain roads under its control.

4.4.1.7 Security Laws (Amendment) Act, 2014

This act entails a legal framework and jurisdiction on security matters. It is a constitutional entitlement to live and feel secure from agents that may compromise ones' life and safety. Security measures are vital in this project following past terrorist experiences reported in the area; the contractor shall embark on a community policing program to be executed by a competent security firm. It is recommended that the government provides adequate support to enhance the security of persons involved in the project and the community at large, providing critical Intel that will trigger a review of the existing security measures and tactics.

4.4.1.8 The Traffic Act, Cap 403

The Traffic Act consolidates the law relating to traffic on all public roads. The Act prohibits encroachment on and damage to roads including land reserved for roads. While noting that the proposed project is properly within the provision of this Act, the project proponent will comply / enforce the Act to the full.

4.4.1.9 The Physical Planning Act Cap 286 of 1999

Section 29 of the said Act empowers the local Authorities to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same Section

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

The Act provides for the preparation and approval of local physical development plan for guiding and coordinating development of infrastructure facilities and services within the area of authority of County, municipal and town council and for specific control of the use and development of land. The authority of approval is bestowed on the planning officer of the specified authority. For compliance, KeNHA will seek the relevant approvals before the proposed project can commence.

4.4.1.10 The Valuers Act Cap 532

The valuation practice in Kenya is governed by the Valuers Act Cap 532, which provides for a Valuers Registration Board that regulates the activities and conduct of registered valuers. Valuers in Kenya are registered upon application to the Board and are required to be full members of the Institution of Surveyors of Kenya (ISK). The Act governs the formation and composition of valuation practices including the qualification of partners and directors in charge of valuation. The Board also deals with discipline and complaints in respect to valuation practice. The project proponent will comply with the Act by ensuring that registered / certified land valuers are involved in the proposed acquisition of private land the proposed development of Muthaiga-Kiambu-Ndumberi Rd (B32) into a dual carriage B52/C558 will carried be out in line with the provisions of this law.

4.4.1.11 The Employment Act, 2007

An Act of Parliament to repeal the Employment Act, declare and define the fundamental rights of employees, to provide basic conditions of employment of employees, to regulate employment of children, and to provide for matters connected with the foregoing. The project proponent will be advised to ensure that appointed contractors comply with the Act.

4.4.1.12 The Work Injury Benefits Act (WIBA), 2007

This is an Act of Parliament that provides for compensation payment to employees for work related injuries and diseases contracted in the course of employment and for

connected purposes. The Act includes the provision of compulsory insurance for employees. The Act also defines an employee as any worker on contract of service with an employer. This Act is triggered by the proposed project and it is thus recommended that all workers contracted during the project implementation phase have the required insurance covers so that they can be compensated in case of injuries while working. The project proponent will be advised to ensure that appointed contractors comply with the Act where required. The contractor will be required to engage a safety officer on site and work closely with area occupation officer and the director of occupation safety and health to ensure compliance with this law when it comes to compensation issues on occupational injuries and diseases.

4.4.1.13 Public Health Act Cap 232

Part IX Section 115 of the Act states that no person or institution shall cause nuisance or conditions liable to be injurious or dangerous to human health. Any noxious matter or waste water flowing or discharged into a watercourse is deemed as a nuisance. Section 116 requires local Authorities to take all lawful necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or conditions liable to cause injuries or just are dangerous to human health. Part XII Section 136 states that all collections of water, sewage, rubbish, refuse and other substance which permit or facilitate the breeding or multiplication of pests shall be deemed a nuisance. The Act addresses matters of sanitation, hygiene and general environmental health and safety which is directly related to road project and associated activities.

Part XII Section 136 is complemented by the Malaria Prevention Act (Cap246) which provides measures to curb the breeding of mosquitoes at development sites. Measures proposed in the Act to control the breeding of the vector include: maintenance of free drainage channels, removal of stagnant water from any land to prevent larvae breeding, removal of wastes and broken bottles, amongst others.

In this regard, the proponent is hereby recommended to implement measures to control the malaria disease vectors by implementing the relevant mitigation measures proposed in the regulation, especially waste management. Stagnant water near workmen's camps, borrow sites or homesteads should be drained to safeguard the health of the workers and the public. The proponent should ensure that all borrow

pits are refilled and the drainage system constructed and maintained to the required standards throughout the project phases.

4.4.1.14 The Occupational Safety and Health Act (OSHA), 2007

This Act applies to all workplaces and their associated workers, whether temporary or permanent. The main aim of the Act is to safeguard the safety, health and welfare of workers and non-workers. The Act requires developers to notify the Director of Occupational Health and Safety of their intended development before commencement. It also sets minimum standards that are to be maintained in such workplaces to safeguard health, safety and welfare of workers. These are all aimed at elimination of hazards from workplaces. The act further requires all workplaces to display the abstract of the act for all workers to read and remind themselves on how to protect themselves from hazards.

The Act also makes it mandatory for occupiers or employers to provide personal protective equipment and all practicable means to prevent injury to health of workers who are exposed to any potentially harmful substances or conditions. Section 9(1) demands that every occupier shall establish a safety and health committee at the workplace in accordance with regulations prescribed by the Minister if:

(a) There are twenty or more persons employed at the workplace

(b) The Director directs the establishment of such a committee at any other workplace

The Act further requires all workplaces to have stocked first aid boxes under the charge of trained first aid attendants. The Factories (Building Operations and Works of Engineering Construction) Rules of 1984 are more specific on standards and requirements for the construction works. The said Act requires that before any premises are occupied or used a certificate of registration should be obtained from the chief inspector. The occupier must keep a general register with provision for health, safety and welfare of workers on site and to record accidents or incidents of Occupational diseases. For safety, fencing of the premises and dangerous areas must be done. There should be provision for clean and sanitary working conditions. Moreover, there must be also provision of portable drinking water.

It is thus recommended that all Sections of the Act related to this project, such as provision of protective clothing, fire safety, clean water, use of explosives, and insurance cover for staff are observed so as to protect all involved from work related injuries or other health hazards.

4.4.1.15 Use of Poisonous Substances Act, Cap 247

This Act provides for the protection of persons against risks of poisoning by certain substances that may be used. The purpose of this Act is to protect persons against risks of poisoning by toxic substances arising from the use, storage, importation, sale, disposal and/or transport. All machinery / equipment imported by the contractor must be free from poisonous substances. The equipment and substances must be approved by the Kenya Bureau of Standards

4.4.1.16 Sexual Offences Act No. 3 of 2006

This is an Act of Parliament that provides for sexual offences their definition (rape, incest, indecent acts, pornography, and child trafficking), prevention and the protection of all persons from harm from unlawful sexual acts, and for connected purposes. The Act on Section 23 states that any one in a position of authority or holding a public office who persistently makes any sexual advances or requests which are unwelcome, is guilty of the offence of sexual harassment and shall be liable to imprisonment for a term of not less than three years or to a fine of not less than one hundred thousand shillings or both. Any indecent behaviour should be reported in a court of law. This will protect children and young girls from defilement and other adult persons from all forms of harassment and discrimination.

Further, Section 26(1) of the Act states that any person who, having actual knowledge that he or she is infected with HIV or any other life threatening sexually transmitted disease intentionally, knowingly and wilfully does anything or permits the doing of anything which he or she knows or ought to reasonably know - (a) Will infect another person with HIV or any other life threatening sexually transmitted disease; (b) is likely to lead to another person being infected with HIV or any other life threatening sexually transmitted disease; (c) Will infect another person with any other sexually transmitted disease, is guilty of an offence. To comply, the proponent and his agents will be advised on the requirements of the Act, not discriminate on the basis sex

during hiring of workers, on sexual harassment, and awareness creation among the workers.

4.4.1.17 Forest Act, Cap 385

The Act guides for the establishment, development and sustainable management, including conservation and rational utilization of forest resources for the socio-economic development of the country. The Act also provides guidelines for management and, registration of forests and is supported by the Forests Act, No. 7 of 2005. The contractor is advised against firewood collection to be used on workmen camp from any forest along the road corridor.

4.4.1.18 The Way leave Act

The areas zoned for communication lines, sewer lines, power lines, water pipes etc are known as way leaves. The Way leave Act prohibits development of any kind in these designated areas. Thus, any developer is bound by this Act to see to it that no development takes place in these areas. The proposed project will not encroach on any way leave and will leave the required space for such services.

4.4.1.19 Persons with Disability Act, Chapter 133

This act protects the rights of people with disabilities ensuring they are not marginalized and that they enjoy all the necessities of life without discrimination. The act guarantees that (1) No person shall deny a person with a disability access to opportunities for suitable employment. (2) A qualified employee with a disability shall be subject to the same terms and conditions of employment and the same compensation, privileges, benefits, fringe benefits, incentives or allowances as qualified able-bodied employees. (3) An employee with a disability shall be entitled to exemption from tax on all income accruing from his employment.

A person with disability is entitled to exemptions which apply with respect to exemptions and deductions as described in Schedule 42 subsection (2) of the act, among other provisions within this act that should be complied with all parties involved.

4.5 National Environment and Management Authority (NEMA) Cap 387 And Associated Regulations

The responsibility of the National Environment Management Authority (NEMA) is to exercise general supervision and co-ordination of all matters relating to the environment and to be the principal instrument of government in the implementation of all policies relating to the environment. The Authority will review the ESIA report for the proposed project, visit the project site to verify information provided in the report and issue ESIA license if it considers that all the issues relevant to the project have been identified and all mitigation properly put in place. The authority makes the decision on whether to approve or disapprove the ESIA application.

Environmental Management and Coordination Act No 8 of 1999, (revised 2015), provides for the establishment of a Legal and Institutional Framework for the management of the environment and for matters connected therewith and incidental thereto. Just as in the new constitution, Part II of EMCA confers to every person the right to a clean and healthy environment and to its judicial enforcement. The new Constitution and EMCA therefore obligates the project's Executing Agency and Contractor to work in a clean environment and not to contravene the right of any person within its zone of influence, to this entitlement. EMCA has provided for the development of several subsidiary legislations and guidelines which govern environmental management and are relevant to the Project implementation. These include:

a) Environmental Management and Co-ordination (Environmental Impact Assessment and Audit) Regulations, 2003 and the (Amendment) Regulations 2016

The Environmental (Impact Assessment and Audit) Regulations provides guidelines for conducting EIA studies. The regulations provide details on the parameters to be evaluated when undertaking an EIA study. It also provides guidelines on the conduct of environmental audits and development of project monitoring plans. The proposed project must comply with the requirements of the regulations that also include conducting continuous monitoring and annual audits on the proposed project and complying with improvement orders from NEMA.

b) Environmental Management and Co-ordination Act (Controlled Substances) Regulations, 2007

These Regulations control the production, and consumption, as well as exports and imports of controlled substances. Controlled substances are grouped into three lists, as indicated below:

- Group 1: list consists of halogenated flouro-chemicals with ozone depleting substances
- Group 2: list consist of hydrobromo-flourocarbons with ozone depleting substances
- Group 3: list consist of bromo-chloromethane with ozone depleting substances

Products containing controlled substances include: air conditioners, air coolers, refrigerants, portable fire extinguishers, heat pump equipment, dehumidifiers, insulation boards, panels and pipe covers, pre-polymers etc. It is thus recommended that this regulation be observed so as to ensure that equipment, machinery, vehicles and chemicals containing such components are not imported for use on this project.

c) Environmental Management and Co-ordination Act (Noise and Vibration Control) Regulation, 2009

These Regulations provide guidelines for acceptable levels of noise and vibration for different environments during the construction and operation phase. Section 5 of the Regulations warns on operating beyond the permissible noise levels while Section 6 gives guidelines on the control measures for managing excessive noise. In this context, the project team should observe the noise regimes for the different zones especially so for working in areas termed as silent zones which include hospitals, academic institutions, and worship places, amongst others. These areas have permitted exposure to Sound Level Limits of 40 dB (A) during the day and 35 dB (A) at night.

The regulation states that a day starts from 6.01 a.m. to 8.00 p.m., while night starts from 8.01 p.m. – 6.00 a.m. Construction sites near the silent zones are allowed maximum noise level of 60 dB (A) during the day, whilst night levels are maintained at 35 dB (A). The time frame for construction sites is adjusted and the day is

considered to start at 6.01 a.m. and ends at 6.00 p.m. while night duration starts from 6.01 p.m. and ends at 6.00 a.m.

Part III of the Regulations gives guidelines on noise and vibration management from different sources. Sections 11, 12 and 13 give guidelines on noise and vibration management from machines, motor vehicles and night time construction respectively. Section15 requires owners of activities likely to generate excessive noise to conduct an ESIA. Also the 3rd schedule provided the maximum noise levels for mines and quarries. The project proponent will be expected to comply with the requirements of this regulation.

d) Environmental Management and Co-ordination Act (Waste Management) Regulations, 2006

These Regulations provide guidance on the appropriate waste handling procedures and practices. It is anticipated that the proposed project will generate a large quantity of solid waste during construction and these will need to be managed through reduction of wastages, reuse, and recycling or appropriate disposal. It is therefore anticipated that the amount of materials to be discarded as waste during the project implementation will be minimal.

As regards waste reduction, it is recommended that the consulting engineer/proponent put in place measures to ensure that construction materials requirements are carefully budgeted for so as to ensure that the amount of construction materials left on site after construction is minimal. It is further recommended that the proponent considers the use of recycled or refurbished construction materials including those excavated from the existing roads. Purchasing and using once used or recovered construction materials will lead to financial savings and reduction of the amount of construction debris disposed of as waste. In addition to the above-mentioned recommendations, and in order to comply with the requirements of these regulations, the proponent should undertake the following:

- Disallow disposal of any wastes on the highway, street, road, campsite, open quarries, recreational area or public places
- Encourage segregation of wastes and grouping them according to their similarity, for example plastics, toxics, organics, etc

- Ensure all wastes are deposited in designated dumping sites approved by the County government
- Ensure all waste handlers engaged by the proponent are licensed by NEMA and possess all relevant waste handling equipment and documentation, such as waste transport license, tracking documents, license to operate a waste yard, insurance cover, and vehicle inspection documents, amongst others
- Implement cleaner production principles of waste management namely reduce, reuse and recycle
- Label all hazardous wastes as specified in Section 24 (1-3) of the regulation.

The fourth schedule lists wastes considered as hazardous and these include solvents, emulsifiers/emulsion, waste oil/water and hydrocarbon/water mixtures. Road projects like this one will involve use of inputs which are likely to generate the fore-mentioned wastes and which will need to be handled as required of by the regulations.

e) Environmental Management and Co-ordination Act (Water Quality) Regulations, 2006

These Regulations provide guidelines on the use and management of water sources and the quality of water for domestic use and irrigation. The proponent will be required to observe the requirements of these Regulations that prohibit anyone from undertaking development within 6m of the highest ever recorded flood level. Section 4(2), 6 and Section 24 of the regulation prohibits pollution of water bodies and requires that all substances discharged into the water bodies should meet the standards set under the Third Schedule of the regulation. In response to the above, the project design team should be advised o the requirements of these Regulations and appropriately incorporate the regulations in the project design document so as to conserve the rivers running across section of the road route.

f) Environmental Management and Co-ordination Act (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006

These Regulations require proponents to conduct an ESIA if their activities may have adverse impacts on ecosystems or lead to unsustainable use of natural resources

or/and lead to introduction of exotic species. The regulation aims at increasing the coverage of protected areas and establishing new special status sites by providing guidelines for protecting endangered species.

Section 5 of the Regulations provides guidelines on conservation of threatened species and Part III of the regulation guides on the access to genetic materials. Section 5 states that the Authority shall, in consultation with the relevant lead agencies, impose bans, restrictions or similar measures on the access and use of any threatened species in order to ensure its regeneration and maximum sustainable yield. It is recommended that landscaping programs should involve use of certified plant species to prevent them from affecting the project area negatively in terms of invading wetlands, indigenous forested areas, grasslands, farmlands, etc.

g) Environmental Management and Co-ordination Act (Fossil Fuel Emission Control) Regulations, 2006

This Regulation aims at eliminating or reducing emissions generated by internal combustion engines to acceptable standards. The Regulations provide guidelines on use of clean fuels, as well as use of catalysts and inspection procedures for engines and generators. These regulations are triggered in that the proponent will use vehicles and equipment that depend on fossil fuel (coal) as their source of energy. As such, it is recommended the requirements of the regulation are implemented in order to eliminate or reduce negative air quality impacts. All equipment that will be used in the project should be kept to manufacturers' specifications to reduce any incomplete combustion and that the contractor should use fuel with the right catalyst.

4.6 International Best Practices, Standards and Conventions

Kenya is a signatory or a party to various international conventions, treaties and protocols relating to the environment which aims at achieving sustainable development. These agreements are both regional and international and became legally binding on Kenya upon ratification thereof by the rightfully designated Kenyan Authority. The agreements of interest to Kenya can be categorized as those for protecting natural resources, atmosphere and the social wellbeing of mankind as discussed below.

4.6.1 Vienna Convention on the Protection of the Ozone Layer

This was an Intergovernmental negotiation for an international agreement to phase out ozone depleting substances concluded in March 1985 which saw the adoption of the Vienna Convention for the Protection of the Ozone Layer. This Convention encourages intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production, and the exchange of information. The mitigation of air emissions during construction will reduce ozone layer depletion and global warming.

4.6.2 United Nations Convention on Biological Diversity (UNCBD)

The purpose of this convention is to ensure the conservation and sustainable use of biodiversity. Kenya signed the convention on 5th June 1992 and ratified the same on 26th July 1992. The National Environment Management Authority (NEMA) is the National Focal Point to this Convention. The provisions of this Convention have been integrated in many laws of Kenya. The biodiversity along the project road should be conserved and protected.

4.6.3 African Convention on the Conservation of Nature and Natural Resources

This convention reaffirms the importance of natural resources both renewable and non-renewable, particularly the soil, water, flora, and fauna. The main objective is to facilitate sustainable use of the above resources. The convention was adopted in Algiers on 15th September 1968 and came into force on 16th June 1969. The sustainable use of resources should be observed for generational equity.

4.6.4 Ramsar Convention 1971

The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty whose mission is “the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world” All identified wetlands and their ecosystems should be conserved.

4.6.5 The 1992 United Nations Framework Convention on Climate Change (UNFCCC)

The primary purpose of the convention is to establish methods to minimize global warming and the emission of the greenhouse gases. The UNFCCC was adopted on 9th

May 1992 and came into force on 21st March 1994. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994. NEMA is the focal point for the Convention.

4.6.6 Kyoto Protocol to the United Nations Framework Convention on Climate Change

The Kyoto Protocol requires signatories to the United Nations Framework Convention on Climate Change to reduce their greenhouse emissions levels to 5% below 1990 levels by the year 2012. The Protocol came into force on 16th February 2005, after it received the pre-requisite signatures. However, major countries like United States, China, India, and Australia are not signatories to the Protocol. NEMA is the national focal point for this Protocol. All vehicles, equipment and construction activities should reduce the emission of GHGs.

4.6.7 Earth Summit on Sustainable Development Agenda 21

Aims to promote and support policies, domestic and international, that make economic growth and environmental protection mutually supportive. Kenya continues to implement Agenda 21 to support sustainable development through the integration of environmental concerns into the national development policies, plans, and program. The proposed road project would need to be consistent with the objectives of Agenda 21.

4.6.8 Sustainable Development Goals (SDGs)

The SDGs include 17 Sustainable Development Goals and 169 targets. They seek to build on the Millennium Development Goals and complete what they did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental. The identified positive impacts of the project will achieve these dimensions.

4.6.9 Convention on the Elimination of all forms of Discrimination against Women (CEDAW)

The Convention on the Elimination of all forms of Discrimination against Women (CEDAW) places explicit obligations on states to protect women and girls from sexual

exploitation and abuse. Universal Declaration of Human Rights (Article 7), the UN Charter (Articles 1, 13, 55, and 76) and the International Covenant on Civil and Political Rights (Article 24) reaffirm the freedoms and rights of all children, including internally displaced children. Gender balance should be given priority when hiring employees for the project implementation. Children should not be engaged in any form of employment.

4.6.10 International Labour Organization

The International Labour Organization (ILO) is built on the constitutional principle that universal and lasting peace can be established only if it is based upon social justice. The ILO has generated such hallmarks of industrial society as the eight-hour working day, maternity protection, child-labour laws, and a range of policies which promote workplace safety and peaceful industrial relations. This should apply to all employees.

4.6.11 World Bank Environmental and Social Performance Standards

The World Bank's environmental and social performance standards are a cornerstone of its support to sustainable poverty reduction. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. The performance standards ensure that environmental and social issues are evaluated in decision making, help reduce and manage the risks associated with a project or program and provide a mechanism for consultation and disclosure of information. The public should be able to access information on the project.

4.6.11.1 Performance Standard 1 (Environmental Assessment)

Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. An effective Environmental and Social Management System (ESMS) is a dynamic and continuous process initiated and supported by management, and involves engagement between the developer/proponent, its workers, local communities directly affected by the project and, where appropriate, other stakeholders. The Standard covers impacts on the natural environment (air, water and land); human health and safety; physical cultural resources; and trans-boundary and global environment concerns. A range of instruments can be used to conduct Environmental Assessments i.e. EIA,

Environmental Audit, hazard, or risk assessment and Environmental and Social Management Plan (ESMP). This has been undertaken.

4.6.11.2 Performance standard 2 (Labour and Working Conditions)

This standard's provisions have been guided by the International Labour Organization (ILO) and the United Nation and it recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. Through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, project proponents/developer may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

With one of its key objectives being promotion of compliance with national employment and labour laws it thus gives provisions in ensuring Occupational Health and Safety of workers for any development projects.

4.6.11.3 Performance Standard 3 (Resource Efficiency and Pollution Prevention)

This performance standard recognizes that increased economic activity and development often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There is also a growing global consensus that the current and projected atmospheric concentration of greenhouse gases (GHG) threatens the public health and welfare of current and future generations. This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices.

4.6.11.4 Performance Standard 4 (Community Health, Safety, and Security)

The standard recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. In addition, communities that are already subjected to impacts from climate change may also experience an acceleration and/or intensification of impacts due to project activities. While acknowledging the public authorities' role in promoting the health, safety, and security of the public, this Performance Standard addresses the developer's

responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.

4.6.11.5 Performance Standard 5 (Land Acquisition and Involuntary Resettlement)

Performance Standard 5 identifies that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement involves both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. The Resettlement Action Plan (RAP) will address and compensate all Project affected persons (PAPs).

CHAPTER FIVE: BASELINE ENVIRONMENTAL AND SOCIAL PARAMETERS

5.1 Introduction

The current vegetation along the project corridor has a mix of both planted and indigenous trees with Karura forest having a pristine canopy of trees. Trees such as Eucalyptus, Grevilea, jacaranda trees, Lantana Camara, Persian lilac, Croton Megalocapus, pine, bamboo, Thika palm, Nandi flame, and Wild strawberries are also visible. Other vegetation includes Napier grass, coffee, and crops such as arrow roots, maize, bananas, and horticultural produce. There are several flower nurseries. The rivers have riparian vegetation such grasses, sedges and rushes. Riparian areas play an important role in keeping water clean, Plate 3 and 4 .

Above ground vegetation acts as a filter to intercept sediments and pollutants found in run off. The root systems intercept the underground translocation of pesticide and fertilizer residues from cultivated uplands. Sediments in streambeds and lakes reduce the quality of habitat for fish and other aquatic organisms. Riverine vegetation that occurs along waterfronts provide an attractive landscape with many aesthetic appealing sights.

Plate 3: Vegetation along the project Route

Plate 4: River Riara and riparian vegetation along its banks

The socio-economic settings have several businesses activities such as; shopping Malls, car yards, petrol stations, restaurants and hotels, kiosks, churches, flower vendors, agricultural produce markets etc. Plate 5 and 6.

Plate 5: Flower Vendors along the Road Reserve

Plate 6: Commercial Building along Kiambu Road

5.2 Layout of the Chapter

5.2.1 Geographical Aspects and Boundaries

5.2.1.1 Project location and description

The project road is in Nairobi and Kiambu Counties of Kenya (Figure 1) at Easting 36 49' 49" and Northing -1 10' 29". The total road length measures approximately 25km (including bypasses, loops, and accesses) and the main road alignment commences at Pangani and Muthaiga Interchanges along Thika Road (A2) and proceeds through Kiambu ending at Ndumberi.

The road traverses an urban and peri-urban development setup which is densely populated. It also passes through an ecologically significant Karura Forest reserve and serves important installations, institutions and developments including; Muthaiga Golf Club, NIS, DCI Headquarters at Karura, Kiambu Institute of Technology, Police Stations, Schools and Shopping Malls. It cuts right across Kiambu Town and proceeds in a North westerly direction to Ndumberi.

Two Bypass Roads to Kiambu Town have been proposed, one on the eastern side starting at Riabai on Kiamnu -Ngewa (B30) Road and moving North wards and

terminating at Kiriguini B on Ndumberi - Githunguri (C210) Road. The other bypass is on the western side of Kiambu town and starts at Ndumberi Githunguri (C210) Road and cuts through Sasini coffee estate, cuts across B32 near Sasini Coffee Factory and terminates at Kiratina on Kiambu- Kanunga- Raini (C205) Road. A spur road to connect Muthaiga – Kiambu – Ndumberi (B32) Road to Kamiti Road has been proposed to start at an interchange to be constructed within the vicinity of Kiambu Institute of Science and Technology (KIST).

5.2.2 Administrative Structure

Nairobi County has a total area of 696.1 Km2 and is located between longitudes 36^0 45'East and latitudes 1^0 18'South. It lies at an altitude of 1,798 meters above sea level. It is divided into nine sub-counties namely; Starehe, Kamukunji, Kasarani, Makadara, Embakasi, Njiru, Dagoretti, Langata and Westlands. The County has 27 divisions 64 locations and 135 sub-locations. The County is divided into nine sub-counties namely; Starehe, Kamukunji, Kasarani, Makadara, Embakasi, Njiru, Dagoretti, Langata and West lands. The County has 27 divisions 64 locations and 135 sub-locations as shown in table 5.1 below.

Table 5.1. Nairobi County Administrative Structure

Sub-County	Area(km2)	Divisions	No. of Locations	No. of Sub-Locations
Starehe	10.6	3	6	12
Kamukunji	11.7	3	9	18
Kasarani	85.7	2	11	24
Makadara	20.1	3	5	11
Embakasi	52.1	3	6	13
Njiru	156.2	3	6	10
Dagoretti	38.7	3	8	16
Langata	223.4	4	7	16

Westlands	97.6	3	6	15
Total	696.1	27	64	135

Source: Nairobi County Integrated Development Plan, 2014.

In addition, Kiambu County is divided into twelve (12) sub-counties namely Limuru, Kikuyu, Lari, Gatundu South, Gatundu North, Githunguri, Kiambu, Ruiru, Thika, Juja, Kiambaa, and Kabete. These are further sub-divided into 29 divisions, 95 locations and 236 sub locations, table 5.2.

Table 5.2. Kiambu County Area by Sub Counties

Sub County	Area (km2)	No. of Sub-locations	No. of Wards
Gatundu South	192.4	38	4
Gatundu North	286.0	28	4
Ruiru	291.9	7	8
Juja	326.6	12	5
Thika	453.6	9	5
Githunguri	173.5	20	5
Kiambu	189.1	18	4
Limuru	281.7	20	5
Kikuyu	236.1	16	5
Lari	439.2	12	5
Kabete	60	40	5
TOTAL	**2543.5**	**233**	**233**

Source: Kiambu County Government, 2016.

Figure 4: Kiambu Sub Counties/Constituencies: Source: Kiambu County Government, 2016.

5.2.3 Government, Non- Governmental and Community Based Organizations

5.1.4.1. The National Intelligence Service (NIS)

The National Intelligence Service (NIS) is a disciplined civilian intelligence agency established under Article 242 of the Constitution of Kenya, 2010, to be primarily responsible for Security Intelligence and Counter Intelligence, besides performing other functions prescribed by national legislation.

5.1.4.2. Karura Forest Reserve

Karura Forest Reserve is an urban upland forest on the outskirts of Nairobi, the capital of Kenya. It is managed by the Kenya Forest Service (KFS) which is a state corporation that was established under the Forest Act, 2005 and Friends of Karura Forest

Community Association. This remarkable geographical location and natural resource is one of the largest gazetted forests in the world fully within a city limits. It covers an area of about 1,000 ha (2,500 ac). The forest has;

- A 15-metre waterfall,
- Archaeological sites (recently excavated, artifacts being analyzed),
- An old chimney incinerator – used by the Central Bank for the burning of decommissioned currency up until the mid-1990's,
- An abandoned stone quarry pond, now called Lily Lake,
- Caves which are considered to be sacred by many and steeped in Kenyan history (they were formerly used by the Mau-Mau freedom fighters as hideouts during the struggle for Independence),
- Patches of bamboo,
- Marshlands that attract bird life including winter migrants from Europe and Asia,
- Serene Groves of secondary and primary indigenous trees.

The Forest plantations cover some 630 ha. Species include imports from South America, Australia and the Asian sub-continent, such as Araucaria cunninghamii, Grevillea robusta, Eucalyptus saligna, E. globule, Cupressus torulosa and Cupressus lusitanica. Indigenous trees cover approximately 260 ha (not including some 25 ha in the largely alienated 110-ha salient east of Kiambu Road). Species include Olea europeae subsp. auspidata, Croton megalocarpus, Warburgia ugandensis (Muthiga in the vernacular or the Green Heart Tree), Brachyleana huillensis (Muhugu, the iconic image on the FKF logo), Uvaridendron anisatum, Markhamia lutea, Vepris nobilis, Juniperus procera (Cedar), Craebea brownii (a huge specimen sits just outside the largest Mau-Mau cave), Newtonia buchananii, Salvadora persica (Mswaki, the Toothbrush Bush), Ficus thonningii (Mugumu), Trichilia emetica, Calondendrum capense and Dombeya goetzenii.

Additionally, a number of shrubs are also found which have wide local medicinal use; these include Strychnos henningsii (Muteta), Erythrococca bongensis (Muharangware), Vangueria madagascariensis (Mubiro), Rhamnus prinoides (Mukarakinga), Caesalpinia volkensii (Mubuthi), Solanum incanum (Mutongu, Sodom Apple), Elaeodendron buchananii (Mutanga) and Rhus natalensis (Muthigio). The riparian belts along the Gitathuru and Ruaka streams host groves of Arudinaria alpina, Kenya's native bamboo

species. The exotic giant bamboo Dendrocalamus giganteus is mainly found growing within the tree nursery along the Karura River.

Additionally, small wetlands are found throughout the forest (occupying some 10 ha). These provide important habitats for birds and bird watchers. Indigenous orchids — representatives of nine Kenyan species — have been re-introduced to Karura Forest.

The forest is known to host a variety of animals. These include the Suni, Harvey's Duiker, Bushbucks, Bush Pigs, Genets, Civets, Honey Badgers, Bush Babies, Porcupines, Syke's Monkeys, Bush Squirrels, Hares and the Epauletted-Bat. A Side-striped Jackal has been recorded in Sigiria. To date, some 200 bird species have been seen in the forest. These include Ayres Hawk-eagle, the African Crowned Eagle, the Silvery-cheeked Hornbill, Hartlaub's Turaco, the Narina Trogon, the African Wood Owl, Crested Cranes, Sparrows, Doves, Weavers and Vultures. The call of the African Snipe has been heard at Lily Lake. The forest provides habitat for numerous species of butterflies, including the African Queen and the Desmond's Green Banded Swallowtail.

5.1.4.3. Friends of Karura Forest (FKF) Community Forest Association

The Friends of Karura Forest (FKF) is a Community Forest Association (CFA) founded in October 2009. A CFA is a mechanism established by the Forest Act of 2005 (sections 46 and 47, Forest Rules 41 and 42) to support the Kenya Forest Service in its mission to protect, manage and enhance Kenya's forest resources.

Under the terms of a Joint Forest Management Agreement with the Kenya Forest Service, FKF is a full partner in the management and conservation of Karura Forest Reserve. The terms of the Agreement cover such areas as security (electric fence, manned gates and associated infrastructure), conservation (reforestation, resource management, controlled access), and eco-friendly activities in support of conservation, education, science and recreation; as well as shared financial accountancy for all joint activities. Basically, the agreement enshrines the principles of cooperation that have hallmarked the phenomenal re-emergence of Karura as a

protected national heritage since 2009, when the FKF was chartered as a Community Forest Association.

5.1.4.4. Directorate of Criminal Investigations (DCI)

The current functions of the Directorate as provided for under the National Police Service Act, 2011 include;

- Collect and provide criminal intelligence,
- Undertake Investigations on serious crimes including homicide, narcotics crimes, human trafficking, money laundering, terrorism,
- Economic crimes, piracy, organized crimes, and cyber-crime among others
- Maintain law and order
- Detect and prevent crimes
- Apprehend offenders
- Maintain criminal records
- Conduct forensic analysis
- Execute the directions given to the Inspector General by the Director of Public Prosecutions pursuant to article 157(4) of the constitution
- Coordinate Country Interpol Affairs
- Investigate any matter that may be referred to it by the Independent Police Oversight Authority
- Perform any other function conferred on it by other written Law.

5.3. Community Organizations/Non –State Actors in Kiambu County

5.3.1. Co-operative Societies

The co-operative movement in the county is well established with societies covering several sectors. The county has 254 active co-operatives societies and 22 dormant ones. The total membership is 258,198 and the annual turnover is approximately KShs. 5,069,560,000. Types of co-operatives found in the county include dairy co-operatives, coffee co-operatives, transport SACCOs and housing SACCOs among others. The marketing co-operatives are engaged in production, processing and

marketing of members_ produce. The savings and credit co-operative societies give loans to members at affordable interest rates.

5.3.2. Non – Governmental Organizations

There are about 38 Non -Governmental Organizations that operate in the entire county. However, there is greater concentration in Kiambu and Thika towns within Kiambaa and Juja constituencies. Majority of them, concentrate in the fight against HIV and AIDS, children welfare and women empowerment.

5.3.3. Self Help, Women and Youth Groups

The county boasts of having one of the biggest numbers of registered Community Based Organization's (CBOs). Though actual data is not available, they are estimated to be more than 10,000. The groups are engaged in a wide variety of activities which include: Micro-finance, HIV and AIDS, Drugs and substance abuse campaign, Environmental conservation, Training and advocacy and other income generating activities. The county has over 3,746 active women groups and 1,664 youth groups.

Through these groups, women and youths are able to access loans through the Women Enterprise Fund and Youth Enterprise Fund that assist them to engage in income generating activities. Over 467 youth groups have already benefited from the Fund, while a total of 1,193 women groups have benefited from the Women Enterprise Fund. The youths engage in activities such as Jua kali sector, Micro-Finance (Revolving Loan Fund), HIV and AIDS and drug abuse campaign and Home Based Care, Environmental conservation e.g. tree planting, training and advocacy, entertainment, drama and theatre and income generating activities.

5.4. List of entities operating in the project area

Muthaiga Police Station, Muthaiga Golf Club, Karura Forest, DCI, NIS, Health Centers, Hospitals, Nairobi water and Sewerage, Shopping malls, Petrol Stations, Car Yards, Hotels and Restaurants, Supermarkets, Agricultural Produce Markets, Schools, Colleges.

5.5. ENVIRONMENTAL BASELINE SURVEY

5.2.4 Physiography and Geology

The terrain in the eastern side of Nairobi County is gently rolling but divided by steep valleys towards the City boundaries. To the north, there is the Karura forest which is characterized by steep sided valleys. The Karen - Langata area is characterized by plains surrounded by Nairobi National Park on the east and Ngong Forest on the south.

Several streams with steep-sided valleys covered with vegetation are a dominant landscape feature of the County. The main rivers in the County are Nairobi River, Ngong River, Mathare and Kabuthi River. These rivers are highly polluted as open sewers and industrial waste is directed towards them. Nairobi dam, which is along the Ngong River, and Jamhuri dam are the main water reservoirs in the County. The main types of soils are the black cotton and the red soils that form patches in different parts of the County. There are three forests in the County namely Ngong Forest to the south, Karura Forest to the north and the Nairobi Arboretum. The three forests have a total coverage of 23.19 Km2.

Kiambu County is divided into four broad topographical zones i.e. Upper Highland, Lower Highland, Upper Midland and Lower Midland Zone. The Upper Highland Zone is found in Lari Constituency and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 meters above sea level. It is dominated by highly dissected ranges and it is very wet, steep and important as a water catchment area.

The lower highland zone is mostly found in Limuru and some parts of Gatundu North, Gatundu South, Githunguri and Kabete constituencies. The area is characterized by hills, plateaus, and high-elevation plains. The area lies between 1,500-1,800 meters above sea level and is generally a tea and dairy zone though some activities like maize, horticultural crops and sheep farming are also practiced. The upper midland zone lies between 1,300-1,500 meters above sea level and it covers mostly parts of Juja and other constituencies with the exception of Lari. The landscape comprises of volcanic middle level uplands. The lower midland zone partly covers Thika Town (Gatuanyaga), Limuru and Kikuyu constituencies. The area lies between 1,200-1,360 meters above sea level. The soils in the midland zone are dissected and are easily eroded. Other physical features include steep slopes and valleys, which are unsuitable for cultivation. Large parts of Lari, Gatundu north and south sub counties are covered by forest.

The road project area is generally on a lower highland with moderate to rolling hills with some few mild hills and depressions. There is an average altitude of 2,240m above sea level rising from kikuyu escarpment in the northern westerly direction to Muthaiga in the south easterly side of the project road. The land generally slopes to the south east from the escarpment hills towards Muthaiga. Kiambu town has a relatively flat to moderate terrain as no major river crosses the center.

The project road traverses a series of trachyte and tuff rock rheology that encompass light-colored, very fine-grained extrusive igneous rock that is composed chiefly of alkali feldspar with minor amounts of dark-colored minerals such as biotite, amphibole, or pyroxene. Compositionally, trachyte is the volcanic equivalent of the plutonic intrusive in which abundant, large, well-formed crystals (phenocrysts) of early generation are embedded in a very fine-grained matrix (groundmass). The series of trachyte rock traversed include the following:

- PKA' – Lower Kerichwa Tuff.
- PNt – Nairobi trachyte.
- PKt – Kiambu Trachyte.
- P-I-It – Limuru Trachyte.

The rapid cooling and solidification of trachytic lava produces the fine texture of the groundmass, and cooling may be so rapid locally that small quantities of glass are formed. Trachyte is commonly associated with other lavas in volcanic regions and is thought to have been formed by the crystallization and abstraction of iron, magnesium, and calcium minerals from a parent basaltic lava.

5.2.5 Soils

The common soil type within the project area are the andosols (volcanic soils); these are soils that are formed from recent volcanic material. They are thick, loose, granular, dark grey to black forming the 'A'-horizon. This is overlaid by a yellowish brown or brownish 'C' horizon. Most parts of the project area are covered by soils from degeneration of volcanic rocks which are well drained with moderate fertility. They are red to dark brown friable clays suited for cash crops like coffee, tea and pyrethrum. The soil layer may be coarse or fine textured but has usually high silt content. They are very porous, have a low bulk density (less than 0.85g/cm3) and high organic matter content, table 5.4.

Table 5.4. Soil Permeability Classification

Soil Class	Description
1	Impermeable – e.g. rock surface
2	Very low permeability Clay soils with high swelling potential Shallow soils over largely impermeable layer, very high-water table
3	Low permeability. Drainage slightly impeded when soil fully wetted
4	Fairly permeable. Deep soils of relatively high infiltration rate even when wetted
5	Very permeable. Soils with

Soil Class	Description
	very high infiltration rates such as sand, gravels and aggregated clays

The soil drainage characteristics have been classified in accordance with the (Transport and Road

Table 5.5. Soil Drainage Characteristics

No.	Soil Class	Description
1.	Impeded drainage	• Very low permeability . • Clay soils with high swelling potential. • Shallow soils over largely impermeable layer, very high-water table.
2.	Slightly impeded drainage	• Low permeability . • Drainage slightly impeded when soil

		fully wetted.
3.	Well drained	• Very permeable. • Soil with very high infiltration rates such as sands, gravels and aggregated clays.

Source: TRRL Laboratory Report 706, Transport and Road Research Laboratory, Department of Environment, UK, 1976.

5.2.6 Climate

Nairobi County has a fairly cool climate resulting from its high altitude. Temperature ranges from a low of 10°C to a high of 29°C. It has a bi-modal rainfall pattern. The long rains season fall between March and May with a mean rainfall of 899 millimeters (mm) while the short rains season falls between October and December with a mean rainfall of 638 mm. The mean annual rainfall is 786.5 mm.

The Kiambu County experiences bi-modal type of rainfall. The long rains fall between Mid-March to May followed by a cold season usually with drizzles and frost during June to August and the short rains between mid - October to November. The annual rainfall varies with altitude, with higher areas receiving as high as 2,000 mm and lower areas of receiving as low as 600 mm. The average rainfall received within the county is 1,200 mm. The mean temperature in the county is 26°C with temperatures ranging from 7°C in the upper highland areas towards Limuru, some parts of Githunguri and Kabete constituencies, to 34°C in the lower midland zone found partly in Kikuyu, Limuru and Kabete constituencies (Ndeiya and Karai). July and August are the months during which the lowest temperatures are experienced, whereas January to March are the hottest months. The average relative humidity within the county ranges from 54 percent in the dry months and 300 percent in the wet months of March to August.

5.5.4. Climate Change

Climate change effects within Kiambu County are manifested through changes in rainfall patterns, distribution and amounts. The county experiences less drought and flooding effects in comparison to other counties. In drought periods, the water levels within the rivers and wetlands are reduced resulting in ripple effects of reduced water flows hence less water supply within the county for industrial, household and agriculture. Environmental degradation has been rampant in the county, whereby there is massive felling of trees in forests like Kinare, leading to high risk of soil erosion and desertification. This has been brought about by increased population pressure and fuel demand by most industries. This has led to adverse changes in the rains cycle affecting the river discharge. The development of industries coupled with population pressure has significantly increased the pollution levels including air pollution that the existing facilities are unable to handle. Pollution especially from industries for example: tea factories and coffee industries are a real danger to the environment because of disposing effluents into air and the rivers in the county. The poor farming methods, pesticides and chemicals used in agricultural activities have also led to pollution of rivers and the environment.

To mitigate climate change, county government continues to work closely with relevant county and national institutions, to ensure proper waste management, good treatment of effluent wastes to the required standards, sensitization and education on proper and sustainable environmental conservation measures, including afforestation of private land, to make the county environmentally clean. Other mitigation initiatives by the county include the promotion of climate smart agriculture, soil and water conservation, promotion of water value chains, agricultural value chains, and use of renewable energy, including solar and biogas digesters at the household and institutional levels.

5.2.7 Air Quality

Peak carbon monoxide levels were all above the NEMA limit levels for ambient air. All the sampling sites had heavy traffic loading during the peak hours. Site1, Muthaiga site recorded the highest level of 15.8 ppm, higher than three times the NEMA limit

level for 8 hrs. All sites recorded high levels for carbon monoxide during the morning (6.30 -10.00am) and evening (16.00-20.00pm) sampling periods, values higher than the NEMA limit levels for 1hr (8.6ppm) but lower values during the midday sampling period (11.00-14.00pm). The average carbon monoxide levels for all sampling sites were all below the NEMA limits for 8hr and 1hr for ambient air.

Peak nitrous oxides levels were all above the NEMA limit levels (0.05ppm) which was the case for all sampling sites for average nitrous oxide levels (except site 3 during the morning sampling period). The average nitrous oxide levels were all lower than the peak nitrous oxide values recorded.
Peak levels of sulphur oxide levels were all above NEMA ambient limit values (for 24hr, average levels 0.05ppm), while the average levels were all below the NEMA limit levels for ambient air.

Levels of volatile organic compounds, non- methane hydrocarbons and hydrogen sulphide were all below the detection limit for the sensors for all sites. The levels of volatile organic compounds, non-methane hydrocarbons, and hydrogen sulphide were below detection limit. There are no activities along Kiambu road generating these gases, e.g. chemical industrial activities, solid waste dump sites or petroleum handling facilities.

Maximum levels of particulate matter of diameter less than 10 micron (PM_{10}) were high and above 1000 µg/m^3 for all sites. The average PM_{10} recorded were below the NEMA limit levels except for site 2 (Kiambu road-bypass junction) during the morning sampling.

5.2.8 Surface and Groundwater Resources

The project area lies within the Upper Athi catchment basin which is bound by latitudes 1° to 4.5° South and Longitudes 37° to 40° East, and ranges in altitude from 2600 m to 1500 m above mean sea level. It extends from the Ngong Hills and part of the Aberdares to the North West, abuts the Rift Valley to the west, the Yatta Plateau to the east and the Indian Ocean to the south east, fig. 5.1 and 5.2.

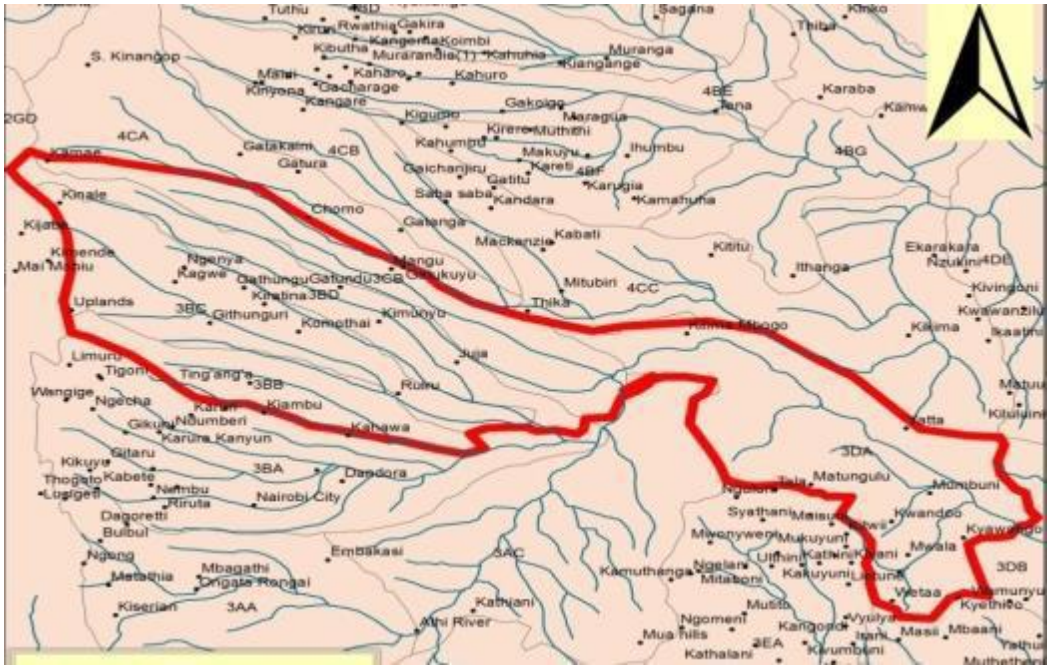

Figure 5.1. Upper Athi Sub Catchment: Source, Kiambu County Water and Sewerage Services Sector Policy, 2017 February.

Figure. 5.2. Kiambu County Sub-Catchment: Source, Kiambu County Water and Sewerage Services Sector Policy, 2017 February.

Several streams in Nairobi County have steep-sided valleys covered with vegetation are a dominant landscape feature of the County. The main rivers in the County are Nairobi River, Ngong River, Mathare and Kabuthi River. These rivers are highly polluted as open sewers and industrial waste is directed towards them. Nairobi dam, which is along the Ngong River, and Jamhuri dam are the main water reservoirs in the County. The main types of soils are the black cotton and the red soils that form patches in different parts of the County.

Nairobi County has no main water tower; most of the supply is from the Tana Basin and is pumped to the City from distances of around 50 Km. This bulk water-supply is not reliable during periods of drought, and is also endangered by siltation of the reservoir due to deforestation in the catchment areas. The supply problem is further aggravated by the poor state of the distribution system, which results in about 50 per cent losses due to leakage, illegal connection and inefficient and wasteful use of water by some consumers. The main sources of water for the residents in Nairobi County are from Sasumua Dam in Nyandarua, Kikuyu Springs, Ruiru Dam, Thika and Ngethu water works. Although Nairobi River is permanent, its water is unsafe for human consumption. There are residents that use borehole water, wells and roof catchments. Over 80 per cent of the residents have access to piped water.

Water in Kiambu County is from two principal sources- surface and sub-surface. About 90 percent of the county's water resource comprises of both surface water resources and ground water potential. The county is divided into several sub-catchments areas. The first one is Nairobi River Sub-catchment which occupies the southern part of the county with the major rivers being Nairobi, Gitaru, Gitahuru, Karura, Ruirwaka, and Gatharaini. The second one is Kamiti and Ruiru Rivers Sub-catchment which is located to the north of the Nairobi river sub-catchment.

It has eight permanent rivers which include Riara, Kiu, Kamiti, Makuyu, Ruiru, Bathi, Gatamaiyu and Komothai. The third one is the Aberdare plateau that contributes to the availability of two sub-catchments areas comprising of Thiririka and Ndarugu Rivers. The main streams found in the two areas include Mugutha, Theta, Thiririka,

Ruabora, Ndarugu and Komu. They flow from Nairobi, Kamiti, Ruiru, Thiririka, and Ndarugu sub-catchments to form Athi River sub-catchment. The fourth is the Chania River and its tributaries comprising of Thika and Kariminu Rivers which rise from the slopes of Mt. Kinangop in the Aberdare range. Last one is Ewaso Kedong sub catchment which runs in the North-South direction and occupies the western part of the county. It has several streams that normally form swamps.

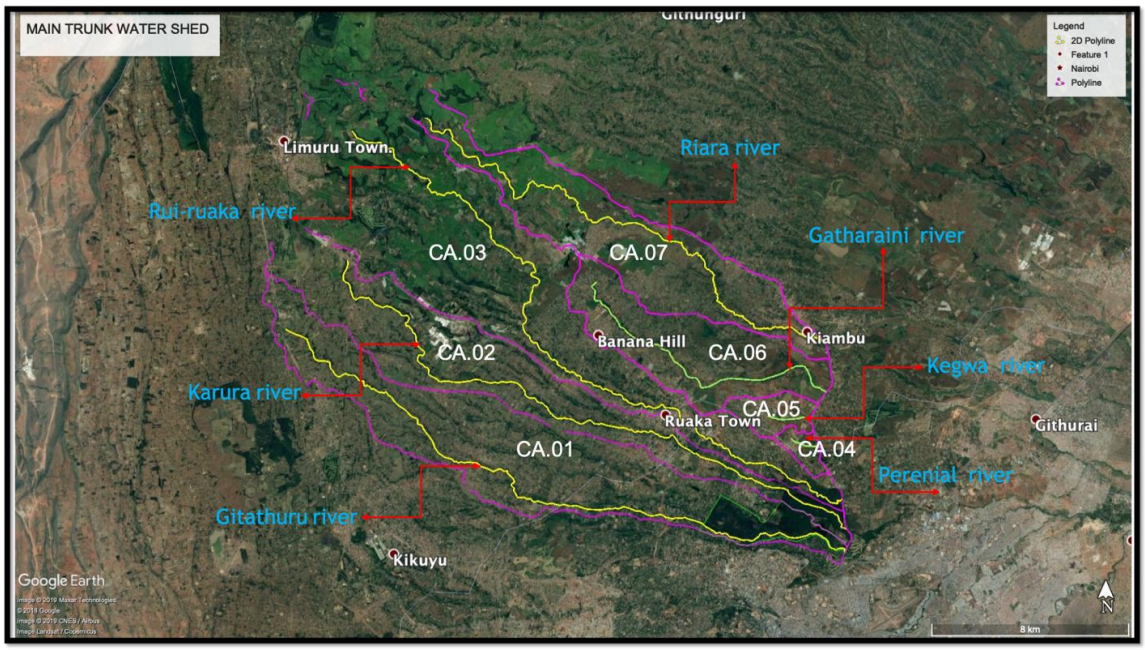

Figure 5.3. Site layout of the proposed road and drainage.

The proposed road drains at the locations is as indicated in table 5.5 below

No.	Name of River	Chainage
1	Gitathuru river	Km 0+683
2	Karura river	Km 1+783
3	Rui-ruaka river	Km 3+064.53
4	Perenial Stream	Km 5+360
5	Kigwa river	Km 6+544
6	Gatharaini river	Km 7+840
7	Riara river	Km 9+820
By-passes		
1	Karumu River	

2.	Riara River- Upstream	
3.	Riara River tributary /Stream #1	
4.	Kiu River tributary/Stream #1	
5.	Kiu River tributary River/Stream #2	
6.	Kiu River	

5.2.9 Ground Water

Kiambu County is in a sub catchment that has two main aquifers; the Nairobi Suite and Basement Athi Suite. Most of the ground water exploitation is from the Nairobi Suite which is predominantly volcanic. Kiambu County falls within the Upper Athi Catchment Area, which covers seven Sub-Catchments viz;

- 3BA (Nairobi)
- 3BB (Kamiti, Riara, Kiu),
- 3BC (Ruiru, Mukuyu, Gatamaiyu),
- 3BD (Thiririka & Theta),
- 3CB (Ndarugu, Ruabora)
- 4CA (Chania)
- 3DA (Athi River)

5.5.8. Degradation of the water resources

Some water resources are highly polluted, making them unsafe to use. This is due to pollution of water sources from effluent waste, disposal of waste water from treatment plants, raw effluent discharges in urban and semi urban settlements, and agro-chemical in the agricultural areas. There is high depletion of vegetation cover due to deforestation within the water resources, including wetlands within the county. This is attributed to population pressure and increased demand for both environmental and forest resources especially timber. Depleted vegetation cover exposes water resources to high evapotranspiration rates, more runoff and less/low recharge of ground water aquifers. There is high rate of depletion of ground water resources due to over extraction, low recharge and environmental degradation. The crop and fertilizer residuals have resulted to eutrophication of waters, presence of invasive plant and animal species and pollution. Majority of the water resources have challenges of encroachment of riparian zones and wetlands. Some of the riparian

lands are under farming of agricultural crops, loosening the soils and clearing the vegetation, hence soils erosion and increased levels of evapotranspiration.

5.2.10 Water Quality

The project is likely to obtain water from boreholes and from rivers along the road route. There are five rivers along the project route i.e. Rivers Karura, Rwaka, Riara, Gatathuru, Kigwa and Gatharaini rivers. A borehole can be drilled along the road corridor for use to reduce over reliance on water from the rivers. Drilling boreholes that tap deep aquifers requires Government approval, through an abstraction permit from the Water Resources Authority (WRA), and an EIA license from NEMA. These are required for each borehole that may be drilled. Water quality grab samples were collected from the rivers above and KIST natural spring.

5.2.11 Terrestrial/ Aquatic Environment: Flora and Fauna

Nairobi County is predominantly a terrestrial habitat that supports a diverse web of biodiversity ecosystems. It is home to about 100 species of mammals, 527 bird species and a variety of plant species. Although it is endowed with some permanent rivers, the aquatic ecosystems are largely choked by the effects of pollution from different sources. It is home to three gazetted forests namely Karura, Ngong Road forest and Nairobi Arboretum. Karura forest is the largest of the three with 1,041 hectares located in northern Nairobi. It contains 605 species of wildlife including three types of antelopes. 632 hectares contain plantations while indigenous trees cover 260 hectares. The rest of the forest is shrubs and other plants. Ngong Road forest covers 538 hectares with 80 per cent being indigenous trees and 20 per cent exotic eucalyptus plantations.

Nairobi Arboretum is 30 hectares of wooded landscape, an oasis close to the heart of the City situated about 3Km from the City centre and adjacent to State House. It is one of the few remaining green spaces in Nairobi with shaded walkways, picnic lawns and jogging trails.

5.2.12 Land Resources

The size of arable land in the county is 1,878.4 Km2 and the non-arable land is 649.7 Km2 and 15.5 Km2 is under water mass. The main mining activities include natural gas exploitation in Lari constituency by Carbacid Company Limited and extraction of ballast, hardcore, gravel, murram, sand and building stones in Juja, Gatundu South and Gatundu North Constituencies. The arid parts of the county mainly Ndeiya and Karai in Limuru and Kabete constituencies contain diatomite deposits that are unexploited.

5.5.11.1. Land and Land Use

There are seven main land use classes in Kiambu County which are classified as wet-land, water body, grassland, forest land, built area /urban, bare land/rock area and agricultural land, (Musa & Odera,2015).

5.5.11.2 Mean holding size

The size of arable land in the county is 1,878.4 Km2 and the non-arable land is 649.7 Km2 and 15.5 Km2 is under water mass. The average holding size of land is approximately 0.36 Ha on small scale and 69.5 Ha on large scale. The small land holdings is mostly found in upper parts of Gatundu North, Gatundu South, Kiambaa, Limuru and Kikuyu constituencies. The fragmentation of the land has made it uneconomical and hence majority of the farmers are converting their farms into residential plots to supplement the meagre income from the farms. The large land holdings are usually found in the lower parts of the county especially in Juja constituency and the upper highlands in Limuru and Lari constituencies.

5.5.11.3. Percentage of land with title deeds

Nairobi County Land use is in the following zones; Industrial, Commercial, Residential, Infrastructure, Natural Resources (Forests and National Park, Riverine areas), Plantations, Sports Stadiums and play grounds, Railway and bus terminus, Airport and KPA dry port.

Kiambu County Plans indicated that 85 percent of the population with land in the county has title deeds to their land and there are no recorded cases of incidences of landlessness. The remaining 15 percent have not received their title deeds due to unfinished land adjudication process and non-payment of the necessary levies.

Agriculture is the predominant economic activity in the county and contributes 17.4 per cent of the County‘s population income. It is the leading sub sector in terms of employment, food security, income earnings and overall contribution to the socio-economic wellbeing of the citizens. It is also a major source of employment. Coffee and tea are the main cash crops in the county. The main food crops include maize, beans, pineapples and irish potatoes. They are mainly grown in small scale in the upper highlands of Limuru, Kikuyu, Gatundu North and South Constituencies. The County is promoting agribusiness initiatives through greenhouses support to with

objective of increasing production of horticultural crops and increase income for famers.

Kiambu County is known for its livestock production especially dairy farming. There is need therefore to ensure adequate animal feeds production. According to 2009 Population and Housing Census, the numbers of livestock in the county were as follows: 230,294 cattle, 120,056 Sheep, and 89,817 goats. The growth in the agri-business sub-sector has been encouraged by a ready urban market in Thika, Ruiru, Kiambu and Nairobi and the availability of local food processing factories such as Farmers´ Choice Ltd, Kenchic Co. Ltd, Brookside Dairies, Githunguri Dairies, Ndumberi Dairies, Limuru Milk and Palmside Dairies, among others. The county government of Kiambu is promoting fish farming with an objective of improving nutritional status of the citizens and increase income of the farmers.

5.2.13 Archaeological, Historical and Cultural Sites

Both colonial and post-colonial leaders have their statues erected here. They include Queen Victoria, Kings George V and VI, and Lord Delamere, a member of the British peerage. President Jomo Kenyatta, the Mau Mau freedom fighter Dedan Kimathi and national leader Tom Mboya are the contributions of the post-colony. The Kiambu county government has set Ksh5 million to build an Iganjoini cultural site in Gatundu north forest. Mugumo Gardens is one of the Kiambu county sights named after a 15-foot diameter, giant tree. The site in Thika serves as a historical site in memory of Prophet Mugo wa Kibiro. Thika World War Memorial Park attracts tourists interested in learning more about the world war and those who lost their lives in defense of their country. In 1888, the missionary Rev, Watson Scott of the Church of Scotland arrived in Thogoto in Kikuyu to start a mission, currently PCEA Church of the Torch in Kikuyu.

5.2.14 Visual Aesthetics

Muthaiga Golf club, Karura forest with pristine tree canopies and several winding rivers with riparian vegetation provide beautiful and pristine aesthetics.

5.5.14 Noise and Vibrations

The Kenya Government has set a noise standard limit at 90 dB (A) for 8 hours as the Occupational Exposure Level (OEL), which most workers can continually be exposed to

without developing occupational hearing loss in industries (BS 5228,1997). This is the recommended noise limit to reduce hearing loss (occupational deafness).

The regulations also require that: -

i. Where noise gets transmitted outside the workplace shall not exceed 55 dB (A) during the day and 45 dB (A) during the night;

ii. Noise measurements shall be carried out at least once in every period of twelve months in order to determine the prevailing noise conditions at workplace;

iii. Where noise exceeds continuous equivalent of 85 dB (A) an effective noise control and hearing conservation programme shall be developed and implemented.

iv. World Health Organization has recommended for residential area noise exposure limits not to exceed Leq 55dB (A) daytime and Leq 45dB (A) night time.

For Industrial and commercial area: Day Time – 70 dB (A) and Night Time –55 dB (A)

i. Daytime is dawn or 7 am (whichever is later) to dusk or 7 pm (whichever is earlier)

ii. Evening is from the end of the daytime to 10pm

iii. Night is from 10 pm. to the start of daytime

Other international Recommended Threshold Limit Values (TLV) include (International Labour Organization (ILO), American Conference of Industrial Hygienist (ACGIH) 1989-guideline document) and World Health Organization (WHO).For ILO and ACGIH, in offices however the nature of work requires higher mental concentration and therefore, the noise level should be below 60 dB (A).

i. For speech, comfort and work interference, noise levels less than 60 dB (A) is adopted.

ii. For workshop and plant area where occasional communication is required, the recommended limit is 75 dB (A).

iii. For workshop office, control room, laboratories and workshop where easy communication is required, the recommended limit is 60 dB (A).

iv. For offices, mess-room, canteens, the limits recommended is 50 dB (A).

v. For prestige offices, conference rooms, the noise level limits recommended are 35 dB (A).

WHO has recommended noise exposure limits for residential area not to exceed Leq 55dB (A) daytime and Leq 45dB (A) night time (World Bank, 1998).

5.5.15. Solid and Liquid Wastes

About 61.5 per cent of the population in Nairobi County use flush toilets as the main waste disposal method, while 32.1 per cent use pit latrines. The remaining 4.8 percent of the population have no means of waste disposal. On garbage collection, 36.1 per cent of the communities have their garbage collected by private firms and similar percentage is collected by neighborhood community groups.

Waste Water Treatment Works (WWTW) for Kiambu town which has a design capacity of treating only 2,200 m^3/day. The WWTW was not fully constructed and it is currently overloaded. The sewerage network and WWTW is not able to meet the existing demand thus the Water Service Provider (WSP) Kiambu Water and Sewerage Company (KIWASCO) is no longer connecting consumers to the sewerage network). Most of the developing areas within the county are not served by the sewer system. The urban and peri-urban areas which are not served by the sewerage network use septic tanks as an alternative mode of sanitation.

Garbage disposal around the urban centers within the county of Kiambu covers a small percentage of waste/garbage collection as only 2.6 percent of the total population has facilities for waste disposal, about 0.7 percent of the total population uses private firms, 29.1 percent use garbage pits, 29.6 percent use farm gardens, 12.1 percent use public garbage heap and 25.9 percent opt to burn the waste/ garbage. This has a negative effect on the environment and hence proper mechanisms for waste disposal need to be put in place to ensure the county remains clean. There is a proposal to construct a county landfill which will handle all solid waste from sub-

counties which should be accompanied by modern incinerators to burn hazardous waste as well as waste that cannot be decomposed.

The county does not have enough resources for development of waste water, effluent and solid waste treatment plants. Some of the few infrastructures available are non-functional or having blockages from uncontrolled solid waste disposal.

5.3 Social-Economic Baseline Survey

5.3.1 Social Characteristics

5.3.1.1 Demographic Features

5.3.1.1.1. Population Size and Composition

In 2012, Nairobi County population was projected to be 3,517,325 and is expected to rise to 3,942,054 in 2015 and 4,253,330 in 2017. According to the 2009 Kenya Population and Housing Census, Kiambu County population for 2012 was projected to be 1,766,058 with 873,200 males and 892,857 females. Further, the population is expected to reach 2,032,464 people by the end of 2017. This is influenced by the County's high population growth rate, which is at 2.81 per cent and the influx of people working in the city who prefer to stay in Kiambu and its environs where there is less congestion and well developed infrastructure. In terms of gender, the sex ratio of male to female is approximately 1:1.02. Ruiru constituency had the highest population with a total of 219,752 people while Gatundu North constituency had the lowest population of 109,460 people. The county's population is projected to be 1,921,392 in 2015, and 2,032,466 in 2017.

5.3.1.2 The Gender Inequality Index (GII)

It reflects gender-based disadvantage in three dimensions—reproductive health, empowerment, and the labour market. The index shows the loss in potential human development due to inequality between female and male achievements in these dimensions. It varies between 0—when women and men fare equally—and 1, where one gender fares as poorly as possible in all measured dimensions. Kenya has an overall GII of 0.651(Draft 7th Human Development Report). This is however, not equal everywhere as there are regional disparities with counties located in Arid and Semi-Arid Lands (ASALS) having high Gender Inequality Indices. In addition, there are certain groups which are more likely to experience poverty. These vulnerable groups

include children living in poor households, the disabled and the youth. Improving equity in gender issues and reducing gender disparities will benefit all sectors and thus contribute to sustainable economic growth, poverty reduction and social injustices.

5.3.1.3 Persons with Disabilities

The population of Persons with Disabilities comprises of visual – 0.47 percent, hearing – 0.23 percent, speech 0.42 percent, physical/self-care 0.79 percent, mental 0.32 percent and other 0.15 percent. The total percentage is 2.38 percent of the total population. These groups of people are vulnerable and experience low capital base, inappropriate entrepreneurial and vocational skills and unemployment. This leads to increase in dependency ratio.

5.3.1.4 Education

Nairobi County is very vibrant on the education front. This is demonstrated by high concentration of tertiary and university level institutions with science and technology institutions being 237 as at 2012. It hosts the oldest public university in the country; The University of Nairobi, and 16 university colleges and campuses. There are 1,225 primary schools in Kiambu County out of which 576 are public and 349 are private. The total number of primary school teachers is 21,090 and the teacher to pupil ratio is 1:38.

The total enrolment rate stands at 295,409 pupils comprising of 115,375 males and 113,910 females. The gross enrolment rate stands at 109.6 percent, while the net enrolment rate is 99.7 percent. This could be attributed to the introduction of Free Primary Education programme. Infrastructure in schools has also improved through devolved funds e.g. Constituency Development Fund (CDF) and Local Authority Transfer Fund (LATF). However, the county still needs to invest in the provision of additional education facilities because of the increasing number of school going population. In addition, there are 303 secondary schools consisting of 227 Public and 76 private schools. The total enrolment rate is 89,065 out of which 44,777 are males and 44,288 are females.

The County has one public University, Jomo Kenyatta University of Agriculture and Technology located in Juja Constituency. There are five private universities which

include Gretsa University, Mount Kenya University, St. Paul's University, Kiriri Women's Science and Technology University and Presbyterian University of East Africa and a number of tertiary colleges. The county has some of the best national secondary schools such as Alliance Boys High School, Alliance Girls School, Loreto Girls High School, Limuru Girls High School and Mangu High School.

5.3.2 Economic Settings

There are 2061 industries in Nairobi County with 422 being in manufacturing. Most of these industries are located in industrial area, Kariobangi and Baba Ndogo areas. Kiambu County is well endowed with industries mostly located in Thika and Ruiru Constituencies. Thika Town constituency has several industries namely Bidco Oil Industries, Thika Motor Vehicle dealers, Thika Pharmaceutical Manufacturers Limited, Devki Steel Mills, Broadway Bakeries, Kenblest Industry, Kel Chemicals, Thika Rubber Industries Limited, Macadamia Nuts, Campwell Industry and Kenya Tanning Extracts Limited. In Ruiru constituency, the major industries include Clay Works as well as Spinners and Spinners.

The Bata Shoe Factory which is the Country's major producer of leather products is located in Limuru constituency. These industries act as a major source of employment and market outlet for agricultural and non-agricultural products both for domestic use and export. The agro processing includes Farmers´ Choice Ltd, Kenchic Co. Ltd, Brookside Dairies, Githunguri Dairies, Ndumberi Dairies, Limuru Milk and Palmside Dairies, among others.

In addition, the County has a total of 116 markets with Gatundu South and Lari sub-counties having the largest number of markets at 18 and 15 respectively. Other markets in the county include Githunguri (12), Juja (11), Kiambu (10), Ruiru (4), Limuru (11), Kikuyu (6), Kabete (6), Gatundu North (8), Kiambaa (7) and Thika (8). (Source: County Department of Trade). There are also a number of urban centres with the largest being Thika Town which is one of the largest industrial towns in the country. Other urban centres include Kiambu and Karuri in Kiambaa constituency, Kikuyu in Kabete constituency, Limuru in Limuru Constituency, Gatundu in Gatundu South Constituency and Ruiru in Juja Constituency.

Kiambu County is well covered by mobile network which is estimated at 98 percent even though landline coverage is very poor with only 214 connections in the entire county. This might be attributed to the fact that landlines are becoming obsolete and have a high maintenance cost. There are 19 post offices and 14 sub-post offices which are fairly distributed within the county. Currently there are 149 cyber cafes and eight private courier services operating within the county which are mostly located in the urban centres of Thika, Ruiru, Karuri, Kiambu, Limuru and Kikuyu.

There are a total of 17 commercial banks with branches well distributed within the county. In addition, there are eight microfinance institutions, one building society, four village banks and 12 insurance companies. The institutions are well distributed within the county and hence they are easily accessible. This is an indication of vibrant economic activities that are able to sustain the financial sector making it one of the fastest growing sectors in the county over the last five years.

5.3.2.1 Employment and Other Sources of Income

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

5.3.2.2 Wage Earners

Kiambu County has 902,848 persons who are wage earners representing 51.6 per cent of the total household's income in the county. These people are either skilled or unskilled and most of them are employed in coffee plantations, tea farms, industries, quarry sites and other agricultural farms. In order to ensure the county's economy remains vibrant there is need for expansion of the job market to ensure great percentage of the population becomes wage earners. In rural areas, 157,473 persons are self-employed whereby they engage in agricultural activities for their livelihoods. On the other hand, 384,935 of the persons in urban centres are self-employed, having set up businesses and small scale industries. Unemployment rate is high with 17 percent of the population unemployed.

5.3.3 Tourism

5.3.3.1 Main Tourist Attractions, National Parks/Reserves

Nairobi is the only capital City in the world with a national park close to its City centre. The Nairobi Safari Walk is a major attraction to tourists as it offers a rare foot experience for wildlife viewing. The County boasts of the Nairobi National Museum which houses a large collection of artefacts portraying Kenya's' rich heritage through history, nature, culture and contemporary art. Other important museums include Nairobi Gallery and the Karen Blixen Museum. Nairobi is considered the safari capital of the world and has many spectacular hotels to cater for safari bound tourists. It is also home to the largest skating ice rink in East Africa at the Panari Hotel sky centre covering 15,000 square feet and accommodating 200 people.

Kiambu County does not have National parks or game reserves apart from tourist attraction sites which are unexploited. The sites include Kinare Forest in Lari Constituency, Chania Falls and Fourteen Falls in Juja Constituency, Paradise Lost and Mugumo Gardens in Kiambaa Constituency, Mau Mau Caves, Gatamaiyu Fish Camp and historical sites in Gatundu and Githunguri Constituencies respectively.

5.3.3.2 Main Wildlife

Nairobi County is home to about 100 mammal species, 527 bird species and a variety of plant species. Nairobi National Park has got a variety of Africa's best known animals such as giraffes, zebras, ostriches, lions, baboons, cheetahs and endangered species of black rhinos and white rhinos.

Kiambu County has few wildlife resources since many gazetted forests were allocated illegally to individuals. However, Kinare forest in Lari Constituency has an ecosystem that constitutes a dense forest with elephants, hyenas, bush baby, baboons, colobus monkeys, dik-dik, bush pigs, tree and ground squirrels, porcupines and many species of birds such as weaver, guinea fowls, sparrow among others.

5.3.3.3 Tourist Class Hotels/Restaurants, Bed Occupancy

The tourism sector in Nairobi County is supported by several world class hotels and restaurants together with excellent conference facilities. There exist fifteen 5-star hotels and twelve 4-star hotels with a combined bed capacity of 5,700 beds.

Kiambu County has 682 unclassified hotels and 694 bars and restaurants which are well distributed within the county. Availability of such facilities in this county is affected by its proximity to Nairobi where tourist facilities of all classes exist in abundance.

5.4Health Settings

Kenyatta National Hospital is the major referral hospital in Nairobi County. There are 16 sub- County hospitals, 9 mission, 32 private, 15 nursing homes, 38 public health centres as well as 45 private health centres. The County has 30 public dispensaries, Private dispensaries, 84 private clinics and 22 public clinics. Kenyatta National Hospital has a total bed capacity of 1,800. Level 5 hospitals in the County have a bed capacity of 750.

There are 364 health facilities spread across Kiambu County. Under the public facilities, the county has one level-five hospital namely Thika District Hospital, three level-4 in Gatundu South, Kiambaa and Kikuyu Constituencies, four level-three in Gatundu North, Juja, Kiambaa and Limuru Constituencies. There are 20 level-two (Health Centres) and 54 level-ones also known as dispensaries which are well distributed within the county. The rest of the facilities are private with 17 Mission Hospitals, five nursing homes, 36 dispensaries and 169 private clinics. The doctor/population ratio in the county is 1:17,000 and the nurse/population ratio stands at 1: 1,300. The average distance to the health facility is seven Km and the facilities are well accessed since the road network is good.

5.4.1 Morbidity

The most prevalent diseases in the county are Flu which accounts for 35.3 per cent of the total hospital visits, Malaria accounts for 18.6 percent of the total hospital visits, Respiratory Tract Infections (RTI) at 9.7 percent, and Ear Nose and Throat Infections account for 3.1 percent of hospital visits.

5.5 Security and Public Safety

Street lights will form part of the road furniture and this will improve security of the area along the roads also better road communication would result in an improvement of security by increasing easier movement by security agents.

Any improvement in security from the current levels would be a major benefit to the community living along the proposed road. The use of National Police service and private security firms will enhance security and safety of the construction workers and road users.

5.6 Community Views and Concerns

5.6.1 Introduction

As part of the assignment and in conformity with the Constitution of Kenya and in compliance with the provisions of Environmental Management and Coordination Act (EMCA) cap 387, Public participation/ stakeholders consultative meetings were held in various locations covering the project alignment and at diverse dates as detailed in the table 5.7 below and Appendix 6 and 7.

Table 5.7. The Public Consultation Meetings

DATE	VENUE	TIME
18th June 2019	Our Lady of Rosary Catholic Church, Ridgeways	10.00 am
19th June, 2019	ACK Church Hall, Thindigua	10.00 am
20th June, 2019	Kirigiti Chief's Hall	10.00 am
21st June, 2019	Kiambu Municipal Hall	10.00 am
24th June , 2019	Ndumberi Chief's Ground	10.00 am
27th June, 2019	Directorate of Criminal Investigations	10.00am
27th June, 2019	Muthaiga Golf Club	5 Pm
28th June, 2019	Kiambu Institute of Science and Technology (KIST)	10.00am
16th July, 2019	PCEA Evergreen Church, Runda	10.00 am

The process of Public involvement started by determining the scope of the interested and affected publics. In this regard, the administration of both the National Government in Nairobi and Kiambu County were contacted, and several introductory meetings and briefings of the proposed road were undertaken. Other interested

publics such as neighbourhood associations, business owners, institutions and other stake holders were informed through letters or oral sensitization.

On arrival participants registered and were given questionnaires to fill and return at the end of the meetings. The National and County government officials were always introduced before the start of public engagements. The Proposed project was introduced to the participants through use of cross-sections, map of the area and projection of the detailed project design. Thereafter participants would raise their concerns and views either individually or focus group presentations. Memoranda's were also received from some stakeholders to beef up their concerns. The responses and assurances were addressed, and their concerns were factored in the project design, during construction and commissioning.

5.6.1.1 Attendance and participation

The public participation meetings were well attended with an average of about 150 participants attending per session. Three meetings were held with key stakeholders at their premises at DCI, Muthaiga Golf Club, PCEA Evergreen Church, Runda and Kiambu Institute of Technology. The stakeholders gave their views enthusiastically and expressed their concerns and suggestions with clarity. The views, concerns and suggestions were recorded and has formed part of impact identification, mitigation measures and the road design. The design issues and concerns raised which falls within the terms of reference (TOR) were being investigated and incorporated into the design. Other design views and proposals which falls outside the TOR and which were considered pertinent to furthering the project goals and further address critical issues of safety and security have been summarized in this brief.

5.6.1.2 Key concerns raised and requests/proposals made by participants during PPMS

The issues and views raised by participants in the various venues and were as follows; and Appendices 8,9,10,11,12,13,14,15,16,17 and 18.

i. Muthaiga Golf Club.

The Kiambu Road Project Committee of the Muthaiga Golf Club made the following submissions during engagements with the design team at different occasions and

during the PPM Meeting. The Muthaiga Golf Club through the committee affirmed their support for the project.

- They reiterated their desire to trade off part of their land on the Right Hand Side (RHS) of the Golf Course with KeNHA in an effort to save their establishment on the Left Hand Side (LHS) which lies right at the periphery on inside the current extents of the road reserve.
- They affirmed the need for a dedicated crossing to connect both sides of the golf course which is separated by Kiambu Road.
- They confirmed the proposed overpass connecting both golf courses as a preference over an underpass.
- They lobbied for a public foot bridge conveniently located to serve the public and school children crossing to attend Muthaiga Primary School.
- Culverts to be redone to accommodate flood waters
- Proposed sewer lines to the new buildings be accommodated into the design through ducts.

ii. Security Installation – The DCI

The Directorate of Criminal Investigation (DCI) noted that DCI HQs opposite Karura Forest was a national security installation and required critical consideration in terms of space required for inspection of incoming vehicles and public parking outside the facility. They requested for a buffer zone between the boundary wall of their facility and the edge of the main highway of 30-40m.

Their view was that part of the road should be ceded from Karura Forest. The consultant explained the limitations of his mandate as far as road reserve is concerned. It is, however, apparent that despite the 60m corridor some amount of land has to be acquired from Karura Forest to secure this facility and to maintain its current operations without much disruption. It is necessary for KeNHA to consider possibility of acquiring a little land of Karura Forest for the expansion of the road at this location.

The Director of Criminal Investigation suggested that risk assessment and analysis should also be undertaken to inform the outcome of road designs and to put in consideration matters of security and possible acts of terrorism.

iii. Thindigua-Northern By-pass Link Road at Windsor (3kms)(Road1).

There was a continuous articulation at the PPMs of the need to service Thindigua Estate with a link road that would connect Kiambu Road through Thindigua and Northern bypass at the current Windsor Golf Club roundabout. This is a 3km long road passing through a rapidly growing area in terms of population, number of high-rise buildings and vehicle population. The identified road has a corridor of approximately 20m and serves, schools, a police post, churches among other public facilities.

iv. Kugeria- Mushroom Service Road (2 Kms)(Road 2)

This is a loop road serving the high-end estates of Mushroom and Kugeria Estates which are located on the RHS of Kiambu Road after Thindigua. The loop connects Kiambu Road on either end. Residents of these estates expressed their request for incorporation of this access road to the project.

v. Edenvile-Boma Road link (2.6Kms) (Road 3)

The public widely expressed the need to incorporate improvement of **Edenvile-Boma Road link** to bitumen standards to the upgrading of Kiambu Road. This access road currently serves Edenville Estate and the community beyond the estate. It connects Kiambu Road to Boma Road (Kiambu- Kanunga – Banana Road). It is a 2.6Km stretch which would act as a bypass to vehicles heading North to Banana, Limuru and beyond. From Kiambu Road to Endenvile (1.5kms) the stretch has been paved with concrete blocks ostensibly to serve Edenville Estate. The pavement is approximately 6m wide with a road reserve of approximately 15m up to Edenville estate, narrowing down to about 9- 12m for a stretch of 1km from Endenville to Boma Road.

vi. Kiambu Institute of Science & Technology (KIST).

The management of KIST observed that the institute has expanded and now has the higher population of students residing out of the college. They noted most of the students walk from neighbouring estates to the institute. They therefore requested for;

- Enhanced NMT facilities.
- Diffuse most of motorized traffic on the service road prior to KIST entrance. This would be made possible by providing adequate and enhanced turnings for traffic to and from Endenville and from Kamiti Road through the proposed new road through Kiambu High School.
- Non- motorized lanes should be demarcated
- Riverside estate will be affected by noise from the BRT station
- KIST Natural springs should be preserved

The board of management was receptive to the project and promised to support the implementation of the proposed road. They did not object to acquisition of part of

the institutions' land if the due process was followed and acknowledged that the institution was a publicly owned establishment. They proposed that the natural spring next to the workshop be preserved.

vii. Kiambu Town Roads (Road 4,5,6,7).

The problem of access to and through Kiambu Town was expressed to be compounded by:

- Narrow road reserve through the town (space availability)
- Lack of free and un occupied public land within the town
- Unserviceable loop roads.

The participants in the PPM held in Kiambu Social Hall requested for the following considerations

- Improvement of the loop road from Boma Road through Indian Bazar and linking to Kiambu road at the Kiambu County Governor's Office (1.1km).
- Improvement of a back street linking Kiambu road to the current bust stage and joining the Indian – Governor's Office Link Road (1.0km).
- Upgrading to bitumen standards of the service roads linking Kiambu (C32) Road to Kamiti- Kirigiti -Kiambu Road with a prong to Kiambu Hospital and Kiambu Primary School.
- That the design should consider a designated motor cycle (boda boda) rider lane.
- That the natural spring next to the KIST workshops should be preserved

viii. **Muthaiga North**.

The residents requested for an access for the monkeys to cross over from Karura Forest to the opposite side of Kiambu Road. The recorded mortality of monkeys along Kiambu road for the last six years justifies the need of a monkey bridge to mitigate loss of the primates (Appendix17). This would reduce fatalities of the wildlife. The monkey bridge will be factored in the design.

ix. PCEA Evergreen Church, Runda

The following were the issues raised.

- Karura forest should be preserved since the KFS plot next to Tala road can be ceded to KeNHA.
- Also the ecology of the riparian at Gitathuru River is already being affected by land occupied next to the old Kiambu road, after the Mua road turn off.
- Access to the Northern part of Karura forest next to DCI should be provided for in the design.
- Improve the Horse shoe road up to Mji wa Huruma.
- Create an exit for Runda residents instead of going to Ridgeways and Tala road would be the best option
- Consider use of Solar power for Street Lighting
- Consider Trauma centres in hospitals along Kiambu road as part of CSR
- Plant trees and other vegetation along the road for Carbon sequestration and aesthetics

x. Extension of dual carriageway from Ndumberi to the proposed Sasini Junction (1.5km) (Road 8).

This is currently a two-lane two-way road to Limuru. The traffic justifiable configuration is like the existing with a proposed provision of NMT facilities. Views by participants of PPM held at Ndumberi was that this section should also be dualled.

The footbridges along the dualled road to be in consultation with the residents. At the same time, no residents should be cut off or blocked from accessing the road.

xi. Documentary presentation of the PPMs proposed additional Roads

The above detailed roads arising from the desires of the public expressed during PPMs are detailed in the Project Roads Location Map (Fig. 1). The PPMs proposed roads are indicated in light blue colour. This brief highlights the registered desires of the public for consideration by the Client and KeNHA for incorporation into the Muthaiga – Kiambu- Ndumberi Dualling of the PPMs proposed roads. The consultant would be glad to execute additional instructions as would be given by the client. The minutes of the PPM meetings and subsequent memoranda are attached as appendices. All stakeholders agreed that the proposed road will safe them time and fuel spent on the

road as they transit to and from Nairobi. They also felt that they will benefit from new business opportunities, increase in land and property values.

5.7 Positive and Negative Impacts of the Project

The following table 5.7 shows the positive and negative impacts, views and concerns during the public participation meetings. Appendix 19

Table 5.7. Summary of Positive and Negative Impacts

S/N	POSITIVE IMPACTS	NEGATIVE IMPACTS
1.	Unused road reserve land which will be used for construction of new lanes, BRTs and BRT stations for easy transportation, better/Efficient Access for all	Air and noise pollution, Essential Services disconnection, Inefficient mobility
2	Business Growth within the area Property value will Appreciate	Land Acquisition/Displacement
3	Increased property and land values Attract Investors, improve institutions	Service interruption (existing power lines, water pipes, fibre cables and service lines which might be cut or rerouted), Business Relocation and Loss of Established Businesses, Loss of employment
4.	Improved Infrastructure	Accessibility will be Hard
5.	Employment Opportunities	Loss of Land, landscape disfiguration by embankments and deep cuts, fills and quarries Drainage/Sewer system
6.	Community development	Demolition of Structures
7.	Decongestion of the road reducing time wastage and safety on the road.	High population in town, Displacement of people, rural-Urban Migration.
8.	Improved access and provide development of real estates and industries.	Deforestation or Loss of tree coverage within the affected area along the road, Sewer Lines will be Affected.
9.	Increasing the value of land in the area.	Heavy traffic
10.	Fast and wide development of Sasini and	Poor access to the premises especially for new

S/N	POSITIVE IMPACTS	NEGATIVE IMPACTS
	other coffee and tea industries.	customers in the area
11.	No more problems towards taking our farm produce to the market.	Dust and smoke pollution, deforestation, destruction of certain existing structures. Batching plant operations, emissions from machinery
12.	Reduce traffic congestion, hence faster connectivity.	Congestion during construction,
13.	The project will benefit the residents of Kiambu-Ndumberi.	Accidents may increase if safety precautions are not put in place and some businesses and properties will be affected
14.	Being cosmos town, Kiambu will have many upcoming business and residential areas.	Acquisition of land may affect people's livelihoods.
15.	If well done it will ease traffic flow at Four Ways Junction.	Pedestrian movement may be affected and increased obstructions during construction.
16.	Shorter transit time and BRT for the public.	Over speeding
17.	Reduce traffic jam/Accidents	Lack of by-passes to use during the construction process.
18.	Congestion/Pollution Reduction	Respiratory diseases due to dust.
19.	Infrastructural Development	Increased crime rates.
20.	Economic improvement.	Inadequate/No pedestrians foot paths and traffic arrangements.
21.	Opening up Kiambu area	Waste disposal might be an issue, road side litter
22.	Reduction of Accidents	Cracks in the apartments along the road. Immorality as the contractors impregnate the local school girls.
23.	Population Increase	Moral standard might deteriorate. Underground pipes, wires may be uprooted.
24.		With increase of influx of people to Kiambu town and its environs, crime and prostitution may increase.

S/N	POSITIVE IMPACTS	NEGATIVE IMPACTS
25.		Environmental disturbance of primates crossing Kiambu Road.
26.		Further congestion at Pangani Underpass, if that area is not worked on before Kiambu Highway is completed.
27.		Dust, drilling and vibrations during construction phase, forceful acquisition of private land, weakening of the foundations of buildings near the road and accidents.
28.		The traffic issue will escalate to great heights, dust and safety of neighborhoods, bus stop need to be marked out clearly, speed limits must be clearly marked and access of businesses will be inconvenienced therefore business turn over will be low.
29.		Motor vehicle business will go down if access roads will not be factored.
30.		We need to avoid intrusion on Karura Forest.
31.		Too many people will move in to the area and stiffle public facilities and destruction and snarl ups during construction.
32.		Demolition of property and psychological torture to the displaced.
33.		Pollution of rivers and other water sources leading to water borne diseases, storm water, destruction of Karura forest and pollution as seen on Ngong Road.
34.		Pedestrian crossing conflicts, surface run off, planning and zoning changes and diversions during construction.
35.		Contamination of land soil and water by asphalt, paints, grease, oil and fuel

S/N	POSITIVE IMPACTS	NEGATIVE IMPACTS
36.		Erosion of lands below the road bed receiving concentrated outflow from covered or open drains.
		Alteration of overland drainage and subsoil drainage (where road cuts intercept perched water tables, springs
		Alteration of hydrological regimes of wetlands by causeways, with harmful effects on these ecosystems
		Obstruction of routes from homes to farms, etc., increasing travel time.
37.		Waste water from residential areas
38.		Welding may affect workers eye sight
39.		Floods. During long rains season especially at river crossings.
40.		Vulnerable people such as patients in hospitals adjacent to the road corridor, elderly persons will be affected.
41.		Areas where the aggregates will be sourced will be strained. Accident risks from burrow pits and health hazard from water bourne diseases

5.8 Corporate Social Responsibility (CSR)

Trauma centres should be set up in major hospitals along the project corridor. Also, the contractor should employ the local people both in casual and professional job categories. Any other CSR from the contractor is welcome.

CHAPTER SIX: ANALYSIS OF PROJECT ALTERNATIVES

6.1 Introduction

The Project Road is currently two-lane carriageway carrying traffic in both directions and classified as Class B road according to the latest Road Classification by the Kenya Roads Board. The project road has a 60m road reserve from Muthaiga to Kirigiti Junction and thereafter the reserve narrows down to 25-30m as it passes Kiambu town all the way to Ndumberi. The road traverses through a level to a rolling terrain. The Project Consultants had identified several routes that would form possible Bypass roads for Kiambu Town. In accordance to Regulations 16 (b) of EIA/EA Regulations, 2003, the identification of project alternatives was as follows.

6.2 No Project Alternative

The "No Project Alternative" assumes that the activity does not go ahead, implying a continuation of the current situation or the status quo. However, it was not considered for the proposed road since there were more benefits identified from the construction of the dual carriage way. Moreover, all identified negative impacts will be avoided, minimized or compensated for to ensure implementation of the proposed road.

6.3 Selection Criteria for Project Alternative Routes and Kiambu Town Bypass Routes

6.3.1 Road alignment

The consultant identified five routes to diffuse traffic and five bypass options that will be presented to the Client. The BRT road reserve has been considered in the middle of the road whose corridor width is 60m.The selected route for the main project road from Muthaiga to Ndumberi follows the existing road alignment. However, preliminary route assessment done to identify possible Kiambu Town bypasses resulted to several proposals (table 1). On further assessment based on the criteria detailed below and restricting the length of the project road to 25kms as specified in the ToR, two road alignment were selected to serve as Kiambu Town bypasses.

6.3.2 Selection Criteria Considerations

a) Rationale

Routes that would reasonably diffuse traffic and make travel through town centre less attractive were more favourable as bypasses. Existing road alignments were more favourable than new roads due to extents of land acquisition. Routes within the town would just serve as access roads within the urban set up and would be undesirable as bypasses while routes far off would serve little to diffuse the local traffic from the town centre. Balancing between purpose and location is therefore a desirable aspect for choice. Routes that passes through built up environment and have restricted road reserves would require expensive land acquisition rendering the considered route not economically feasible. In this regard, routes through undeveloped or low developed areas were considered.

b) Restrictions in the Road Reserve.

The restrictions and the general road condition areas are shown in table 6.1.

Table 6.1. Restrictions in the Road Reserve

Route	Name	Road Length (Km)	Estimated Road reserve (m)	General Road Condition
1.	Kiambu-Kanunga Road(D409)-Ndumberi (Road E1520)	9.8Km	Varies	**a) <u>Kiambu-Kanunga section</u>** ➢ Length=5.6Km ➢ Road reserve = 25M ➢ Road to Bitumen standards ➢ Carriageway Width =6.5m ➢ Worn out road surface and with potholes ➢ Worn out shoulders ➢ Earth drain not well defined at some sections **b)<u>Part Kanunga-Ndumberi RoadE1520(Kiratina Road)</u>** ➢ Length =1.3Km ➢ Road reserve<20m

				➢ Road to bitumen standards ➢ Road width=5.5m ➢ No road shoulders ➢ Road failure cracks ➢ Earth drain not well defined at some sections **c)<u>Part Kanunga-Ndumberi Earth Road off Kiratina Road</u>** ➢ Length =2.9Km ➢ Road reserve not defined ➢ Road Width = 5.5m ➢ Earth road ➢ No side drains
2.	Road D409 / Old Kiambu road junction-Ndumberi	4.6Km	<20m	➢ 6.0m Wide Carriageway Tarmacked 1.6Km section from Ndumberi and 0.5Km from D409 Junction ➢ 2.5Km 7.0m Carriageway under construction by KeRRA
3.	Ting'ang'a-Riabai Road E432	4.6Km	<20m	➢ New Road to bitumen standards by KeRRA ➢ Road width=6.5m ➢ Road shoulders ➢ Earth drain well defined
4.	Riabai Road Junction-Kiriguini B Road	3.9Km	12m	➢ Gravelled Road ➢ 6.0m Wide Carriageway ➢ Power Lines on road reserve ➢ Terrain can allow good alignment curves
5.	Kiratina Loop Road	3Km		➢ Tarmacked Length =1.6Km ➢ Road reserve <20m ➢ Road to bitumen standards ➢ Road width=5.5m ➢ No road shoulders ➢ Road failure cracks ➢ Earth drain not well defined at some

				sections ➢ 1.4Km Section Under Construction by KeRRA

The above route selection criteria was used to eliminate some of the routes that were not favourable as follows;

Route 1; a.) Kiambu to Kanunga Junction which is approximately 5.6km

Only improvements will be carried out at the junctions where the road touches the project roads.

Route 1; c.) Kanunga-Ndumberi Earth Road off Kiratina Road;

This is the route renamed as Kiambu Town Eastern Bypass whose length is 3.2km from Kiratina Road. The route serves a settled area with a rural setup. A steep terrain in one location will be a consideration in the design. This section serves as a connection to complete the western loop that passes through Sasini coffee farm.

Route 2; Road D409/Old Kiambu road junction – Ndumberi

Part of this route, starting from the Junction with Old Kiambu Road through Kiratina Road Junction to Kiambu Road was under construction under KeRRa. Moreover, a section of the route extending from Kiratina Road to Ndumberi was already tarmacked. This route was not desirable to act as a bypass due to proximity to Kiambu town and besides it was under construction. As the route approaches Ndumberi Centre, the road reserve was too narrow for any expansion. Thus, it was deemed unattractive.

Route 3; Tinganga – Riabai Road E432

This road was in the final stages of construction under the low volume seal road programmes by KeRRA. Despite being an attractive route, it was dropped off.

Kiambu Road - Githunguri Road Route through Sasini Coffee Farm

This route forms part of Kiambu Town Eastern Bypass through Sasini Coffee Farm and connects well to Riabai road through a junction along Githunguri road. The route is attractive due to availability of undeveloped land to be acquired.

Riabai - Kiriguini B Road Route

This route is an existing earth road on the Western side of Kiambu town. The terrain is favourable and though it serves a built up area it bypasses both Ndumberi and Kiambu Towns. The roads considered as bypass routes and spur roads and earmarked for improvement are as shown in table 6.2.

Table 6.2: Kiambu Town Selected Bypass Routes and Spur Roads

Route	Name	Road Length (Km)	Estimated Road reserve (m)	Existing Status & Way Forward
1	**Eastern Bypass.** a) Githunguri Road through Sasini Coffee Farm to Ndumberi-Limuru Road.	8.0Km	• No Reserve within Sasini Coffee Farm.	• Virgin land through sasini coffee - No road established. Road reserve to be acquired. A tarmacked road to be established.
	b) Limuru Road- Sasini Coffee- Kiratina Road		• 12m from Sanini through Kiratina to Kanunga Road	• Earth road from Limuru Road to Kiratina Road- Alignment requires Improvement and upgrading to bitumen standard.
	c) Kiratina Road - Kanunga			• Sealed road from Kiratina to Boma Road. - Requires upgrading and widening.

Route	Name	Road Length (Km)	Estimated Road reserve (m)	Existing Status & Way Forward
2	**Western Bypass-** Riabai Road Junction-Kiriguini B Road Part of Kiambu Town Eastern Bypass	3.9Km	12m	• Existing 6m wide Graveled Road • Power Lines on road reserve • Favourable Terrain for good alignment • Road to be upgraded to dual carriageway.
3	**KIST - Kamiti Road.**	2.4Km	60m	• No existing road Road to be dualled
4	**b)Kirigiti Junction -Old Kiambu Road Section** – A Link Road	0.8Km	No road reserve	• Road reserve to be acquired • Road to be dualled • Bus Terminal proposed.
5	**Boma/Kiambu Road Junction to Old Kiambu Road** Link Road(spur)	1.4Km	25m	• **Service Road, narrow and worn out road surface** – Requires widening, upgrading and establishment of side drains

CHAPTER SEVEN: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

7.1 Introduction

7.1.1 Project Environmental and Social Potential Impacts

7.1.1.1 Positive impacts (Environmental, Social, and Economic)

The identified positive impacts are as in table 7.1.

Table 7.1. Identified Positive Impacts

S/N	Positive Impacts
1.	Better/Efficient Access for All
2.	Business Growth within the area Property value will Appreciate
3.	Increased property and land values Attract Investors, improve institutions
4.	Improved Infrastructure
5.	Employment Opportunities
6.	Community development
7.	Decongestion of the road reducing time wastage and safety on the road.
8.	Improved access and provide development of real estates and industries.
9.	Increasing the value of land in the area.
10.	Fast and wide development of Sasini and other coffee and tea industries.
11.	No more problems towards taking our farm produce to the market.
12.	Reduce traffic congestion, hence faster connectivity.
13.	The project will benefit the residents of Kiambu-Ndumberi.
14.	Kiambu will have many upcoming business and residential areas.
15.	If well done it will ease traffic flow at Four Ways Junction.
16.	Shorter transit time and BRT for the public.
17.	Reduce traffic jam/Accidents
18.	Congestion/Pollution Reduction
19.	Infrastructural Development
20.	Economic improvement.
21.	Opening up Kiambu area
22.	Reduction of Accidents
23.	Population Increase

7.1.1.2. Negative Impacts and Mitigation Measures

Table 7.2. Negative Impacts and Mitigation Measures

S/N	Negative Impacts	Mitigation Measures
1.	**Air Quality.** - Respiratory diseases due to dust, -batching plant operations, - emissions from machinery and other construction activities	-Use dust muffs, sensitization, health checkups and treatments - water areas to minimize dust - Engineering controls to reduce dust and other emissions, regular maintenance of machines and plants to reduce emissions -Use physical buffers, engine maintenance and equipment's calibrations. -Water dusty sections as per the weather and traffic flow - plant trees for carbon sequestration -Use PPEs - using polymer coating dust suppressants. - Sweep or remove sediment from paved or sealed areas regularly - Control dust from stockpiles - tune engines to reduce exhaust emissions
2.	**Noise and Vibrations.** - Noise during construction and transportation - Vulnerable people such as patients in hospitals adjacent to the road corridor, - elderly persons will be affected.	-to avoid noise at night, construction should be during the day - Vibrations should be controlled near buildings - Controlled noise near the affected facilities
3.	**Water and Pollution.** - Solid Waste and Effluent Disposal - Alteration of overland drainage	• Installation of adequate and suitable (size) drainage works. • Realignment to avoid wetlands installation of culverts, bridges, etc as needed and according to criteria from prior hydrological surveys

S/N	Negative Impacts	Mitigation Measures
	and subsoil drainage - Alteration of hydrological regimes of wetlands by causeways with harmful effects on these Ecosystems - where road cuts intercept perched water tables, springs),surface run off - Sewer Lines will be Affected. - Pollution of rivers and other water sources from storm water drains, cut offs, material sources, construction, embankments, fills and waste disposal leading to water borne diseases, storm water - deforestation of Karura forest and pollution. - Waste water from residential areas - Contamination of land, soil and water by asphalt, paints, grease, oil and fuel - Floods during wet seasons especially at river crossings and unprecedented climate change impacts	• Adequate time for sewerage companies to realign/ relocate their services • Provide storm water drains with screens, protect surfaces with mulch and use non erodible surfaces, • Control pollution at source, use standardized portable water treatment • Connect to sewer lines • Accidental spills should be avoided, recycle lubricants and use proper methods of waste disposal • Construction to be undertaken during the dry seasons • Accommodate mitigation measures of unforeseen weather changes
4.	**Socio-economic Losses;** -Land Acquisition/Displacement (RAP) - Service interruption, Business Relocation - Loss of Established Businesses, -Loss of employment	• Compensation and resettlement • Sensitization and Compensation through National Land Commission, • Provide ample time for relocation

S/N	Negative Impacts	Mitigation Measures
	- Demolition of Structures - Increase in population in town, -Displacement of people, - rural-Urban Migration - Demolition of property and psychological torture to the displaced - Loss jobs/employment during decommissioning	• Assist using environmentally friendly techniques to save on building materials for the affected persons • Access roads to business premises • Improve and add more utilities and facilities • Counselling • Employees to be advised on how to invest their income and plan on what next to do after the project is decommissioned
5.	**Waste Disposal.** - Waste disposal(solid and liquid, grey water), - road side litter from construction workers and operation from road users	• Provide well maintained toilets, with water and soap, identify solid waste disposal sites • Garbage disposal mechanisms should be put in place at BRT stations and bus stops
6.	**Traffic Management.** - Accessibility or connecting to both sides of the road will be difficult - Heavy traffic, Congestion during construction, Accidents, Pedestrian movement, over speeding, Lack of by-passes, traffic issue will escalate to great heights - Poor access to premises especially for residents and other customers in the area - Inadequate/No pedestrians foot paths and traffic arrangements. - Obstruction of routes from homes to farms, etc., increasing travel time - Further congestion and traffic snarl ups at Pangani Underpass, if that area is not worked on before Kiambu Highway is	• Sensitization of road users, proper signage, and visible markings/reflectors. • Use traffic marshals, street lights • Use the existing pavement and construct one side of the road at a time • Diversions as per the road design • Use well placed concrete barriers with string reflectors • Speed limits to be visible and well displayed • Set up trauma centres in hospitals along the project road • -Construction drivers should be inducted to avoid over speeding and accidents, follow the NTSA

S/N	Negative Impacts	Mitigation Measures
	completed - Pedestrian crossing conflicts, planning and zoning changes and diversions during construction	regulations. • Design and implement safety measures and an emergency plan • Bus stops/laybys should be marked clearly • Provide designated crossings for pedestrians and non-motorized traffic (NMT). • To be addressed by the client as part of another project • Traffic Management plans
	Occupation Safety and Health (OSH) -Welding will affect workers eyesight - Cracks in the apartments along the road. - Increased crime rates - With increase of influx of people to Kiambu town and its environs, crime and prostitution may increase. - Immorality - Environmental disturbance and fatalities of primates crossing Kiambu Road - Accident risks from burrow pits and health hazard from water bourne diseases	• Use all recommended PPEs such as goggles, muffs, helmets, gloves, gumboots, overalls and etc • Police/NTSA, Contractor should engage private security firms • Sensitization on the negative impact of lifestyle behaviour. -Display signs showing various diseases that can be transmitted through social interactions • Hotels to Provide condoms in their wash rooms • During construction the contractor sub-contracts HIV/AIDS awareness service provider who does most of these activities • Construct monkey bridges is being considered in the design • Restore burrow pits to prevent temporary water storage which could lead to accidents and disease vectors

S/N	Negative Impacts	Mitigation Measures
	Impact on biodiversity and land resources; Loss of vegetation along the road - Loss of biodiversity in Karura Forest and other ecosystems - Erosion of lands below the road bed receiving concentrated outflow from covered or open drains - Areas where the aggregates will be sourced will be strained - landscape disfiguration by embankments and deep cuts, fills and quarries	• Plant more trees and vegetation/grasses • KFS to some land to the client on condition that Vegetation replanting will be undertaken • Conservation measures on other ecosystems • Receiving surface should be lined with stones and concrete • Drain outlets should be increased and be put in a way to avoid cascading effect • RRehabilitation and restoration • Road design to have inclined slopes, fill quarries with spoil

The Project Affected Areas/Persons are as shown in Appendix. The following are samples of photographs of affected properties.

Plate 7: Storey Commercial and Residential Flat at Thindigua Shopping Center

Plate 8: Car Yard and Residential Houses at Ridgeways

Plate 9: OLA Petrol Station in Kiambu Town.

Plate 10: Perimeter wall along the Eastern Bypass

Table 7.3. The project affected businesses/Facilities/Institutions/Structures on the Row.

S/N	Type of Activity	Area	Number Affected
1.	Flower Vendors	Muthaiga to Ridgeways	41
		Edenville Junction- Kirigiti Junction	22
		Total	**63**
2.	Car Baazars	Muthaiga to Ridgeways	13
		Ridgeways-Kirigiti Junction	6
		Total	**19**
3.	Hotels, Bars and Restaurants	Muthaiga-Ridgeways	**5**
		Ridgeways-Kirigiti junction	6
		Total	**11**
4.	Institutions (Hospitals, churches, Golf clubs, Schools)	Muthaiga-Ridgeways	**6**
		Ridgeways-Kirigiti junction	**6**
		Total	**12**
5.	Petrol Stations and Garages	Muthaiga-Ridgeways	**1**
		Ridgeways-Kirigiti junction	**5**
			6
6.		**Grand Total**	**131**

7.1.2 Physiography and Geology

Impacts i. Loss of Land, deep cuts on the landscape ii. Erosion of lands below the road bed receiving concentrated outflow from covered or open drains. iii. Contamination of land soil and water by asphalt, paints, grease, oil and fuel
Mitigation Measures i. Road design to have inclined slopes ii. Receiving surface should be lined with stones and concrete, drain outlets

should be increased and be put in a way to avoid cascading effect iii. Accidents should be mitigated by preventing the spread of dusts and vapors, Neutralizing acids and bases, if possible, controlling the spread of the liquid and absorbing the liquid. Collect and contain the cleanup residues. Dispose of wastes. Decontaminate the area and affected equipment. Recycle lubricants and use proper methods of waste disposal
Residual Impacts i. Loss of soils on the slopes
Recommendations Plant grass concurrently with excavation works

7.1.3 Soils

Impacts

i. Alteration of overland drainage and subsoil drainage, (where road cuts intercept perched water tables, springs),surface run off
ii. Pollution of rivers
iii. Contamination of land, soil and water by asphalt, paints, grease, oil and fuel

Mitigation Measures i. Installation of adequate drainage works ii. Protect surfaces with mulch and use non erodible surfaces iii. Accidents should be mitigated by preventing the spread of dusts and vapors, Neutralizing acids and bases, if possible, controlling the spread of the liquid and absorbing the liquid. Collect and contain the cleanup residues. Dispose of the wastes. Decontaminate the area and affected equipment. Recycle lubricants and use proper methods of waste disposal iv. Use gabions v. terraces
Residual Impact i. Loss of soils on the slopes

Recommendations

7.1.4 Climate

Impacts

i. Air pollution
ii. Deforestation along the road

Mitigation Measures i. plant trees for carbon sequestration ii. Plant a variety of vegetation/grasses
Residual Impacts i. Carbon monoxide releases, fumes from vehicles and equipment
Recommendations i. Encourage Carbon trading

7.1.5 Air Quality

Impacts i. Dust emissions from traffic, cleared areas, stockpiles, and blasting ii. Exhaust fumes from equipment
Mitigation Measures i. Seal or water down dusty surfaces and also use polymer coating dust suppressants. ii. Sweep or remove sediment from paved or sealed areas regularly. iii. Maintain equipment's to reduce exhaust emissions iv. Use recycled water for dust control.

Residual Impacts i. contaminating the environment and buildings
Recommendations i. Re-vegetate areas as soon as practicable

7.1.6 Surface and Groundwater Resources

Impacts i. Alteration of hydrological regimes of wetlands by causeways, with harmful effects on the ecosystems ii. Pollution of rivers, destruction of Karura forest and pollution Storm water pollution iii. Water contamination through oil spills, chemicals, other hazardous and toxic substances
Mitigation Measures i. Realignment of the road and use wetlands installation of culverts, bridges, etc as needed and according to criteria from prior hydrological surveys ii. Protect surfaces with mulch and use non erodible surfaces iii. Provide storm water drains with screens iv. Use dispersants, natural and synthetic sorbent materials
Residual Impacts i. Ecosystem disturbance
Recommendations Minimal disturbance during construction

7.1.7 Terrestrial/ Aquatic Environment: Flora and Fauna

Impacts i. Loss of vegetation along the road ii. deforestation of Karura forest iii. Environmental disturbance of primates crossing Kiambu Road
Mitigation Measures i. Plant more trees ii. Construct Monkey bridges iii. Compensation
Residual Impacts i. Slow plant growth especially for indigenous trees
Recommendations Continuous watering and maintenance of plant saplings

7.1.8 Land Resources

Impacts

i. Loss of Land, deep cuts on the landscape
ii. Contamination of land
iii. Land acquisition
iv. Landscape disfiguration by embankments, deep cuts, fills and quarries

Mitigation Measures i. Compensation ii. Road design to have inclined slopes, fill quarries with spoil iii. Vegetation to control soil erosion and beautify the landscapes
Residual Impacts
Recommendations

7.1.9.Archaeological, Historical and Cultural Sites

Impacts i. N/A
Mitigation Measures i. N/A
Residual Impacts i. N/A
Recommendations

7.1.9 Visual Aesthetics

Impacts

i. landscape disfiguration by embankments and deep cuts, fills and quarries
ii. Visual impact of the interchanges and roundabouts
iii. Waste disposal

Mitigation Measures i. Plant trees and grass along the road sides, laybys and BRT stations to make the road a beautiful vista. ii. Road lighting iii. Waste and garbage collection
Residual Impacts i. Maintenance of the road side vegetation
Recommendations Replanting/replacing dried plants, pruning

7.1.10 Noise and Vibrations

Impacts

i. Noise pollution
ii. Cracks in the apartments along the road.
iii. Physical and Psychological stress to workers
iv. Permanent Hearing loss
v. Workplace accidents and injuries

Mitigation Measures

i. Use physical buffers, engine maintenance and equipment's calibrations.
ii. Avoid noise at night, construction should be during the day
iii. Vibrations should be controlled near buildings
iv. Control noise emissions and transmissions
v. Undertake noise mapping and zoning along the road
vi. Ensure use of ear plugs and ear muffs
vii. Create awareness to workers on impacts of high decibels
viii. Noise and vibrations should be as per the recommended decibels

Residual Impacts

i. Construction sites there will have some noise

Recommendations

7.1.11 Solid and Liquid Wastes

Impacts

i. Waste disposal might be an issue, road side litter
ii. Waste water from residential areas

Mitigation Measures

i. Provide well maintained toilets, with water and soap.

ii. Garbage disposal mechanisms should be put in place iii. Connect to sewer lines
Residual Impacts i. Land and Water pollution from septic tanks
Recommendations County governments to construct up to date waste water treatment plants

7.1.12 Social Characteristics

Impacts

i. High population in town, Displacement of people, Rural-Urban Migration.
ii. Acquisition of land may affect people's livelihoods.
iii. Prostitution and Immorality may increase.
iv. Pedestrian crossing conflicts

Mitigation Measures i. Improve and add more utilities and facilities ii. Compensation iii. Sensitization on the negative impact of lifestyle behaviour. iv. Traffic Management
Residual Impacts i. People have the free will to choose their preferred lifestyle
Recommendations

7.1.13 Economic Settings

Impacts

i. Service interruption, Business Relocation and Loss of Established Businesses, Loss of employment
ii. Acquisition of land may affect people's livelihoods.
iii. Motor vehicle business will go down if access roads will not be factored.
iv. Essential Services disconnection, Underground pipes, wires may be uprooted.
v. Further congestion at Pangani Underpass, if that area is not worked on before Kiambu Highway is completed.

Mitigation Measures i. Sensitization and Compensation through National Land Commission, Give ample time for relocation ii. Compensation iii. Use access roads to be provided during construction iv. Notices to be issued v. To be addressed by the client as part of another project
Residual Impact i. Increase in number of vehicles and other road users
Recommendations

7.1.14 Health Settings

Impacts

i. Respiratory diseases due to dust.
ii. Noise pollution
iii. Prostitution and Immorality could lead to sexually transmitted diseases
iv. Water borne diseases
v. Welding may affect workers eye sight

Mitigation Measures i. dust muffs, sensitization, health checkups and treatments - water areas to avoid/control dust ii. use of PPEs iii. Display signs showing various diseases that can be transmitted through social interactions iv. HIV/AIDS sub- contractor to supply condoms v. Control pollution at workers camps and along the project road, vi. use standardized portable water treatment vii. Use protective goggles
Residual Impacts i. Chemical pollution may be difficult/expensive to treat in water
Recommendations

7.1.15 Security, Public and Transport Safety

Impacts

i. Increased crime rates.
ii. Community Health Impacts
iii. Immigrant Impacts on the community

Mitigation Measures i. Police/NTSA to monitor social and behavioural activities along the project ii. Contractor should engage private security firms iii. Create awareness to the local community of the impacts of interaction with immigrants
Residual Impacts i. People have free will to make personal decisions

Recommendations

7.1.16 Community Views and Concerns/Public Consultation

The main aim of public participation is to encourage the public to have meaningful input into the decision-making process. The following objectives assisted in making each contributor gain a better understanding of the proposed project. They in return raised their views and concerns on how the project could affect them.

Specific Objectives:

i. To provide opportunity for consultation of all stakeholders, including communities to be affected by the project as well as Civil Society Organizations in order to obtain their input during the ESIA process.
ii. To provide opportunity to stakeholders to participate in the identification of mitigation measures for the adverse environmental and social impacts of the project

7.1.17 Methodology Used for PPM

The process of Public involvement started by determining the scope of the interested and affected publics. In this regard, the administration of both the National Government in Nairobi and Kiambu County were contacted and several introductory meetings and briefing of the proposed road were undertaken. Other interested publics such as Neighbourhood associations, business owners, institutions and other stake holders were informed through letters or oral sensitization.

On arrival participants were registered and given questionnaires to fill and return at the end of the meetings. The facilitators, National and County government officials were always introduced before the public engagement. The proposed project was introduced to participants by use of cross-sections, map of the area and projection of the detailed project design. Thereafter participants would raise their concerns and

views. The responses and assurances were given on how these concerns would be factored in the project design, during construction and decommissioning.

7.1.18 Corporate Social Responsibility (CSR)

Trauma centres should be set up in major hospitals along the project corridor. The contractor should employ the local people both in casual and professional job categories.

CHAPTER EIGHT: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Introduction

The Environmental and Social Management and Monitoring Plan (ESMMP) has been prepared for construction and operational phases of this Project. It consists of identified impacts, mitigation measures, cost of mitigation, time and persons responsible. It follows the procedure of avoiding negative impacts or minimizing residual impacts to levels which are acceptable to the environment, health, safety (EHS) and compensation for affected persons. The ESMMP includes the development and implementation of a number of management plans for different phases of the Project such as Occupational Health and Safety Plan, Borrow pit/Quarry Rehabilitation Plan, Vehicle/Traffic Management Plan, Waste Management Plan and Camp design/Installation plan.

8.2 Objectives of the ESMP

The objective of ESMP is to address the anticipated environmental and social project impacts, identify mitigation measures, estimated costs, supervision, and monitoring measures for the proposed road. It also ensures compliance to Occupational Safety and Health (OSH) and other standards.

8.3 Applicable Legislation and Regulations

The following Legislative and Regulations will be adhered to as discussed earlier.

i. Environmental (Impact Assessment and Audit) Regulations, 2003 Legal Notice No. 101;
ii. The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121
iii. The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120
iv. The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 Legal Notice No. 61
v. The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 Legal Notice No. 160

vi. The Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations, 2006 Legal Notice No. 131
vii. The Environmental Management and Coordination (Controlled Substances) Regulations, 2007 Legal Notice No. 73.
viii. The Forests Act, 2005
ix. Forest Conservation and Management Act, 2016.
x. The Water Act, 2016
xi. Land Act No. 6 OF 2012 (Revised, 2016)
xii. Traffic Act, 2016
xiii. Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971
xiv. Occupational Safety and Health Act, 2007
xv. Any other relevant documents

8.4KeNHA Environmental Policies and Procedures

KeNHa's policy advances an understanding of the fundamental interrelationship between development and the environment. The primary goal of this policy is to give guidelines to guide the Authority's activities so that they do not injure the environment and affect communities. The guiding principles are:

- KeNHA recognizes that sustainable development is a fundamental aspect of sound business management and that the pursuit of economic growth and a healthy environment are inextricably linked
- The 'Precautionary Approach Principle' is to be used in the absence of scientific consensus that the project action or policy is harmful
- Environmental impacts are trans-boundary. This means that the effect is felt across national and international boundaries.
- The Authority has embraced the concept "Think Globally, Act Locally". In this concept KeNHA will consider the impacts of her activities on the health of the entire planet and act in her local surroundings.
- KeNHA upholds the principle that every person in Kenya is entitled to a clean and healthy environment and has a responsibility of safeguarding and enhancing the environment.

- KeNHA reckon that the environment offers life support systems and value human life above all else and will manage risks accordingly. Therefore, no task is too important that damage to the environment is justified.

8.5 Roles, Responsibilities and Training

Effective communication should be maintained between contractors, consultants, regulators, and the client. Visible signboards informing the public of road construction should have the following information:-

i. Name of Contractor
ii. Name and contact details of the project Engineer

All workers should be trained in the following areas:-

- Environmental and Social Management Plan (ESMP)
- Environmental and Social Monitoring and Audit
- Solid waste Management
- Disaster Risk Reduction/Management
- Environmental and Social Reporting
- Construction Occupational, Health, Safety and Environment.

8.6 Communication with Stakeholders and Grievance Redress Mechanism

Potential grievances and disputes that may arise during implementation of the RAP may be related to the following:

i) Valuation process
ii) Inventory mistakes
iii) Mistakes related to identification and disagreements on boundaries between the PAPs
iv) Disagreement of the compensation values
v) Disputed ownership of a given asset
vi) Family issues relating to ownership disputes
vii) Delays in releasing the compensation

During implementation of RAP, any of the above-mentioned grievances may occur. The same shall be resolved using the proponent's redress mechanism. In case of any issues raised by the PAPs the grievance redress mechanism will be as follows:

i) **First Order Mechanism**: First order mechanism involves registration of the grievances with the Resettlement Working Group (RWG) to be established

by the Client who in this case is KeNHA. The RWG will then seek to eliminate nuisance claims and satisfy legitimate claimants by attempting to reconcile the aggrieved PAP (s) and the Client. The RWG should respond within two (2) weeks.

ii) **Second Order Mechanism**: This is where the complaint and grievance cannot be resolved by RWG and the complaint is referred to the Tribunal of Public Complaints (PCC) Committee

iii) **Third Order Mechanism**: In instances where the Public Complaints Committee is unable to resolve the matter, the same will be referred to the Courts for settlement. Kenyan citizens and legal entities have access to court recourse in conformance with applicable laws. The aggrieved PAP(s) have the right to pursue the matter up to the supreme Court if necessary

iv) **Fourth Order Mechanism**: Expropriation of land will be used as a last resort when all of the above procedures have either failed or extensive delays to the project are foreseen. Expropriation means taking away of private land for public purpose by the Government with or without the owner's consent subject to laws of eminent domain which stipulates prompt and adequate compensation among other things

8.7 Auditing and Monitoring

The overall objective of environmental and social audit/ monitoring is to ensure that mitigation measures are implemented and that they are effective. It also enables response to new and developing issues of concern. The environmental monitoring program will operate through the preconstruction, construction, and operation phases. The following aspects should be subjected to monitoring:

- All environmental parameters
- Vegetation maintenance around project work sites, workshops and camps
- Works safety elements, including a log of accidents
- HIV/AIDS and any other emerging diseases like COVID 19 programme of implementation and levels at local health centre.

Monitoring includes:-

- Visual observations
- Selection of environmental parameters at specific locations

- Sampling and regular testing of these parameters.

Periodic ongoing environmental audit and monitoring will be required during the life of the Project and the level can be determined once the Project is operational. The Environmentalist and Sociologist should be part of the team to undertake monitoring activities to ensure mitigation measures are implemented and in the training programs.

8.8 The Environmental and Social Management and Monitoring Plan (ESMMP) for the Project

List of components to be addressed include:-

- Physiography and Geology
- Soils
- Air Quality
- Surface and Groundwater Resources
- Water Quality
- Terrestrial Environment (Habitats, Flora, and Fauna)
- Land Resources and National Parks
- Archaeological, Historical and Cultural Sites
- Visual Aesthetics
- Noise and Vibrations
- Solid and Liquid Wastes
- Social Characteristics
- Economic Characteristics
- Occupational Health and Safety
- Security and Public Safety

The structure of the Environmental Social Management and Monitoring Plan (ESMMP) and areas to be addressed is outlined in the table 8.1. The Environmental and Social Impact Management Plan (ESMP) table 8.2 shows the predicted impacts, mitigation measures, responsibility and cost.

Table 8.1. Environmental Social Management and Monitoring Plan (ESMMP)

Environmental Component	Parameters	Indicator	Monitoring frequency/Quantity	Sampling Area	Measurement Units	Method	Target level/ standard	Responsibility for monitoring	Units	Costs estimates (Kshs)	Applicable (yes/No) If 'No' then provide a short justification
	Pre-construction Phase										
Water Quality Extra over item 25.03 for profit	Ph, Total Suspended Solids (TSS) and Total Dissolved Solids(TDS), heavy metals, oils and grease	Physical, Chemical and Biological	Months %	Road/River crossing points of all rivers and KIST springs	NTU, mg/L, PV, CFU per mL)	Testing grab samples in the Laboratory	Ph (6.5-8.5) Turbidity(15) Total dissolved solids = 1000 Total nitrate (Nil) Fluoride=1.5 Lead=Nil Copper= Nil Zinc=Nil Permanganate value(PV)=500 E Coli= Nil	Contractor and KeNHA, WRA, Environmentalist	4 0.15	500,000 *4= 2,000,000/= + 300,0000/= = 2,300,000/=	Yes

Air Quality tests Extra profit and overhead	TSP, NOx, SO2, CO, Dust particles, particulate matter etc		Months	Construction, Quarrying and Earth Borrowing sites, camp	PM2.5 and PM10 µg/m3	Air sampling equipment to measure dust levels, gases and particles	Ambient air quality values= Zero	Contractor and KeNHA, WRA, Environmentalist	4 .15*2,800,000	700,000/= *4=2,800,000/= + 420,000/= =3,220,000/=	Yes
Noise Levels tests	Noise pollution/Levels	Lden: the day-evening-night-level, indicator Lnight: the night-level indicator	Monthly PC Sum	Machines and equipment that produce noise	decibels (dB)	Measurements using Noise meters	vibration levels < 0.5 cm per second beyond any source property boundary or 30 m from any moving source.	Contractor and KeNHA, Environmentalist	4 .15*2,800,000/=420,000/=	700,000*4= 2,800,000/= + 420,000 =3,200,000/=	yes
		Total cost of monitoring during pre-construction phase= 8,740,000/=Kshs									
	Construction Phase										

Water Quality Extra over item 25.03	Ph, Total Suspended Solids (TSS) and Total Dissolved Solids(TDS), heavy metals, oils and grease	Physical, Chemical and Biological	Months %	Road/River crossing points of all rivers and KIST springs	NTU, mg/L, PV, CFU per mL)	Testing grab samples in the Laboratory	PH (6.5-8.5) Turbidity(15) Total dissolved solids = 1000 Total nitrate (Nil) Fluoride=1.5 Lead=Nil Copper= Nil Zinc=Nil Permagante value(PV)=500	Contractor and KeNHA, WRA, Environmentalist	18*500 0.15*9,000,000/=	9,000,000/= 1,350,000/=	Yes
Storm Water Drainage (discharge) Digging, desilting and cleaning of rivers/channels on either side of the road	Rainfall volume, topography	Volume of water from the road surface	Rainy seasons PC Sum	Flood prone areas, culverts, water ways, low lying areas	Total volume =acre-ft or millions of gallons), cubic feet per second (ft3/s or cfs) or cubic meters per second (m3/s) (USGS, 2007).	Depth of flow (m or ft) is most commonly measured as stage.	Storm water can be harvested for use in construction and to safeguard water quality	Contractor and KeNHA,	1	5,000,000/=	yes

Extra over item 25.07			%						0.15*5,000,000	750,000/=	
Solid Waste Generation Extra profit and overhesd	metallic scraps, sludge, waste compositio n, waste cement, spoil	Construct ion sites, campsites	Monthly	Const ructio n sites, camp sites, borro w pits	Waste sampling bins, plastic bags, boxes, weighing machine	Proper Waste Disposal methods(segre gate), 3Rs	Clean Environment	Contractor and KeNHA, Environmenta list		20,000/= per month *30= 600,000/= 90,000/=	yes
Environme ntal Risks Extra overhead and profit	Fire outbreak, floods etc.	Possible hazardous areas only	Continuous	Along the Project road and the vicinity	Exposure profiles, field surveys and inspections	human health risk assessme nt and ecologica l risk assessme nt	No exposure to all risks during construction and operation	Contra ctor and KeNHA ,		45,000 per month *30= 1,350,000/= Kshs 202,000/=	Yes

Noise pollution	Noise pollution/Levels	Lden: the day-evening-night-level, indicator	Monthly	Machines and equipment that produce noise	decibels (dB)	Measurements using	vibration levels < 0.5 cm per second second	Contractor and KeNHA, Environment		20,000/= per month =480,000/=	yes
Air Quality Extra over item for profit and overhead	TSP, NOx, SO2, CO, Dust particles, particulate matter etc		Continuous PC Sum %	Construction, Quarrying and Earth Borrowing sites, camp	PM2.5 and PM10 µg/m3	Air sampling equipment to measure dust levels, gases and particles	Ambient air quality values= Zero	Contractor and KeNHA, WRA, Environmentalist	1 0.15*5,000,000/=	5,000,000/= 300,000/=	yes

Soil Erosion, Monitoring and testing of soil quality during construction at relevant sites. Extra over item for profit and overhead	Soils eroded, Turbidity in storm water and other water sources, sources and causes, heavy metals, oil &grease	Formation of Rills and gulleys Soil and water pollution	Continuous PC Sum %	Excavated areas, sloppy areas along the road	Eroded top soils	Observations and soil tests, take pictures	Controlled soil erosion measures	Contractor and KeNHA, WRA, Environmentalist	1 0.15*2,000,000/=	2,000,000/= 300,000/=	yes
Occupational Health and Safety risks Extra profit &Overhead	Safety training for workers, accident reports and records, number and types of accidents, hazards	injuries and work-related ill health in terms of LTIs, production days lost through sickness absence,	Continuous	Construction sites, campsites	(LTI)-Lost Time Incident Frequency (Rate), Assessments, Incidents log-book	OSH Audits, Use of PPEs	Reduced diseases, accidents and incidents	Contractor and KeNHA, WRA, Environmentalist		50,000 per month *30= 1,500,000/= 225,000/=	yes

Human Accidents Extra profit and overhead	categories of accidents and their locations	Safety of humans	Continuous	Along the proje ct road, shopp ing cente rs such as Ridge ways, Thind	Total number of human accidents	Accident recording book, camera, field patrol vehicle, use GPS/GIS	No accidents or injuries	Contractor and KeNHA, WRA, Environmenta list		60,000 per month *30= 1,800,000/= 270,000/=	yes

Wildlife Accidents Extra profit and overhead	types of animals knocked,	Safety of animals	Continuous	Along the road especially around Karura forest	Wildlife population remains intact	Accident recording book, camera, field patrol vehicle, use GPS ,Animal count especially monkeys	No dead wild animals	Contractor and KeNHA, WRA, Environmentalist		20,000 per month *30= 600,000/= 90,000/=	yes

HIV/AIDS Incidences	Training programs, no. of incidences, no. of condoms distributed, seminars, and participants trained. TOT, HIV subcontractor, Avail and distribute Condoms	No new HIV/AIDS Cases	Months Months Months PC Sum %	Camp sites, construction sites, towns	HIV/AIDS Lab Tests	OSH records	No new HIV/AIDS infections	Contractor and KeNHA, WRA, OSH expert	30 Months@ 100,000/= 30Months@50,000/= 1 30Months@100,000/= 0.15*2,000,000	3,000,000/= 1,500,000/= 2,000,000/= 1,500,000/= 300,000/=	
	Total cost of monitoring during construction phase									**37,087,000**	
	Operation Phase										
Predicted Impacts	**Mitigation Measures**										

Possible risks of accidents on the road Extra profit and overhead	Maintain and ensure foot bridges are used by pedestrians Provide service roads for local traffic Maintain parking areas and bus stops for trucks and bus stages for pedestrians – Provide parking for	Minimized risks and accidents	Monthly	Along the project road and by-passes	Highway Patrol	Accident Records	No accidents	KeNHA, Traffic Police and NTSA	0.15*500,000/=	500,000/= 75,000/=	
Noise pollution and Excessive Vibrations Extra profit and overhead	– Enforcement of Traffic Act regulations to ensure that all vehicles using the road are in good condition all the time to avoid excessive noise generation Maintain signage and road markings even after commissioning -Continuous Planting and maintenance of	Reduced noise	Monthly	Along the project road and by-passes	Highway Patrol	Noise measurements at sampled points	Acceptable noise levels	KeNHA, Traffic Police and NTSA	0.15*700,000/=	700,000/= 105,000/=	

Increased Generation of Solid Waste and sedimentation of drainage tunnels	Proponent/ Client to ensure that all solid wastes are collected and disposed appropriately in order to promote a clean and healthy environment along the transport corridor. -Use of storm water management practices that slow peak runoff flow, reduce sediment	Proper waste disposal and are reduced sedimentation	Monthly	Along the project road and by-passes	Highway Patrol	Check for solid wastes and prosecute wrong doers	No indiscriminate solid waste disposal form road users	KeNHA, Traffic Police and NTSA	0.15*500,000/=	500,000/= 75,000/=	
		Total cost of monitoring during operation= 1,955,000/=KSHS **Grand Total of Monitoring= 8,740,00+37,087,000+ 1,955,000=47,782,000/=Kshs**									

Table 8.2. Environmental and Social Impact Management Plan (ESMP)

Predicted impacts	**Mitigation measures**	**Responsibility**	**Timeframe /Quantity**	**Unit**	**Rate/Estimated costs Kshs**
Noise pollution and Excessive Vibrations, Air pollution	-Avoid night time construction when noise is loudest. -Conduct periodic noise measuring and monitoring to determine levels and extent of harmful noise. -Clearly label high noise areas. -Provide PPE (hearing protection) to persons operating within or visit identified high noise areas. -Equipment should be fitted with standard noise attenuation features, silencers or lagging materials or specially designed acoustic enclosures. -Inform local residents when excessive noise may be generated. - No hooting signs in sensitive areas should be put up and drivers sensitized on the same. -Undertake controlled blasting at hard rock quarries and observe relevant explosives use. This should be undertaken during the day.	Contractor/ KeNHA	1	PC Sum	5,000,000 /=
	Extra over item 25.01 for profit and overhead		0.15	%	750,000/=
Air pollution	-Erection of dust screens all during construction	Contractor/	Monthly		240,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
by air emissions and dust	especially at the workers' camps. -Dust control measures should be adopted at concrete batching plants, providing adequate PPE to staffs, canopying loading points and erecting dust screens around the plant. -Adherence to personal protective clothing such as dust masks. -Harvest storm water, water from rivers to suppress at diversions, haulage routes and construction site and the all-weather access roads if volumes stored are sufficient. -Enforce onsite speed limit regulations. -Re-vegetate exposed areas during the operation phase of the project -Use bumps and/ or clearly marked road signs to slow down vehicles. -Add suitable soil stabilizers on access roads or pave access roads to control dust -Dust control mechanisms at the gravel borrow sites through extraction in wet conditions and transport in covered trucks -Implement dust control measures at the quarry sites and aggregate crushing sites	KeNHA			

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	-Cover soil heaps and berms. -Adhere to the Environmental Management and Co-ordination (Air Quality) Regulations, 2014.				
Emissions control	-Procure machines, equipment and vehicles which are environmentally friendly. -Regular maintenance and servicing of machines and vehicles. - Unnecessary reversing and idling should be discouraged. -Plan for movement of construction traffic. -Construction vehicles should have the requisite inspection certificate. -Control the speed of the traffic movement by having adequate policing. -Adhere to the Environmental Management and Co-ordination (Fossil Fuel Emission Control) Regulations, 2006.	Contractor/KeNHA	Once Monthly		5,000,000/=
Solid waste management	-The contractor to prepare a site waste management plan prior to commencement of construction works. It should have waste storage areas, collection and removal schedule and identification of approved disposal site. -Solid waste collection, segregation, and disposal system should function all times during the	Contractor/KeNHA	Monthly	20,000/= per month 30 +0.15	600,000/= 90,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	construction phase. -Recycle, reduce and re-use wastes where possible such as scraps metal. -Sub-contract a licensed waste handling firm to collect solid wastes on regular basis and dispose-off in an approved dumping site. - Construct proper drainage outfalls to reduce erosion from surface runoff and storm water. -Comply with Environmental Management and Co-ordination (Waste Management) Regulations, 2006.				
Water quality and effluent management	-Construct a standard septic tank/bio-digester linked to a constructed wetland system or use eco-toilets -Promote recycling of wastewater and storm water. -Install meters in workers' camps to control and monitor consumption rates of water. -Ensure regular maintenance of plumbing system and septic tanks to avoid spillage of raw sewage. -Comply with the Environmental Management and Co-ordination (Water Quality) Regulations, 2006. -Earth moving and excavations for the construction to be carried out considering conservation of the rivers and surface drainage.	Contractor/ KeNHA, WRA, Contractor, NEMA	One – off/Monthly /Continuous		5,000,000 /=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	Control siltation of rivers and other surface drains. -Ensure spilt oil does not discharge into water sources -Provide oil spill containment including concrete platform for servicing of construction equipment and holding of scrap oil drums.				
Water abstraction and consumption	-Obtain water permits for the abstraction of water from the rivers along the road. Existing water rights and uses should not be affected by the water abstraction. -Consult with the WRUAs should be done prior to abstraction to gain their support. -Comply with Water and Resources Management Authority Requirements as stipulated in the Water Act, 2016.	Contractor/ KeNHA	Continuous Monthly	7,000,000/= 0.15%	7,000,000/= 1,050,000/= 750,000/=
Climate change adaptation	-Cross-drainage design that accommodates 50-year flood return periods - Road design should withstand the prevailing climate changes and weather patterns.	KeNHA	Once		
Impacts on Drainage and Hydrology	-Control excessive abstraction of water from rivers along the project route River and boreholes. -Avoid complete blockage of river channels during construction of bridges and culverts by providing diversion channels for the rivers.	Contractor/ KeNHA, WRA	Continuous	1.5*3,00	3,000,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	-Re-open all blocked river channels after construction of bridges/culverts. -Quarries and pits for extraction of road construction materials to be used as water harvesting sites after reclamation and should be reclaimed and restored after project completion. -Surface runoff on the sides of the road should be channeled to areas with gentle slopes to avoid excessive erosion of the road slopes. -Construct over passes and bridges in areas occupied by rivers and wetlands			0,000/=	450,000/=
Soil quality and degradation	-Excavated materials should be reused in backfilling trenches or landscaping activities. Any other spoil should be protected against elements of weather such as surface water runoff. -Sensitize workers and enable them to handle concrete spillages or waste cement as per the training -Re-vegetate exposed areas immediately to mitigate against surface water runoff and wind erosion. -Surface runoff generated on impervious surface should not be channeled directly to steep slopes. -Construct flow breaks on roadside drainage	Contractor/ KeNHA	Monthly	2,000,000* .15	2,000,000/= 300,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	channels. -Promote harvesting of surface runoff				
Impact on Vegetation Cover and Biodiversity	-The clearance of vegetation along the project route and riparian zones should be minimized. -Provide adequate protection against scour and erosion; - Construction schedules to consider the onset of the rainy seasons. -Minimize clearing of indigenous plant species, and replanting of indigenous plant species in disturbed areas -Undertake habitat enhancement through placement of nesting boxes in rights of-way, bat boxes underneath bridges, and reduced clearance to conserve or restore native species. -Rehabilitate vegetation to recover lost plant cover through Reforestation and Afforestation -Use existing cleared or disturbed areas for the Contractor's Camp, stockpiling of material. -Demarcate areas to be cleared before the start of the clearing operations. -Minimize clearing and removal of vegetation in areas adjacent to borrow sites.	Contractor/ KeNHA, KFS,KWS	Monthly	3,000,000/= 3,000,000*1.5	3,000,000/= 450,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
Extraction and construction material sourcing	-The materials shall be sought from licensed suppliers, quarry and borrow pit sites by NEMA. This will allow for protection of quarry sites to be used within their natural regenerative capacity. -Inspect site's soil stability before excavation and put in the right safety measures for excavation -Borrow pits and quarries shall be located more than 20 meters from watercourses to prevent the storm water spill off to rivers located along the project route -All roads to and from borrow pits and quarries should be made safe and accessible. -The Contractor shall give a 14-day notice to nearby communities of his intention to begin excavation in the borrow pits -If quarrying should be necessitated, the contractor should prepare health and safety plan before any work on the quarries is commenced -Where possible cordon and fence off the borrow sites to minimize accidents. -Decommission the borrow pits and quarry areas upon completion of the Contract and reinstate the land to its natural condition by grading excavations and planting suitable saplings	Contractor/ KeNHA	Monthly	5,000,000/= 5,000.000* .15	5,000,000/= 750,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
Possible land and water contamination	-Traps will be provided at fueling points to prevent water contamination. -Embankment slopes leading to water bodies will be modified and screened so that contaminants do not mix with water	Contractor/ KeNHA	Monthly	750,000 /= 750,000 *.15	750,000/= 112,500/=
Disturbance to Wildlife	-Review existing information on species and habitats in the project area. Contact appropriate agencies (KWS and KFS) early in the planning process to identify potentially sensitive ecological resources that may be present in the project area. -Locate site facilities like campsites away from important ecological resources (e.g. wetlands, important upland habitats, sensitive species populations). -Use existing facilities and disturbed areas (e.g. access roads, graded areas) to minimize the amount of new disturbance especially when creating diversions -Minimize the number of stream crossings when locating access roads. -Provide Monkey bridges crossing from Karura forest to other habitats. - Transplant indigenous plant species through spading or trenching and replanting in similar ecosystems. Follow the recommended root ball	Contractor/ KeNHA, KWS,KFS	Monthly	700,000 /= 700,000 *.15	700,000/= 105,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	sizes and plant weight. -Comply with the provisions of the Wildlife Conservation and Management Act 2013				
Delays in transportation and possible accidents	-Construct pedestrian crossing points with foot bridges in certain key areas -Inclusion of road bumps in towns and villages and speed breakers at intersections. -Adopt strict policing to ensure that there is no over speeding along the road.	Contractor/ KeNHA	Once Monthly		250,000
Occupational health and safety risks	-Establish work zones to separate pedestrians travelling by foot from vehicular traffic and equipment by routing of traffic to alternative roads when and where possible. -Use protective barriers to shield pedestrians from traffic vehicles, deep trenches, regulate traffic flow by warning lights, avoid use of flaggers if possible, design of the work space to eliminate or decrease blind spots, and ensure reduction of maximum vehicle speeds in work zones. -Train workers in OSH issues related to their activities, such as the hazards of working on foot around equipment and vehicles -Ensure safe practices for work at night and in	Contractor/ KeNHA	Monthly	1,200,000/= 1,200,000*.15	1,200,000/= 180,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	other low-visibility conditions, including use of high-visibility safety apparel and proper illumination for the work space (while controlling glare so as not to blind workers and passing motorists). -Barricade area around which elevated work is taking place. People should not work elevated structures. Use safety procedures including use of fall protection measures (e.g. Scaffolding, railings). -Hoisting and lifting equipment should be rated and properly maintained, and operators trained in their use. -Use of the correct asphalt product with the right temperature for each specific application to reduce fuming of bitumen during normal handling. -Maintenance of work vehicles and machinery to minimize air emissions -Reduction of engine idling time in construction sites -Develop and enforce a fleet transportation management plan that includes work zone safety measures for construction workers and the travelling public. -Employ a competent Environment, Safety and				

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	Health officer to ensure enforcement of OSHA, 2007 and EMCA Act 1999, (Amended, 2015).				
Resettlement and land acquisition impacts	- Use the Resettlement Action Plan (RAP) to compensate for affected assets and sources of livelihood for Project affected persons (PAPs). -Surveyors to confirm the actual cadastral boundaries. -Enter into agreements with the affected people to prevent future disputes.	Contractor/ KeNHA Environmentalist and Sociologist	During construction and to be as per the consultants rates		To be determined after Property/ Land Valuation as per NLC Act
Acquisition of land and property for borrow pits, ,quarries, water ,spoil pits and workmen's camp	-Determination of agreeable rates for compensation to affected persons or land	Contractor/ KeNHA Environmentalist and Sociologist	During construction and to be as per the consultants rates		To be determined after Property/ Land Valuation as per NLC Act
Gender and equality biases	-Apply Kenya constitutional requirements on gender throughout the project -All guidelines under the National Gender and Equality Commission Act, 2011, should be applied -Undertake gender mainstreaming at project design, implementation/ construction, operation and decommissioning stages	Contractor/ KeNHA Environmentalist and Sociologist	During construction and to be as per the consultants rates		300,000

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
Community Health and Safety	-Installation of measures to reduce collisions between pedestrians, motorists and vehicles (e.g. use of signs to alert drivers on road segments with zebra crossing. -Installation of barriers (e.g. guardrails, fencing, plantings) to deter pedestrian access to the roadway except at designated crossing points. -Installation and maintenance of all signs, signals, markings, posted speed limits, warnings of sharp turns, or other special road conditions and other devices used to regulate traffic, specifically those related to pedestrian facilities or bikeways. -Prepare an emergency preparedness and response plan in coordination with the local community and local emergency responders to provide timely first aid. -Provision for adequate wastewater disposal system to avoid breeding of malaria parasite transmitting mosquitos. Proper disposal of wastewater to minimize contamination of water supplies with typhoid causing organisms -Implement health and safety measures as proposed in the ESMP apply to the letter for quarrying and earth borrowing activities.	Contractor/ KeNHA Environmentalist and Sociologist	During construction and as per the consultants rates		200,000/=

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
Social-Political Disputes	-Involve all stakeholders and the public in the planning process. - All affected persons should be fully compensated for loss of land and businesses. -Obtain necessary permissions and approvals from the County Governments. - Local administration and community leaders should be engaged during project implementation. Members of the local community should be considered for employment during the road construction. -Community liaison officers, local administration and interested and affected persons should be consulted to identify members of the grievance address committee.	Contractor/ KeNHA Environmentalist and Sociologist	During construction and as per the consultants rates		200,000/=
Loss of Businesses along the road reserve	-Provide support to squatters to establish small-scale businesses in other suitable locations in affected area for instance they can be taken to other county government market centers. -Educate squatters on the need to maintain free road reserve -Provide comprehensive health and safety education to squatters in affected town. -Promote other sources of livelihood among the	Contractor/ KeNHA Environmentalist and Sociologist	During Construction and as per the consultants rates		As per estimated business losses

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	local communities. -Provision of subsistence of transitional allowance to squatters through the RAP -Provision of employment in the project for the squatters where possible during construction of the road				
Spread of communicable diseases and HIV/AIDS infection	-Develop a comprehensive STDS, HIV and AIDs control and awareness program such as provision of condoms to workers both male and female -Provision of STDs, HIV and AIDS prevention measures to workers. -Creation of awareness of STDs, HIV/AIDS in workers' camps through trainings and installation of posters -Adhere to and implement the Sexual Offences Act, 2006 and its amendment 2012	Contractor/ KeNHA Environmentalist and Sociologist	During Construction and as per the consultants rates		5,000,000 /=
Possible Insecurity and terrorism	-Workers, suppliers and distributers should be thoroughly screened during the construction period. -Ensure 24-hour surveillance and random patrols by Traffic and Administration Police services. -Install CCTV cameras in strategic locations of the camps. - Local people should be given the first priority in	Contractor/ KeNHA Environmentalist and Sociologist NTSA, Traffic Police and	During Construction		500,000

Predicted impacts	Mitigation measures	Responsibility	Timeframe /Quantity	Unit	Rate/Estimated costs Kshs
	employment to be beneficiaries of the project and to safeguard it. -Liaise with the local administration and police for intel and enhancement of security protocols. -Road construction should withstand terrorist attacks	NIS			
	Total Estimated Cost of Mitigation Measures				**50,359,000/= Kshs**

8.9 General EHS Plans Requirements in Construction Projects

8.9.1 Occupational Health and Safety Plan

The primary objective of the OSH plan is to identify the major hazards associated with construction of the road work and to ensure that appropriate controls are in place before work commences. The OSH plan starts with planning the activity which is carried out by the Supervisor/foreman or site safety supervisor. This is followed by hazard identification, risk assessment, and risk control which is undertaken prior to start of work and the following must be in place;

- Supervision is essential to ensure the activity is completed as planned, and to a safe system of work.
- A current safe pass should be given to all people engaged in construction work current having successfully completed a one-day safe-pass training.
- Plant/equipment certification - It is a legal requirement for most construction plants to be tested and examined regularly, in particular all lifting appliances and lifting gear. The certificates relating to these must be kept up to date.

- The Construction Skills Certification Scheme identifies certain skills on construction sites that require mandatory training and a certificate is issued.
- Communication/induction - Every new contractor or new employee on a site should undergo an induction when they first arrive on site. This induction should inform the attendees about: site rules and procedures; the arrangements for their safety and welfare on site; and who the key responsible persons (duty holders) are. Emergency plans/procedures should be explained at inductions (they must also be available in writing). These measures must also deal with rescue. Clear communication helps to ensure that tasks are understood and completed in a safe manner.
- WC & Washing- provide toilets and hand-washing facilities on all sites.
- Canteen & Shelter- Arrangements must be made to provide a facility for workers to take breaks.
- Drinking water- An adequate supply of portable drinking water must be provided at a convenient point (or points).
- First Aid equipment must be provided and maintained, and be easily accessible.
- Personal Protective Equipment (additional protection to the individual, PPEs) must be used to protect against hazards which are unavoidable.
- Road diversions and signage should be meticulously planned to ensure that the volume and size of traffic diverted can safely navigate the alternative road. The signing, lighting and guarding-works must be supervised by a competent person
- Traffic Management Plan - traffic and pedestrian management must be considered as part of the detailed Risk Assessment. Measures to control traffic may include: bollards, flagmen, ramps, stop-go men, stop-go systems, temporary traffic lights and warning signs. Before road works or road-related activity is undertaken, traffic-control signs must be erected.
- Fencing, pedestrian routes and security- Suitable fencing must be used to secure sites. Where members of the public have to access close to, or around construction work, suitable safe routes must be provided to protect them. Consideration must also be given to people with disabilities. Only authorized people should be allowed onto construction sites.

8.9.2 Borrow pit/Quarry Rehabilitation Plan

The contractor shall at the onset of the project and prior to opening up any material site provide a plan on how the material shall be;

i) Harvested
ii) Stockpiled
iii) Transported

The contractor shall prepare a plan showing how dust will suppressed and maintained at acceptable levels. Noise and Vibrations levels may be detrimental to people and the environment. The material sites should be fenced off and access control mechanism established to keep off animals and unauthorized persons. The contractor shall provide a material site rehabilitation plan for all materials. The rehabilitation plan should allow growth of natural fauna and flora, drain water and fence off open burrows to reduce the risk of human or animals drowning.

Completion and acceptance of rehabilitation of borrow pit and material sites shall be signed off by the relevant authorities including the Site Engineer, NEMA, County authorities and where land is privately owned the owner or the owner's representative. Agreements between the land owner and the contractor authorizing material harvesting shall be deposited with the Engineer prior to commencement of the harvesting process. All nuisance emanating from the borrow areas / material sites including health hazards shall be mitigated.

8.9.3 Vehicle/Traffic Management Plan

The traffic plan should address deliveries, traffic path, pedestrian path and internal traffic path that should be used once construction commences. The construction site should be fenced off and description of the construction area and surroundings, parking or laydown area, bypass lanes, diversions posted speed limits, land width, traffic volumes and heavy vehicle component be put in place. Traffic control methods such as signage, line-marking, bollards, barricades should be put in place. Signs, line markings and delineation should be in good condition, be clean and not faded, retro-reflectivity should be adequate and where applicable power supply should be fully operational. Over-sized vehicles or loads may need to

be accommodated as part of the traffic management regime, indicate the likely sources and routes taken by pedestrians and cyclists marked clearly. Where paths are interrupted, alternative safe access needs to be provided. All potential risks associated with the traffic passing near and through the construction site should be addressed and emergency services contacts should be documented. The traffic control diagrams which show the proposed locations of the traffic control devices traffic direction, road furniture, temporary lighting if necessary, that will be used during the construction works. Monitoring and audit programs should undertake inspection on a regular basis to ensure corrective actions are incorporated immediately to minimize negative impacts. Truck and other equipment operators should be trained on safety and Health issues to avoid accidents, incidents, diseases and fatalities.

8.9.4 Waste Management Plan

The disposal of construction wastes should follow these principles:

- minimize the production of wastes- Waste can be avoided by good planning. Waste packaging may be reduced by selecting different products or returning the packaging to the supplier. Waste in the form of contaminated soil can be avoided by careful use of substances such as fuels, chemicals, concrete wastes on site to ensure that the soil is not contaminated by spillages and leaks caused by poor practices.
- maximize the reuse and recycling of wastes- Where possible, recycle excess materials including surplus soils, concrete, steel and timber rail sleepers, etc. Higher levels of recycling will be achieved if suitable bins/designated stockpiles can be used to enable separation of different wastes.
- dispose of wastes in an environmentally responsible manner- Common hazardous/ listed wastes include waste oil, acids, dangerous substances, paint sludge and residues, etc. Others are paints, sprays or other chemicals as hazardous wastes. All listed or hazardous wastes should be collected and disposed of by a licensed waste contractor to a licensed waste depot.

8.9.5 Camp design/Installation plan

Location, and design of the offices and the construction camps shall be the responsibility of the contractor. Nevertheless, standard drawings for Engineers office and housing has been provided. The contractor may however decide to hire the office and the Engineers Housing. The contractors' camps, offices including workshops should have the necessary environmental mitigation measures put in place such as good drainage, disposal of liquid and solid waste, firefighting equipment, dust and noise suppression, general cleanliness and maintenance of the camps. There should also be good lighting, aeration, clean supply of water and disposal of human waste and periodic monitoring and reporting as highlighted in the ESIA report.

Potential Impacts	Mitigation
▪ Disposal of liquid and solid waste ▪ Water borne diseases ▪ Fire outbreak	▪ Provide garbage bins, toilets ▪ Provide clean water ▪ Drain stagnant water and spray to get rid of waterborne disease vectors ▪ Firefighting equipment

8.9.6 Auxiliary Plants

Auxiliary plants refer to concrete mixing plants, bitumen storage and heating plants, asphalt plants, crusher and mobile pavement milling plants. These facilities could emit poisonous gases and fumes into the air. They could also be a source of heat, dust and noise. In this regard, there might be the need for a considerable amount of water for internal operations, cooling and suppression of dust. A lot of energy to run the plants may be an issue to consider if possible to incorporate renewable energy. The ecosystem at the water intakes should have minimal disturbances. Storm water drainage should be controlled to prevent pollution into water courses. Rehabilitation of these sites after the completion of the project may require special attention owing to spillage of hydrocarbons including bitumen.

Potential Impacts	Mitigation
▪ Poisonous gases and fumes ▪ Noise ▪ Energy consumption	▪ Proper storage, use dust masks ▪ Use mufflers, calibrate and service equipment/engines ▪ Renewable Energy i.e Solar

8.9.7 Spills Prevention and Response Plan

In the event of a hazardous substance spill or release, review and follow applicable OSHA SDS guidelines to prevent the spill from entering sewer or storm drains, spreading off-site, or affecting human health. In all situations precaution must be maintained with the overall aim being to prevent and/or limit personal injury.

- **Stop, contain, and clean up the chemical spill if:**
  - The spilled chemical and its hazardous properties have been identified.
  - The spill is small and easily contained.
  - Responder is aware of the chemicals' hazardous properties. If a spill or release cannot be controlled or injuries have occurred due to the release, the following procedures should be implemented: • Call for help or alert others of the release.
  - Evacuate immediate area, and provide care to the injured- Call 911.
  - If potential fire or explosion hazards exist initiate evacuation procedures- Call 911.
  - Immediate response to contain uncontrolled spills:
    - ✓ Use appropriate personal protective equipment when responding to any spill.
    - ✓ shut off the source of the release (if safe to do so).
    - ✓ Eliminate sources of ignition (if safe to do so).
    - ✓ Protect drains by use of adsorbent, booms or drain covers (if safe to do so).
    - ✓ Notify onsite emergency contact(s).
  - Notify other trained staff and assist with the spill response and cleanup activities. Coordinate response activities with local emergency personnel (fire department).
  - Be prepared to provide information to fire department, EMT, hospital or physician.

- Notify appropriate agency if a release has entered the environment. Refer to Notification and Reporting section for reporting thresholds.

➢ **Fuel and chemical storage**

- Store all fuels, oils and chemicals within sealed and banded areas.
- Ensure that bunds are regularly cleared of storm water. Oily water mixtures must be removed by licensed waste contractor.
- Dispense fuels and oils within a sealed area, if possible.
- Clean up any spillage as soon as practicable.
- All clean-up material must be disposed of by a licensed waste contractor.

8.9.8 Emergency Response Plans (ERP)

Road works Emergency Response Plan

Water is extremely powerful and could wash away anything, including pavement, road works, cars, trucks buildings. The shut-off valves should be identified and required tools to contain the situation be kept on site. Storm water, service water management and electricity service lines should also be factored in plan. Other pre-requisites to be considered are;

- A detailed traffic signage layout and practice a dry run before the work team get on site. Keep signage handy, with enough clean orange flags and trained traffic controllers on site to initiate stop-go traffic control, then convert to proper signage and sturdy barriers. Water drums may be useful.
- Keep an emergency vehicle on site to block off any roads that require sudden closure to minimize traffic flow.
- Perform a risk assessment of alternative traffic routes, and consider closing some roads to reduce the flow of vehicles into the controlled zone.
- Consider high risk road users such as trucks, long-haul vehicles, priority road users such as ambulances, fire trucks, and public transport, in selecting which direction of traffic must be given priority.
- Consider nearby traffic intersections, to prevent causing down-stream traffic obstructions.
- Notify FM radio stations of road closures, and keep their numbers handy.

- The work site may change as work progresses, and the buffer or emergency zone may change depending on events.
- Road works should be considered emergency operations from the start, with the emergency manager in overall command, and not doubling as the works engineer or occupational health and safety practitioner.

8.9.9 Environmental Awareness Plan

Environmental awareness and training includes;

- Environmental impacts from developmental projects
- Site induction, including key project specific environmental issues i.e. management of waste, and prevention of water and air pollution
- Environmental risk assessment briefings.
- Global warming and Climate Change
- Land take and green belt shrinkage
- Resource usage, 3 Rs (Recycle, Reduce and Reuse)
- Habitat destruction and species extinctions.
- Storage, handling, prevention of accidental spillage of hazardous substances
- Environmental posters and site notices.
- Toolbox talks, including instruction on incident response procedures.

All site staff shall be competent, must have orientation to the overall environmental program and comply with key environmental matters on site such as;

- Orientation to environmental contingency plans (e.g., spills response) and responsibilities for implementation;
- Awareness of individual responsibilities and decision-making procedures regarding environmental matters;
- Environmental Compliance
- Communication

8.9.10 Decommissioning Plans for Camps and other Installations

Decommissioning plan should be a deliverable to the client and be followed in the process of decommissioning the site. The plan should include rehabilitation of camp sites, material sites, reinstatement of detours to the natural state etc.

8.10 Commissioning Phase

The Main Contractor shall prepare a programme in the form of a GANTT chart that shows each element of the testing and commissioning process (including client validation and witnessing where specified) for all those services required under the contract and/or for compliance with statutory requirements. The programme shall be submitted to the Project Manager, Engineering Team Clerk of Works for review and to the client. Testing and commissioning will be carried out on the completed roads to ensure that they are safe and meet the design requirements.

The witnessing of tests on and off site shall be defined by:

- Design specifications - Mechanical and Electrical
- Requirements of the validation process
- Safety department policy statements
- Tender documentation
- Building Engineering services

8.11 Cost of the Project

Cost of the proposed road and other related Bills of Quantities for the entire project to be provided by APEC Consortium in JV with SPAN Contractors.

CHAPTER NINE: CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusion

The findings of the Environmental Impact Assessment show that the proposed Muthaiga-Kiambu-Ndumberi road has positive impacts that outweigh the potential negative impacts.

Some of the main positives impacts identified include; employment opportunities improved standards of living, security, access to schools and health facilities, aesthetics, ease traffic congestion and improve transport of goods and services, growth of towns along the project road among others. Among the potential negative impacts identified are noise pollution, dust emissions, solid waste generation, increased water demand, increased energy consumption, generation of exhaust emissions, workers accidents and hazards during construction, possible exposure of workers to diseases, increased storm water among others can however they can be sufficiently mitigated.

The project will undertake reclamation on the disturbed areas and during construction the wildlife including monkeys from karura forest will have minimal disturbances. Increased sedimentation in water resources such as Karura, Rwaka, Riara, Gatathuru, Kigwa and Gatharaini rivers will mainly be prevented by use of silt traps and locating stockpiles away from the rivers and increased wildlife mortality will be mitigated by providing crossings for monkeys' road signs and speed limits on conservation areas and wildlife corridors. With proper implementation of the provided mitigation measures, these impacts can be avoided or minimized. Due process of addressing the project affected persons through compensation will be followed. The proponent of the proposed project shall be committed to putting in place several measures to mitigate the negative environmental, safety, health and social impacts associated with the life cycle of the project. The project will benefit Nairobi and Kiambu Counties and the surrounding environs.

9.2 Recommendations

It is recommended that in addition to this commitment, the proponent shall focus on implementing the measures outlined in the Environmental Management and Monitoring Plan as well as adhering to all relevant national and international environmental, health and safety standards, policies and regulations that govern establishment and operation of such projects in Kenya. More emphasis should also be put on complying with the 10 Equator Principles and IFC World Bank Guidelines discussed in the report. Monitoring should be undertaken in consultation with environmental, Social and OSH experts.

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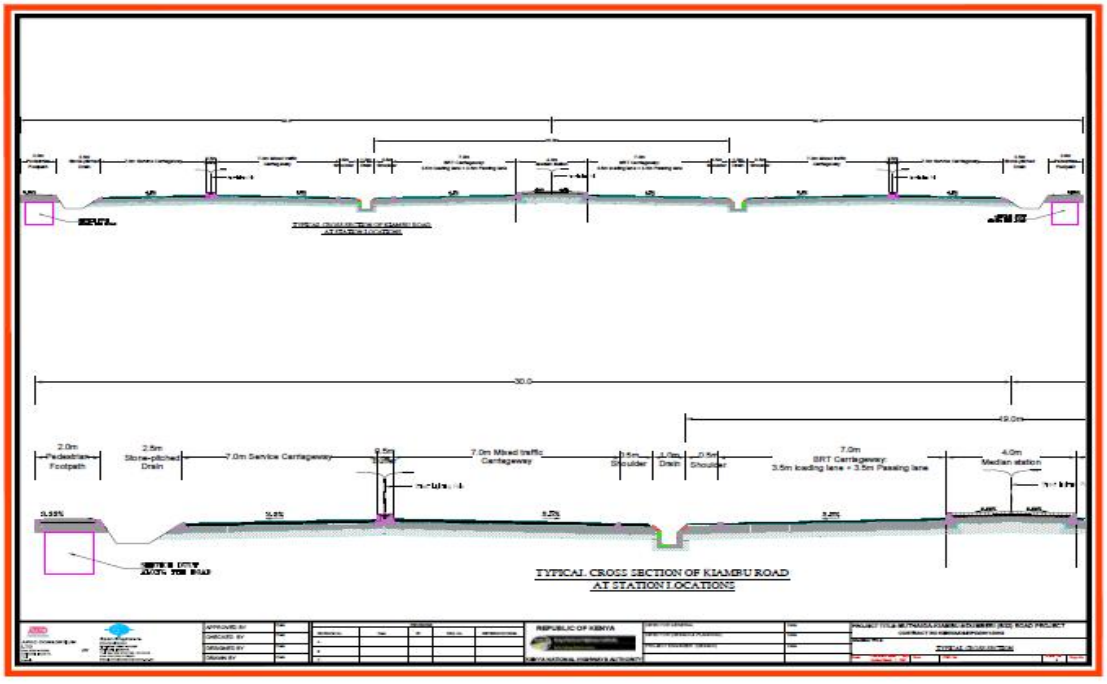
10 APPENDICIES

10.1 Appendix 1: Detailed Inventory of the Road Components

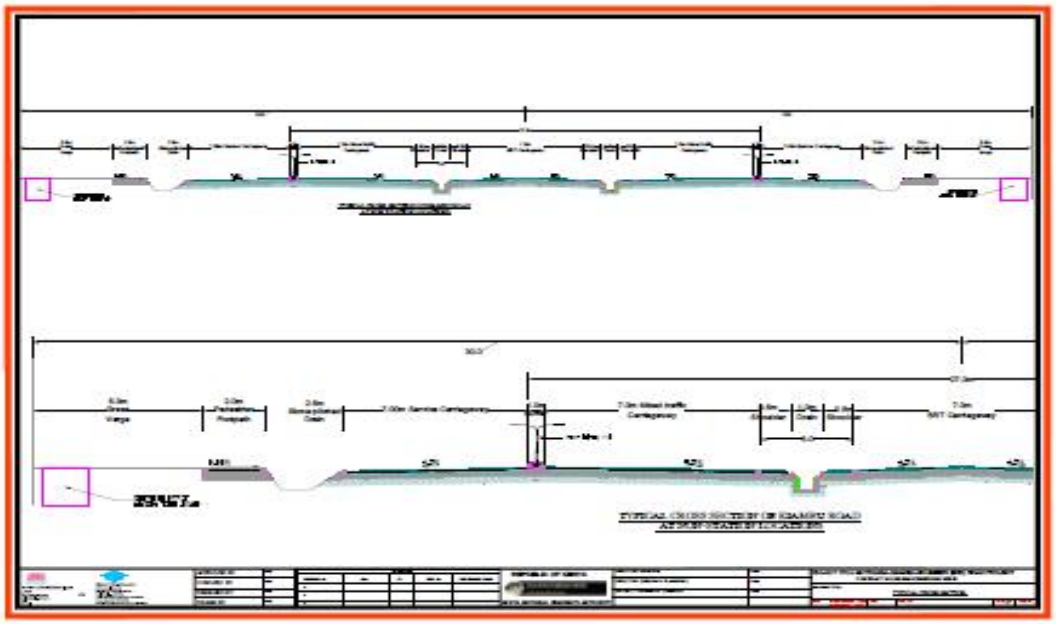
S. No.	Item	Details
1)	Project Name	Proposed Dualling Of Muthaiga-Kiambu-Ndunberi (B32) Road (Contract No Kenha/Cs/HPD/2611/2018).
2)	Project Location & Description.	The Project is located in Nairobi & Kiambu Counties- It comprise Dual carriageway from Muthaiga to Ndumberi- 15kms, Two bypasses to Kiambu Town and Spur Road to Kiambu High School. The main road alignment commences at Pangani and Muthaiga Interchanges along Thika Road (A2) and proceeds through Kiambu ending at Ndumberi. Bypasses Roads to Kiambu Town one on the eastern side and the other on the western side of the town have been identified.
3)	Scope of works	Consultancy Services encompass Economic Feasibility Studies, Technical and Engineering Studies, Environmental and Social Studies, Field investigations, Engineering designs and preparation of tender documents. The designs shall provide space for future development of BRT system along the main road as necessary and provide NMT facilities, junctions and service roads and as necessary provide for accommodation of current and future services within the road reserve. The consultant shall further provide training of client staff attached to the project on requisite aspects of the assignment.
4)	Design Consultants	Apec Consortium Ltd in JV with Span Engineers
5)	Award Date for Design.	22nd June 2018, letter Ref: KeNHA/1908/2018
6)	Source of funds	Government of the Republic of Kenya
7)	Commencement date	22nd October 2018
8)	Contract Period	12 months
9)	Detailed design submission	21st October 2019

S. No.	Item	Details
10)	Length of Project	25 kms
11)	Assignment	• Survey • Traffic studies • Alignment Soils • Materials Investigations • Existing pavement analysis • Alignment Design • Drainage & structural Design • Pavement design • ESIA/RAP • Tender Documentation

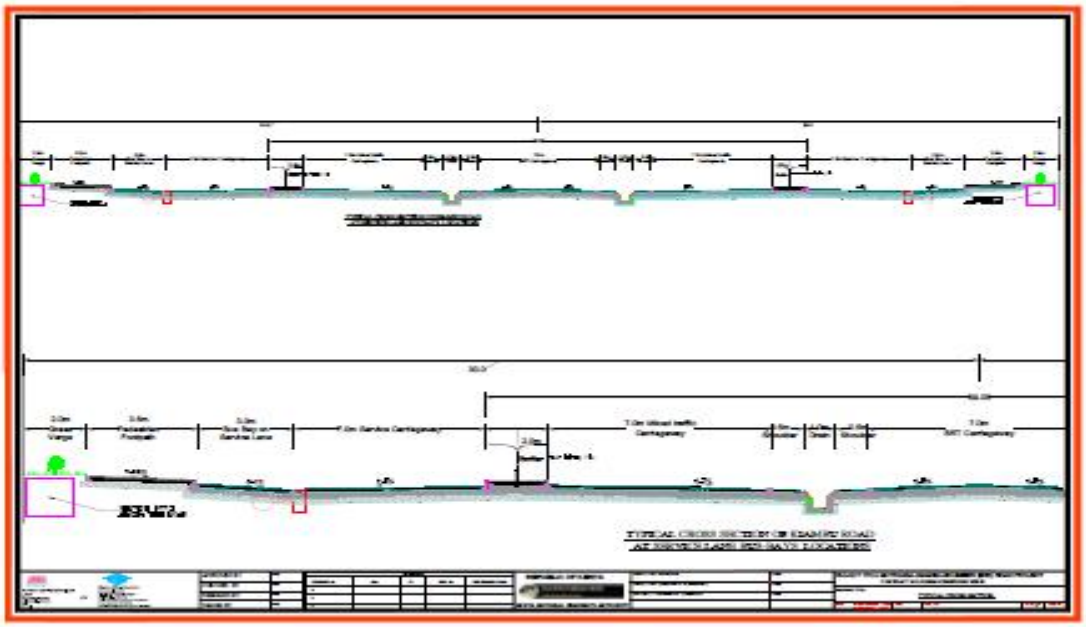
Appendix 2: Typical Cross-Sections



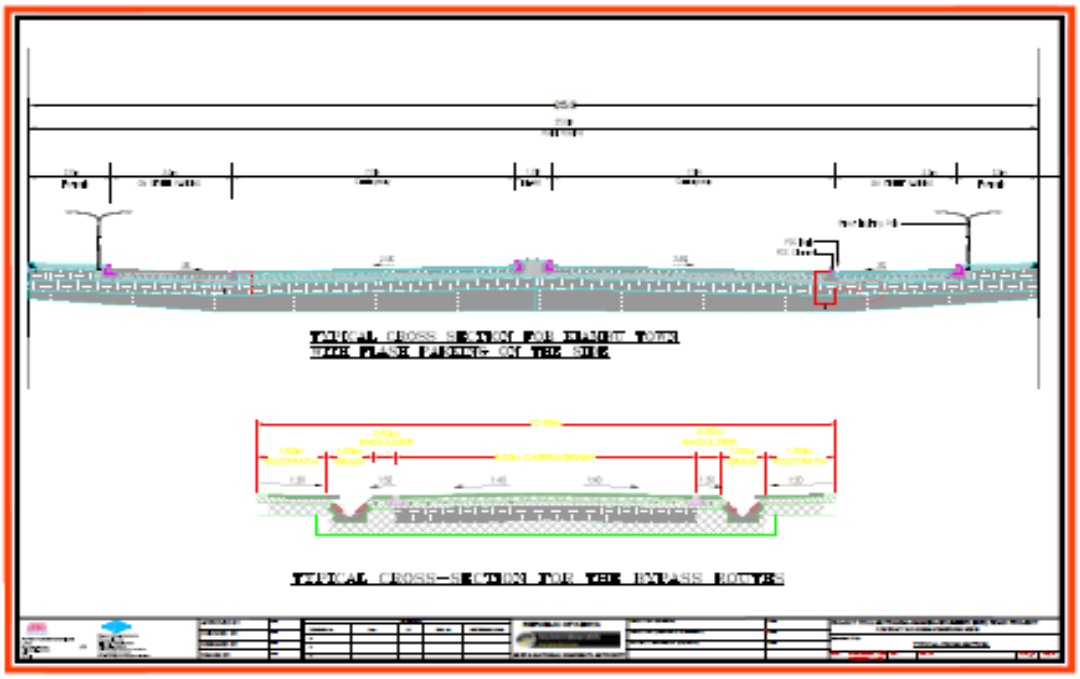
Typical Cross Sections of Kiambu road at Station Locations



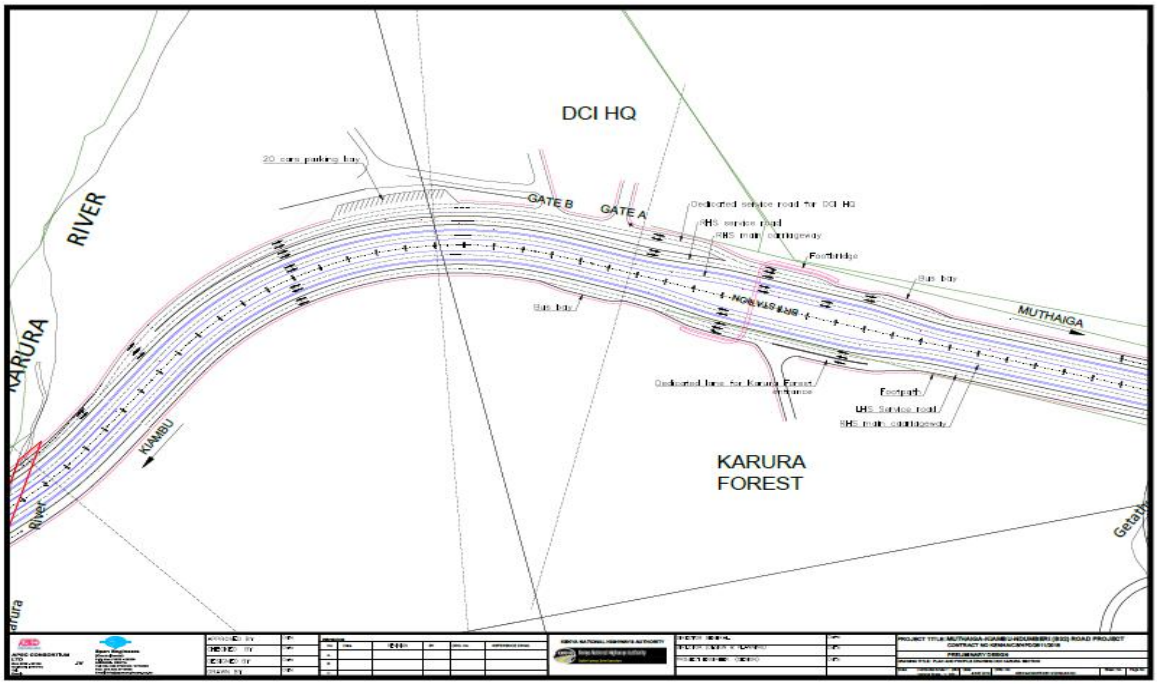
Typical Cross Sections of Kiambu road at Non-Station Locations



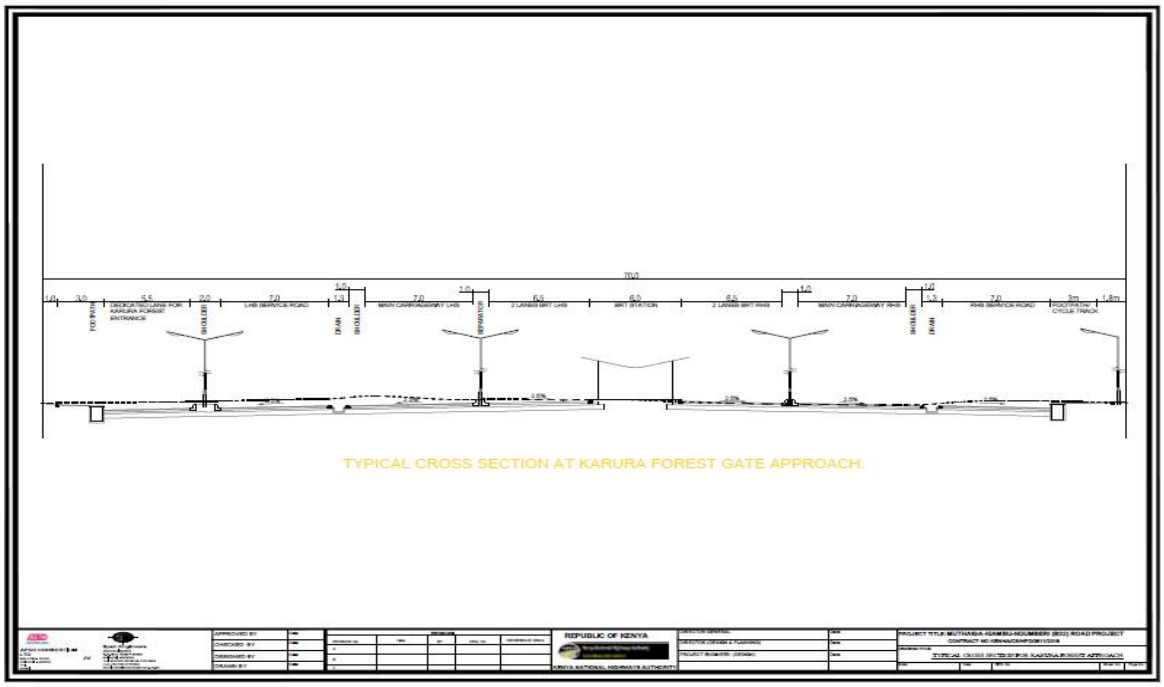
Typical Cross Sections of Kiambu road at Service Lane Bus Bay Locations



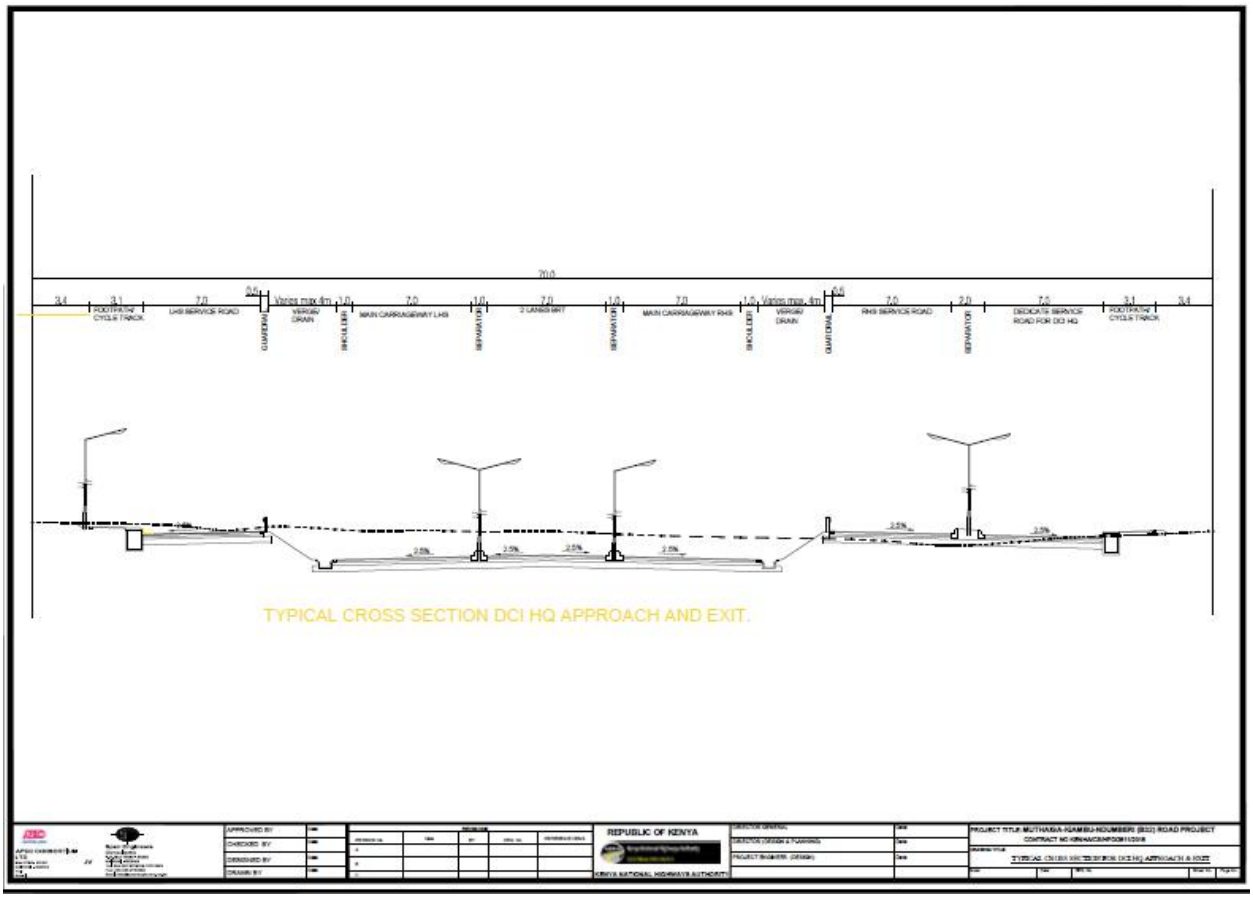
Typical Cross Sections for Kiambu Town with Flash Parking on the side



DCI HQ and Karura Forest Access



Typical Cross Section of Karura Forest Gate Approach



Typical Cross section DCI HQ Approach and Exit

6.3.2.1 Appendix 3: Preliminary Design Inventory

ROAD SECTION ; MUTHAIGA- DCI SECTION			
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way	2 Lanes x 2 sides	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Service Roads	1 Lane x 2 sides	5.5m	Both Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
HIGHWAY CROSSING AND DRAINAGE STRUCTURES			
Structure and Location		**Description**	
Concrete Box Culvert at Gitathuru River		3 Cell 5x3 Box Culvert	
Muthaiga Golf Club Concrete Box Bridge 1		Dimensions 7mx4.5m underpass	
Muthaiga Golf Club Concrete Box Bridge 2		Dimensions 7x4.5m underpass	
KFS / DCI		NMT Steel Foot Bridge	
Other Facilities			
Location		**Description**	
DCI / KFS		Bus Stops / Lay bys on both Directions	
DCI/KFS		20m Wide BRT Station on BRT Corridor	
Roadside storm water drains			

Road Section; DCI – Tala Road			
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way	2 Lanes x 2 sides	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Service Roads	1 Lane x 2 sides	5.5m	Both Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Concrete Box Culvert at Karura River		3 Cell 5m x 3m High Box Culvert	
Concrete Bridge at Rui Ruaka River		1 Span 15m x 4.5m High	
Concrete Box Bridge at Rui Ruaka River		30m Span Bridge	
Sharks Palace		NMT Steel Foot Bridge	
Other Facilities			
Location		**Description**	
Sharks Palace		Bus Stops / Lay bays	
Sharks Palace		20m Wide Corridor for BRT Station	

Roadside storm water drains	

Road Junction – Tala Road Junction at Ridgeways			
Junction Type	**Grade Separated Junction (Trumpet Junction)**		
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way (Kiambu Road) At Grade	2 Lanes x 2 sides	3.5m	Both Directions
Tala Road crossing Elevated	2 Lanes x 2 Both Directions (Within the Interchange)	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Slip Roads	1 Lane x 4 sides	5.5m	All Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
Highway Crossing And Drainage Structures			
Structure and Location		**Description**	
Concrete Bridge		53m Span Bridge	

Road Section; Tala Road Junction – Northern Bypass junction (Ridgeways)			
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way	2 Lanes x 2 sides	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Service Roads	2 Lane x 2sides	3.5m	Both Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
U-Turn Concrete overpass Ramps at Walkabout area and after Runda Gate		Provided for vehicular circulation within Ridgeways	
Pedestrian crossing Footbridge at Ridgeways		3No. NMT Steel Foot Bridge	
Concrete Box Culvert for the Stream near the Northern Bypass on the 2 slip roads and on the Main Carriageway		4mx2m High Box Culvert	
Other Facilities			
Location		**Description**	
Ridgeways		Bus Stops / Lay bys	

Ridgeways	20m Wide Corridor for BRT Station
Roadside storm water drains	

Road Junction – Kiambu Road/Northern Bypass Road Junction			
Junction Type	**Full Interchange (Full Clover Junction)**		
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way (Kiambu Road) At Grade	2 Lanes x 2 sides	3.5m	Both Directions
Northern Bypass Road Elevated	2 Lanes x 2 Both Directions	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Slip Roads	2 Lane x 4 sides	3.5m	All Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Concrete Bridge		45m Span Bridge	

Road Section ; Northern Bypass Interchange - Thindigua			
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way	2 Lanes x 2 sides	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Service Roads	2 Lane x 2 sides	3.5m	Both Directions
NMT Facilities	2Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Concrete Box Bridge at Evergreen Area		Overpass for local vehicular circulation	
Concrete Box Bridge at Thindigua Area		Overpass for local vehicular circulation	
Pedestrian crossing Footbridge at Bypass and Thindigua areas		NMT Steel Foot Bridge	
Concrete Box Culvert for Kigwa River		4mx2.5m High Box Culvert	
Other Facilities			
Location		**Description**	
Bypass area , Evergreen and Thindigua		Bus Stops / Lay bays	
Bypass and Thindigua		20m Wide Corridor for BRT Station	
Roadside storm water drains			

Road Section; Thindigua – Kwa-Ngethe Area			
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way	2 Lanes x 2 sides	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Service Roads	2 Lane x 2sides	3.5m	Both Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Concrete Box Culverts at Gatharaini River		3 Cell 4mx3m High	
Concrete Box Bridge at Gatharaini River		8mx4.5m High Overpass on BRT on both Circulation Lanes forming a roundabout	
2 Separate Concrete Bridge on Main Carriageway over Gatharaini River		32.5m Span Bridge	
Pedestrian crossing Footbridge Kwa ng'ethe and KIST area		NMT Steel Foot Bridge	
Other Facilities			
Location		**Description**	

Kwangethe Area	Bus Stops / Lay bays
Kwangethe Area	20m Wide Corridor for BRT Station
Roadside storm water drains	

Road Junction – Kiambu Road/Kamiti Road Junction			
Junction Type	**Grade Separated Junction (Trumpet)**		
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way (Kiambu Road) At Grade	2 Lanes x 2 sides	3.5m	Both Directions
Kamiti Road Elevated	2 Lanes x 2 Both Directions	3.5m	Both Directions
BRT	Corridor	9m	Corridor
Slip Roads	2 Lane x 4 sides	3.5m	All Directions
NMT Facilities	2Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Concrete Bridge		Overpass Bridge	

Road Junction – Kiambu Road/Boma/Kirigiti Road Junction			
Junction Type	**Grade Separated Junction (Roundabout)**		
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way (Kiambu Road) Elevated	2 Lanes x 2 sides	3.5m	Both Directions
Boma/B30 (Kirigiti) Road At Grade	2 Lanes x 2 Both Directions	3.5m	Both Directions
BRT	Corridor	9m but, BRT Corridor Terminates at this Location and the BRT traffic merges with the rest on the Main Carriageway. BRT buses are given the right of way.	
Service Roads	2 Lane x 2 sides	3.5m Wide but merges further with the main Carriageway due to restricted road reserve.	
NMT Facilities	2Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Concrete Bridge		Overpass Bridge over Boma/Kirigiti Road	
Concrete Box Culvert at Riara River		3 Cell 5m x 3.5m High Box Culvert	

Road Section; Kiambu Town – Ndumberi Town			
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way	1 Lanes x 2 sides	3.5m	Both Directions
BRT	No BRT Corridor		
Service Roads	2 Lane x 2sides	3.5m	Both Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Vehicular Circulation at grade by use of 2 No. round abouts at Kiambu Law Courts and County Government Offices. 2No. U-turn areas between Kiambu and Ndumberi.			
Pedestrian crossing Footbridge within Kiambu Town		At least 3No. NMT Steel Foot Bridge	
Other Facilities			
Location		**Description**	
Roadside storm water drains		Concrete boxed, or Piped drains	

Road Section; Ndumberi Town – Sasini Coffee			
Description	**No. of Lanes**	**Lane Width**	**Other**
Main Carriage Way	1 Lanes x 2 sides	3.5m	Both Directions
NMT Facilities	1Lane x 2 sides	2m	Both Directions
Highway Crossing and Drainage Structures			
Structure and Location		**Description**	
Vehicular Circulation at Grade by use of 2 No. round about at Ndumberi and at the Location of Kiambu South and Northern Bypass			
Pedestrian crossing at Grade			
Other Facilities			
Location		**Description**	
Roadside storm water drains		Earth Drains	

Appendix 4: Hydrology Drainage Structures

Grade Separation Structures										
No.	Chainage	Location	Type of structure	Span Configuration	Total span	Orientaion	Angle	Camber	Deck Orientation	Remarks
1	M.K.N Rd Km 0+429.5	Muthaiga Golf Club	Bridge	10x15x15x10	50	Orthogonal	-	"-2.5% -2.5%"	-	Underpass
2	M.K.N Rd Km 0+752.72	Close to Mua Rd	Bridge	20 x 2	40	Orthogonal	-	"-2.5% -2.5%"	-	Overpass
3	M.K.N Rd Km 1+845.75	Close to DCI	Bridge	20 x 2	40	Orthogonal	-	"-2.5% -2.5%"	-	Overpass
4	M.K.N Rd Km 3+147.58	U-turn to Coffee Garden Rd.	Bridge	20 x 1	20	Orthogonal	-	"-2.5% -2.5%"	-	Overpass
5	M.K.N Rd Km 3+531.1	Tala Rd	Bridge	22 x 15 x 22	59	Skew	39°	"-2.5% -2.5%"	-	Underpass
6	M.K.N Rd Km 3+845.86	U-turn to Ridgeways LHS	Ramped Bridge	20 x 20 x 10 x 8.1 x 9.2 Centre line	125.4	Curved	Custom	"-2.5% +6.0%"	-	Underpass
7	M.K.N Rd Km 5+073	U-turn to Runda	Bridge	20 x 1	20	Orthogonal	-	"-2.5% -2.5%"	-	Overpass
8	M.K.N Rd Km 5+173	U-turn to Ridgeways RHS	Bridge	20 x 1	20	Orthogonal	-	"-2.5% -2.5%"	-	Overpass
9	M.K.N Rd Km 5+502	Northern By-Pass	Bridge	20 x 10 x 20	50	Skew	22°	"-6.0% +6.0%"	-	Underpass
10	M.K.N Rd Km 6+084	Near Northern By-Pass	Box Bridge	8 x 8 x 8	24	Orthogonal	-	"+1.2% -2.5%"	-	Underpass
11	M.K.N Rd Km 6+854	Near Kasarini	Box Bridge	8 x 8 x 8	24	Orthogonal	-	"-2.5% -2.5%"	-	Underpass
12	M.K.N Rd Km 7+795	Before R.Gatharaini	Bridge	20 x 1	20	Orthogonal	-	"+1.0% -2.5%"	Cambered LHS	Overpass
13	M.K.N Rd Km 8+154	After R.Gatharaini	Box Bridge	8	8	Skew	12°	"-6.0% +6.0%"	-	Underpass
14	M.K.N Rd Km 8+648	U-turn to Edenville	Box Bridge	8 x 8 x 8	24	Orthogonal	-	"-2.5% -2.5%"	-	Underpass
15	M.K.N Rd Km 9+446	KIST roundabout	Box Bridge	8 x 8 x 8	24	Orthogonal	-	"-2.5% -2.5%"	-	Underpass
16	M.K.N Rd Km 9+555	KIST roundabout	Box Bridge	8 x 8 x 8	24	Orthogonal	-	"-2.5% -2.5%"	-	Underpass
17	M.K.N Rd Km 10+025	Kirigiti Junction	Bridge	20 x 20 x 20 x 20	80	Orthogonal	-	"-2.5% -2.5%"	-	Overpass

Drainage Structures										
No.	Chainage	River	Type of structure	Configuration	Total span	Orientaion	Angle	Road Camber	Road Orientation	Remarks
1	M.K.N Rd Km 0+683	River Gitathuru	Concrete Box Culvert	3 Cell 5 x 3	15	Skew	33°	"-2.5% -2.5%"	-	
2	M.K.N Rd Km 1+783	River Karura	Concrete Box Culvert	3 Cell 5 x 3	15	Skew	55°	"0% -2.5%"	-	
3	M.K.N Rd Km 3+048.92	River Ruiruaka	Concrete Box Culverts on service roads	3 Cell 5 x 4	15	Skew	41°	"-2.5% -2.5%"	-	
3A	M.K.N Rd Km 3+050	River Ruiruaka	Bridge	15 x 4.5	15	Skew	41°	"-2.5% -2.5%"	-	
4	M.K.N Rd Km 5+356.25	Perennial stream	Concrete Box Culvert	4 x 2	4	Skew	58°, 9°, 47°	"-6.0% +6.0%"	Cambered RHS	
5	M.K.N Rd Km 6+621	River Kegwa	Concrete Box Culvert	4 x 2.5	4	Skew	54°	"+6.0% -6.0%"	Cambered LHS	
6	M.K.N Rd Km 7+899.76	River Gatharaini	Concrete Box Culvert	3 Cell 4 x 3	12	Orthogonal	-	"+6.0% -6.0%"	Cambered LHS	
7	M.K.N Rd Km 9+924.84	River Riara	Concrete Box Culvert	3 Cell 5 x 3.5	15	Skew	8°	"-2.5% -2.5%"	-	

Kamiti Road Bypass Structures				
No.	Chainage	Purpose	Type of structure	Remarks
1	Km 0+047.43	River Riara crossing	Concrete Box Culvert	Not included in preliminary design submission
2	Km 0+182	Water pipeline crossing	Concrete Box Culvert	Not included in preliminary design submission
3	Km 1+343	Drainage crossing	Concrete Box Culvert	Not included in preliminary design submission

Sasini Northern Bypass Structures				
No.	Chainage	Purpose	Type of structure	Remarks
1	Km 1+105	Drainage crossing	Concrete Box Culvert	Not included in preliminary design submission

Sasini Southern Bypass Structures				
No.	Chainage	Purpose	Type of structure	Remarks
1	Km 0+685	Drainage crossing	Concrete Box Culvert	Not included in preliminary design submission
2	Km 2+770	Drainage crossing	Concrete Box Culvert	Not included in preliminary design submission

Appendix 5: Impact Scoring and Ratings

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
Positive Environmental and Social Impacts during Construction and operational Phase							
1.	Creation of employment opportunities	+4	+5	+4	**+4**	**High**	N/A
2.	Increased business opportunities	+4	+5	+4	**+4**	**High**	N/A
3.	Contribution of revenue to the county and national governments	+4	+5	+4	**+4**	**High**	N/A
4.	Revitalizing of existing Centers/Towns along the road route	+4	+4	+4	**+4**	**High**	N/A

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
5.	Increased Security	+3	+3	+4	**+3.5**	**Medium**	N/A
Likely negative environmental impacts during construction							
1.	Noise pollution and Excessive Vibrations	-3	-1	-3	**-3**	**Medium**	-Avoid night time construction when noise is loudest. - Clearly label the high noise areas. -Conduct periodic noise measuring and monitoring - Provide PPE (hearing protection). - Equipment's should be equipped with standard noise attenuation features. - Hard rock quarries should carry out controlled blasting - Observe explosives use and blasting permits
2.	Air pollution by air emissions and dust	-2	-2	-3	**-2**	**Low**	- Dust control measures at concrete batching plants, -Provide adequate PPEs (dust muffs), - Use waste water

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
							(storm water) to reduce excessive dust, - Enforce onsite speed limit regulations, -re-vegetate exposed areas as soon as possible for carbon sequestration to take place -Add suitable soil stabilizers on access roads or pave access roads -Cover heaps and berms of soil. Adhere to the Environmental Management and Co-ordination (Air Quality) Regulations, 2014. -Calibrate machines, equipment and vehicles as per the Environmental Management and Co-ordination (Fossil Fuel Emission Control) Regulations, 2006.
3.	Increased generation	-3	-2	-3	**-3**	**Medium**	-Site waste management plan

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
	of solid waste						-Solid waste collection, segregation, and disposal system, -recycle and re-use wastes, -Drainage outfalls should be properly constructed, -Comply with Environmental Management and Co-ordination (Waste Management) Regulations, 2006.
4.	Increased Discharge of Wastewater, Sewage and Degradation of Water Quality	-2	-3	-3	**-3**	**Medium**	-Construct a standard septic tank/bio-digester, - Recycle wastewater and storm water, - Earth moving and excavations should not accelerate compaction rivers and pollution of surface drainage, Spilt oil should not discharge into water sources, -Construct an oil spill

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
							containment including concrete platform for servicing of construction equipment and holding of scrap oil drums, -Comply with the Environmental Management and Co-ordination (Water Quality) Regulations, 2006.
5.	Water abstraction and consumption	-2	-3	-3	**-3**	**Medium**	-Water permits for the abstraction of water shall be obtained from WRA, -Consultations with the WRUAs should be done prior to abstraction - Comply with Water and Resources Management Authority Requirements as stipulated in the Water Act, 2016.
6.	Climate change and	-1	-1	-3	**-3**	**Medium**	-Cross-drainage should accommodate 50-year flood return periods

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
	potential Impacts on road project						- Road infrastructure design should withstand high rainfall, strong winds as well as temperature
7.	Interference with Drainage and Hydrology	-1	-1	-3	**-3**	**Medium**	-Control excessive abstraction of water from rivers, -Provide diversion of river channels during construction of bridges and culverts, - Re-open all blocked river channels after construction of bridges/culverts, -Surface runoff on the sides to be channelled to areas with gentle slopes to reduce soil erosion, -Construct over passes and bridges in areas occupied by rivers and wetlands
8.	Increased soil erosion risk and	-1	-1	-3	**-3**	**Medium**	-Excavated materials should be used for backfilling trenches or landscaping,

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
	soil quality degradation						-Sensitize workers on properly handling of concrete spillages or waste cement - Immediate re-vegetation of slopes to control soil erosion, - Construct flow breaks on roadside drainage channels.
9.	Loss of Vegetation Cover and Biodiversity	-3	-3	-2	**-4**	**High**	-Clearance of vegetation the shall be kept to a minimum -Minimize clearing and disruption of riparian vegetation along the rivers, -Provide adequate protection against scour and erosion, -Construction schedules to factor in the impact of the rainy season, -Minimize clearing of indigenous plant species, replant indigenous trees and avoid disruption of riparian vegetation

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
							along the rivers.
10.	Disturbance to Wildlife	-2	-2	-3	**-2**	**Low**	-Locate site facilities like campsites away from important ecological resources, -Provide crossing for monkeys from Karura forest (monkey bridges) -Replant indigenous plant species in disturbed areas, -Use existing facilities and disturbed areas (e.g. access roads, graded areas to minimize the amount of new disturbance, -Comply with the provisions of the Wildlife Conservation and Management Act 2013,
11.	Extraction and construction material sourcing	-1	-1	-3	**-3**	**Medium**	-Materials should be sought from NEMA licensed quarry and borrow pit sites suppliers, -Cordon off the borrow areas,

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
							-Carry out site's soil stability tests before excavation and put in the right safety measures for excavation, -All roads to and from borrow pits and quarries should be made safe and accessible, -Prepare health and safety plans for quarries, -Topsoil stripped prior to removal of borrow should be stockpiled on site for reuse in restoration of the sites after decommissioning.
12.	Resettlement and land acquisition impacts	-4	-3	-4	**-4**	**High**	-Prepare a Resettlement Action Plan (RAP) for the Project Affected Persons (PAPs), -Surveyors to confirm the actual cadastral boundaries -enter into

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
							agreements with the affected people to prevent future disputes.
13.	Loss of Businesses along the road reserve	-2	-2	-3	**-2**	**Low**	-Support squatters to establish small-scale businesses in other suitable locations -Educate squatters to avoid encroaching road reserves, -Create awareness on other sources of livelihood among the local communities, -Provide subsistence and transitional allowance to squatters through RAP and offer employment during construction.
14.	Social-Political Disputes	-3	-2	-3	**-3**	**Medium**	-All stakeholders and the public be involved in the design and construction process, - Proper identification and compensation of all affected persons. -Obtain necessary permissions and

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
							approvals from the County Governments, -involve the community in the project through their leaders, -Allow area community liaison officer to come up a grievances committee and the local administration should be represented.
15.	Gender and equality biases	-1	-1	-2	**-1.5**	**Very Low**	-Apply gender Kenya constitutional requirements under the National Gender and Equality Commission Act, 2011, -Mainstream gender at project design, implementation/ construction, operation and decommissioning stages

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
16.	Occupational health and safety risks	-3	-2	-3	**-3**	**Medium**	-Separate pedestrians and work zones and use protective barriers to shield pedestrians from traffic vehicles, deep trenches - regulate traffic flow by warning lights, avoiding the use of flaggers if possible, -design of the work space to eliminate or decrease blind spots, - training to ensure safe practices for work at night and in other low-visibility conditions, -use high-visibility safety apparel, good illumination for the work space, - barricade the area where high elevated work is taking place, - Maintain elevating platforms and they be operated according to established safety

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
							procedures e.g. Scaffolding, railings, -Correct asphalt products for each specific application and apply at the correct temperature to reduce the fuming of bitumen. -Develop and enforce a fleet transportation management plan, -Employ a competent EHS officer to enforce the OSHA,2007 and EMCA Amended 2015 regulations
17.	Spread of communicable diseases and HIV/AIDS infection	-2	-2	-3	**-2**	**Low**	-Develop a comprehensive STDS, HIV and AIDs control and awareness and preventive measures program and training -Adhere to and implement the Sexual Offences Act, 2006 and its amendment 2012
18.	Delays in transporta	-3	-2	-3	**-3**	**Medium**	-Construct pedestrian crossing points with

S/N	Type of Impact	Severity of Impact	Spatial Scope of the Impact	Duration of Impact	Average score	Interpretation	Mitigation Measures
	tion and possible accidents						foot bridges in key areas, - Erect road bumps in towns and villages and speed breakers at intersections, - Use traffic marshals to control speed limits

Kenya National Highways Authority

Quality Highways, Better Connections

Appendix 6: Sample Questionnaire for Public Consultation

QUESTIONNAIRE FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PUBLIC CONSULTATION FOR THE DUALLING OF MUTHAIGA-KIAMBU-NDUMBERI ROAD.

Kenya National Highways Authority (KeNHA) plans to improve **Muthaiga-Kiambu -Ndumberi (B52/C558) Road into a dual carriage way**. The design shall incorporate the Bus Rapid Transport (BRT) system along the main road as necessary. The road commences at Pangani and Muthaiga interchanges along Thika road and proceeds through Kiambu town ending at Ndumberi. The road covers a distance of 25 Kms which includes by-passes, loops and accesses. The design shall incorporate design for all access roads to Government institutions including but not limited to schools, colleges, District headquarters and other Government offices. Major loop roads within townships or market centers and potential bypasses along the road shall also be included. Design of a bypass road for Kiambu town shall be mandatory. Also design of interchanges where necessary shall be undertaken.

According to EMCA, 1999 and Environmental Impact and Audit Regulations 2003, public consultation is an important aspect to effective and adequate Environmental and Social Impact Assessment (ESIA). In order to undertake this activity for the above project, we would like to capture your views using the questions below. You are also free to raise any pertinent issue that is not addressed by the questionnaire. Please note that your name and information therein will **ONLY** be used for the stated purpose in this particular project and will be treated with utmost confidentiality.

NAME_____ ID No: _____

Occupation: _____ Company/Organization: _____

Tel No: _____ Location/Area of residence _____

1. Are you aware of this project? (Tick one) Yes [ ] No [ ]
2. Do you believe this project will be of any benefit to your area Yes [ ] No [ ]
3. Please tell us how this project will benefit you and the community (FAIDA)

   _____

   _____

   _____

   _____

4. What are the problems/issues related to the current state of the road?

   _____

   _____

   _____

   _____

5. What are the negative impacts (either environmental or socio-economic) that could result from the construction and operation of the road?

   _____

   _____

   _____

6. How would you like the negative impacts associated with the project to be addressed?
7. How would you like the local community/institution/association to be involved in the project?

---

8. Any other comments/proposals/ concerns about the road project?

   _____

   _____

   _____

9. How will the community benefit from this Project?

10. How do you view the current situation?

11. How does the current road affect you and the community in regard to:

- Health
- Safety
- Pollution
- Property values
- Jobs
- Congestion
- Crime
- Local economy

12. Are there parts of the community that might be disproportionately burdened by the project?

13. Who is committed to the various interest groups, such as community groups or business groups, and will be responsible for acting as liaison and leader?

For more information, please contact us at P.O BOX 49712 - 00100 Nairobi or 3786-00100 or Email: info@*apecltd*.co.ke. Thank you for your cooperation

Appendix 7: Sample Socio-economic Survey Questionnaire

RESETTLEMENT ACTION PLAN (RAP) FOR MUTHAIGA-KIAMBU-NDUMBERI ROAD PROJECT

SOCIO-ECONOMIC AND VALUATION INSTRUMENTS/TOOLS

Social Economic Survey Questionnaire

General Information

County	Sub-County	Location	GPS Coordinates	Respondent
			Eastings_____ Northings_____	Relationship with the HOH_____ Household No_____ ID No. of Head of Household_____ Interview Date_____ Telephone_____ Enumerators: 1_____ 2_____ Verified by: _____ Verification date_____ Entered electronically by_____

1. HEAD OF HOUSEHOLD

1.1 Name of the Head of household: .....

1.2 .Gender:☐ M /F ☐1.3 Age: .....☐ 1.4 Tel .....

1.5 Religion.....

1.6 Marital Status: ☐i. Single ☐ii. Married Monogamous☐ iii. Married Polygamous ☐iv. Separated/Divorced ☐v. Widowed

1.7 Vulnerability.....

☐i. Widow.....☐ii. Orphan .....☐iii. Household headed by children under 18yrs .....☐iv. Sick ☐v. Disabled

☐vi. elderly over 65yrs ☐vii. (others) specify .....

1.8 Other household members: Provide information on other household members specifying their relationship with the Head of the household

No	Name of House hold member	R/ship with Head of household	Gender 1.M 2.F	Age	Occupation 1 Primary 2 Secondary	Education	Can read and/ or write 1. Yes 2. No	Main language spoken by majority at home

Relationship with the household head:☐ i. Spouse ☐ ii. Son/Daughter ☐iii. Parent (Father/Mother) ☐iv. In-laws ☐ v. Brother/Sister☐ xi. Brother/Sister-in-law ☐xii. Nephew/Niece ☐viii. Grand-son/daughter ☐ ix. Cousin ☐x. parent ☐ xi. Other (specify)

2. Primary and secondary occupation (multiple responses possible)

☐i. Subsistent retail trader ☐ii. Farmer ☐ iii. Livestock/Animal Keeper

☐iv. Builder ☐ v. Agricultural worker ☐ vi. Civil servant ☐vii. Student ☐viii. Housewife ☐ix. Shop Assistant ☐x. Self-employed ☐xi. Non-employed home helper ☐xii. Boda boda operator ☐xiii. Employed-NGO/CBO ☐xiv. Without occupation/employment

☐. Xv. Other.....

3. Education:☐i. Without education ☐ii. Did not complete primary☐ iii. Completed primary ☐ iv. Did not complete secondary ☐v. Completed secondary ☐vi. Completed technical training ☐vii. Completed vocational training ☐viii. University Graduate ☐
ix. Other: .....

4.OCCUPATION OF THE HEAD OF THE HOUSEHOLD

4.1 Can read and/or write: ☐ 1. Yes ☐2.No

5. HOUSEHOLD'S LIVING CONDITIONS

5.1 Access to drinking water (more than one possible answer): ..... ☐i. Traditional well at home ☐ii. Borehole at home ☐iii. House with a water tap ☐iv. Access to public water taps outside the house ☐v. Access to well/boreholes outside the house ☐vi. Access to surface water e.g. river ☐vii. Rainwater ☐viii. Other (specify).....

5.2 Sanitary facilities (more than one possible answer): ..... ☐ i. Flush toilet in the house☐ii. Latrine with septic tank☐ iii. Latrine without septic tank
☐ iv. Public toilets outside the house ☐v. Bush/open defecation ☐ vi. None

5.3 Energy - Type of lighting (more than one possible answer): .....

☐i. Electricity (public utility) ☐ ii. Electricity Source (Power generator, Main Grid, Solar) ☐iii. Kerosene lamp/lantern ☐iv. oil lamp/lantern ☐ v. Wood ☐ vi. Candle ☐vii. Solar panel/lamp ☐viii. None ☐ ix. Other

5.4 Energy source - Cooking combustible (more than one possible answer): ..... ☐i-Electricity☐ii. kerosene ☐iii. Charcoal ☐iv. LPG Gas ☐v. Biogas
☐vi. Dry plants (wood/firewood) ☐vii.Other

5.5 Household Assets: (indicate number of items if applicable) (multiple response expected) ☐i. Bicycle: ..... ☐ii. Motorcycle: ..... ☐iii. Truck: ..... ☐ iv. Car: .....☐v.

Generator: ..... ☐vi. Radio..... ☐ vii. Tractor… ☐ viii. Water pump…..☐ix. Mobile Phone ……. ☐ x. Television ☐xi. TukTuk: ……

5.6 Access to Social Services

Main mode of transport……☐i-Bicycle ☐ii-Bodaboda ☐iii-Bus/Matatu PSVs ☐iv- Private Car ☐v-On foot ☐vi- Lorry ☐vii-Other (specify)……

5.7 Nearest Primary School……..☐ i. 0-1km ☐ii. 2-5km ☐iii. 6-10km ☐iv. More than 10km

5.8. Where do you seek medical treatment? ☐i. Public Health facility ☐ii. Private health Facility ☐iii. Mission/NGO Hospital ☐ iv . Traditional/spiritual healer ☐v. Chemist/shop ☐ vi. Other (specify)

5.9 **Nearest Health Facility**……..☐ i. 0-1km☐. ii. 2-5km iii. 6-10km ☐iv. More than 10km 5.5 What main disease(s) did you or a member of your household suffer from in the last one year? (multiple responses possible) ☐i. Amoeba/typhoid ☐ii.Malaria☐iii.Tuberculosis ☐iv. Common cold ☐v. Diarrhoea ☐vi. Fever ☐vii. Hypertension/High blood pressure ☐ viii. Diabetes ix. Other specify

6. LIVELIHOOD – (MULTIPLE RESPONSES EXPECTED)

6.1. Sources of CASH income for the household head

No	**Source of income**	**Sector**	**Average distance (KM)**	**Monthly income of household**		
				Nb	Income of Household	Amount
Main source					Member of household Household head Spouse Adult child	

					Other……	
Secondary source					Head of household Spouse Adult child Other…….	

SECTOR: ☐I. Crop Farming ☐ii. Animal husbandry☐iii. fish-farming☐ix. Handicraft☐ construction☐ vi. Property rental ☐vii. Trading/Commerce ☐viii. Civil service ☐ix. Pension ☐x. Economic support: Family or friends ☐xi. Economic support: Government or NGO ☐xii.-Economic Support: Remittances ☐xiii-Other (specify).....

6.2 Other types of affected household production (Identify income sources and income amounts that are potentially affected by the project)

No.	Affected Asset	Income			Affected	
		Type of Income	Sector	Amount/month	Type of Impact	Duration of Impact
1 2 3 4 5						

TYPE OF INCOME

i) Rent – generated from house on an affected plot of land
ii) Rent – generated income from business owner on an affected plot of land
iii) Rent generated from person undertaking agrarian activity on affected land

iv) Sale generated income from affected business

v) Income generated by sale of products from an affected land plot

vi) Income from an employee of an affected business

vii) Employment-generated income for a farm worker operating on affected Plot of land

viii) Other (Specify)

Sector: ☐1.Formal ☐ 2. Informal

Type of impact: i. ☐Partial impact ☐ii. Total impact

Duration of impact: ☐ i. Temporary impact ☐ii. Permanent impact

7. Main expenses of the household - (multiple responses expected)

Specify amounts based on the reference period of your choice i.e. week, month **OR** year in each category

No	Main expenses of the household	Amount		
	Choose the reference period	Week	Month	Year
1.	House rent			
2.	Rental of agricultural land			
3	Agricultural input			
4	Food			
5.	Water			
6	Health			
7	Transport			
8	Education			
9	Other (specify)……			
10	Other (specify)……..			
11	Other (specify)……..			

8. HOUSEHOLD'S PERCEPTIONS IN RELATION TO THE PROJECT AND TO AVAILABLE COMPENSATION AND RESETTLEMENT OPTIONS

8.1 Are you aware of Muthaiga-Kiambu-Ndumberi road Project? ☐i. Yes ☐ii. No

8.2 What is your main source of information about this project? …… ☐i. Members of your family ☐ii. Neighbours ☐iii. National or regional Government ☐iv. Local authorities ☐v. public meeting ☐vi. other……..…

8.3 Are you aware that your land, structures or livelihood sources could be affected by this project?☐ Yes☐No

8.4 In the event that your assets or livelihood is affected by the project, what type of compensation would you prefer?☐ i. Provision of alternative Land or Structures for my affected land parcel ☐ ii. Cash compensation for loss of assets or livelihood

8.5. In the event that you would be affected, what other type of assistance would you need during resettlement? (More than one possible answer) ☐ i. Assistance for the transportation of the affected assets. ☐ ii. The authorities to allow for salvage of materials ☐iii. Compensation to include 15% disturbance allowance ☐ iv. No assistance ☐ v. Other (specify): ……

How do you think the proposed project could affect your household?

No	Theme	Impact	
		Type	Explanation
1	Household income		
2	Household expenses		
3	Household food		
4	Employment of members of the household		
5	Household children's education		
6	Household members health		
7	Household's access to service utilities		
8	Household's social networks		
9	Road and /or pedestrian network		

	frequently used		
10	Other (specify)……		

How affected: ☐1. Positive ☐2. Negative ☐3.No impact ☐4. Don't know

MUTHAIGA-KIAMBU-NDUMBERI RESETTLEMENT ACTION PLAN (RAP) ASSET INSPECTION SHEET

ii) Asset Inventory Tool

Household No / unique Identifier ……

A) GENERAL DETAILS OF AFFECTED ASSET OR LIVELIHOOD

Area/cluster	Location	Sub-county	County
Plot number	PAP category	Ownership/rented	GPS coordinates

Codification

PAPs Category: 1. Land owner 2. Structure Owner 3. Crop /tree Owner 4. Livelihood Owner 5. Tenant 6. Employees

B) DEMOGRAPHIC DATA OF PAP

Name of Household owner	ID	Telephone	Gender	Age
Spouses details				
Household size				
Education level				
Livelihood/income sources				

C) VULNERABLE PERSONS

No	Vulnerable parameter	Answer	
		Yes	No
1.	Is the household headed by a woman?		
2	Is the household headed by a child under 18 years?		
3	Is the household headed by a disabled person		
4	Is the household headed by a chronic ill person?		
5	Is the household headed by an elder person over 65years of age?		

Yes (1) or No (2)

D) LAND AFFECTED (Yes/no) …… Total Size (acre/square meters) …….. Area Acquired…… (acres) LR Number …… Title Deed Issued / Not Issued…… (Attach Copy) Status of Land: Ownership / Land Successions ……

E) STRUCTURE …… (partial / total impact) tick appropriately ……..... (commercial/residential)

Type of structure	No. of rooms	Type of material used			Size in Sq. ft.	GPS coordinates	Photo No
		Wall	Roof	Floor			

(F) LOSS OF LIVELIHOOD

S/ NO	Type of Business	Average Daily Income	Affected		Owner of the business	Employees
			Total / Partial	Type	Name (ID and address if not member of the household)	Name (ID and address)

G) CROPS GROWN

Type of Crop	Area in Square Feet	Name, ID and address (if not member of the household)

H) TREES GROWN

Type of tree	Age of trees			Name (ID and address if not member of the household)
	Young	Medium	Mature	

I) TENANTS

List the Names and Telephone Numbers of Residents Tenants in the Structure

TENANT'S / EMPLOYEE INFORMATION USING STRUCTURE OR BUSINESS

Name of Tenant	Gender	Rent amount in KShs	Telephone	ID Number

Appendix 8: Affected Properties along the Proposed Road

S/N	LR NO./NAME	RHS/LHS	CHAINAGE	Description of Affected Items
1	209/6037	RHS	0+200	Trees
2	209/6037	RHS	0+250	Trees
3	13134/3	RHS	0+350	Trees
4	13134/3	RHS	0+500	Trees
5	17338	LHS	0+575	Trees
6	17337	LHS	0+625	Trees
7	17336	LHS	0+650	Trees
8	17335	LHS	0+700	Trees
9	17334	LHS	0+725	Trees
10	15291/1	RHS	0+725	Trees
11	15291/2	RHS	0+750	Trees
12	KFS	RHS	1+200	Trees
13	KFS	LHS	1+200	Trees
14	12236	RHS	2+350	Trees
15	21095	LHS	2+850	Trees
16	27/331	RHS	3+400	-Perimeter wall & timber fence (Karura Gardens)
17	27/328	RHS	3+550	Mabati (Iron Sheet) structures, mabati gate
18	5989/14	LHS	3+650	-Container, iron sheets , metallic electric grilled fence , bungalow , mabati fence -2 Storey stone building -Single storey stalls , billboard ,metal grilled

				fence ,cabro path ,mabati fence
19	5989/10	LHS	3+800	-Fuel canopy
20	5989/14	LHS	4+000	-Mabati structure , cabro parking , carbro parking , mabati structure (go down) , perimeter wall
21	27/313	RHS	3+600	-3 Storey building , fuelling canopy , parking
22	27/310	RHS	3+650	-Temporal tents , mabati structure
23	27/14	RHS	3+950	-Single storey stone house with tile roof -Masionette , 2 storey building , water tanks , perimeter wall
24	5989/55	LHS	4+100	-Gate , perimeter wall , electric fence , live fence
25	5989/178	LHS	4+150	-Perimeter wall , metal grill fence ,gate ,security room , generator room
26	27/361	RHS	4+150	-Gate , perimeter wall with metal grill
27	27/49	RHS	4+175	-Perimeter wall with metal grill
28	5989/180	LHS	4+250	-Perimeter wall with grill , gate
29	5989/125	LHS	4+350	
30	5989/121	LHS	4+400	-Wire mesh fence with steel poles (basketball court)
31	5989/119	LHS	4+450	-Perimeter wall ,cabro

				parking ,gate , stone building , single storey (ablution block)
32	27/30	RHS	4+400	-perimeter wall ,live electric laser
33	27/270	RHS	4+450	-Perimeter wall , live electric laser , gate
34	27/272	RHS	4+500	-Gate , perimeter wall
35	27/271	RHS	4+550	Trees
36	27/74	RHS	4+575	Trees and cabro-parking
37	5989/117	LHS	4+500	-Mabati structure , perimeter wall , electric wire laser
38	5989/115	LHS	4+525	-Grilled electric fence , parking
39	5989/113	LHS	4+575	-Grilled electric fence , parking
40	5989/111	LHS	4+600	-Grilled fence , bill board
41	5989/109	LHS	4+650	-2 Storey stone building , grilled electric fence
42	14970/57	LHS	4+750	Trees
43	14970/11	LHS	4+825	Trees and fence
44	5989/6	LHS	4+950	-Grilled electric fence , 2 storey mabati structure
45	27/330			-Mabati shed ,electric grilled fence
46	27/321			-Metal grilled fence , cabro parking
47	27/307	RHS	4+675	-Grilled electric fence , gate
48	27/305	RHS	4+725	

49	27/361			-Stone building ,perimeter wall ,trees , gate
50	4884/1	RHS	4+875	Trees
51	5989/186	LHS	5+175	Trees
52	5989/19			-Perimeter wall , billboard
53	5989/123			-Metal grilled electric fence , gate
54	5989/183	LHS	5+300	Mabati structures and trees
55	188	LHS	5+500	-Car wash ,car yard , light mast ,petrol station
56	4884/2	RHS	5+250	Coffee bushes
57	5980	RHS	5+650	-Grilled electric fence , 3 storey building
58	5989/187	LHS	5+675	- Chain link fence with concrete posts
59	12825/26	LHS	6+150	-Grilled electric fence , gate , mabati structures
60	12825			-Gate ,chain-link ,trees
61	11668/2	RHS	6+300	-Bungalow (church) , Trees
62	11668/1	RHS	6+400	Single storey stone building and trees
63	76/324	RHS	6+600	-Perimeter wall, stone building ,security room , gate , trees
64	76/323	RHS	6+700	-Stone building stalls
65	76/322	RHS	6+800	-5 Storey easy stay court , 2 storey gateway , stone building stalls , 5 storey , mabati structure , gate , containers (double

				storey),perimeter wall with electric grill , 6 storey house
66	UNKNOWN	LHS	6700-7050	Trees and parking
67	UNKNOWN	LHS	7050-7200	Mabati structures
68	76/472	RHS	7+000	Single story stone building
69	76/450			-Stone building , mabati structure
70	76/471	RHS	7+050	Trees
71	76/470	RHS	7+100	Stoney building, mabati structure , perimeter wall
72	76/469	RHS	7+150	Trees
73	76/468	RHS	7+200	-Mabati structure , timber yard
74	76/467	RHS	7+250	Mabati structures
75	76/466	RHS	7+300	-Double storey containers
76	76/465	RHS	7+350	-6 Storey flat
77	76/464	RHS	7+400	Mabati structures, stone building
78	76/463	RHS	7+450	-Metal grilled fence , mabati fence
79	76/453	RHS	7+500	-Steel shed
80	12825/9	LHS	7+425	-Perimeter wall with metal grilled , gate , container sheds , stone-built stalls grilled fence ,gate
81	75/464			-4 Storey stone flat
82	UNKNOWN	LHS	7+650	Trees
83	8845	LHS	7+900	Trees
84	76/387	RHS	7+500	-Fuel station canopy , 2

				storey stone building
85	76/388	RHS	7+525	-Grilled , gate
86	76/389	RHS	7+575	-Perimeter wall with grilled , cabro
87	76/390	RHS	7+625	2 storey stone building, perimeter wall
88	76/391	RHS	7+650	Single storey stone house
89	76/392	RHS	7+725	Mabati structures, live fence, mabati gate
90	76/393	RHS	7+825	Trees
91	21882/33	RHS	7+950	Trees
92	21882/34	RHS	7+975	Trees
93	21882/11	RHS	8+050	Structures and trees
94	81/1	LHS	8+200	Coffee bushes
95	21882/10	RHS	8+200	Structures and trees
96	21882			-Perimeter wall , containers
97	21882/9	RHS	8+225	-2Bungalow , trees
98	21882/8	RHS	8+275	-2 Masionettes , live fence , trees
99	21882/7	RHS	8+325	Stone building, trees, perimeter wall and steel gate
100	8844/1	LHS	8+325	-Grilled fence ,land,Mabati structure , stone building ,telecom mast , perimeter wall
101	UNKNOWN	RHS	8+350	Single storey stone building and trees
102	7022/12	RHS	8+500	-Perimeter wall ,electric

				razor , masionette
103	81/1	LHS	8+500	Coffee bushes
104	81/2	LHS	9+300	-Single storey buildings (classrooms) -mabati & live fence
105	7022/11	RHS	8+900	-Parking , live fence
106	7022/10	RHS	9+200	-Mabati structure, stone building , 2 storey building , 1 storey building ,perimeter wall
107	80/2/R	RHS	9+400	-Single storey building (classrooms) ,live fence
108	N/R/52	RHS	10+075	-Mabati structure (stalls) , latrine
109	N/R/2203	LHS	10+000	-Single storey buildings (classrooms) -mabati & live fence
110	UNKNOWN	RHS	10+800	Mabati structure, stone building , 2 storey building , 1 storey building ,perimeter wall
111	UNKNOWN	RHS	10+900	Trees
112	KM/324	RHS	10+950	Trees
113	UNKNOWN	RHS	11+000	-Single storey buildings (classrooms) -mabati & live fence
114	KM/18	RHS	11+200	-Perimeter wall (Kiambu Hospital)
115	KM/70	LHS	10+900	Trees
116	KM/29	LHS	10+900	Trees
117	KM/39	LHS	10+925	-7 Storey building

118	KM/198	LHS	10+950	-5 Storey building
119	KM/197	LHS	10+950	-5 Storey building
120	KM/196	LHS	10+975	-5 Storey building
121	KM/163	LHS	10+975	Trees
122	KM/92	LHS	11+025	-5 storey building
123	KM/11	LHS	11+025	-4 Storey
124	KM/10	LHS	11+050	-3 Storey
125	KM/9	LHS	11+100	-3 Storey
126	KM/352	LHS	11+100	-5 Storey
127	KM/351	LHS	11+125	-Fuel station canopy
128	KM/71	LHS	11+150	-2 Storey building
129	UNKNOWN	LHS	11+175	-2 Storey building
130	KM/370	RHS	11+225	Trees
131	KM/161	RHS	11+375	-2 Storey building
132	KM/112	RHS	11+475	Mabati structure, stone building , 2 storey building , 1 storey building ,perimeter wall
133	KM/29	RHS	11+525	-1 Storey building ,timber stalls
134	KM/45	RHS	11+550	-2 Storey building
135	KM/46	RHS	11+700	2 storey stone building
136	KM/47	RHS	11+675	Cabro parking
137	N/N/1982	RHS	12+050	-Iron(stone shops)
138	N/N/2337	RHS	12+125	-iron (stone shops)
139	N/N/2330	RHS	12+125	-iron(stone shops)
140	N/N/2344	RHS	12+150	-iron (stone shops)

141	N/N/2340	RHS	12+150	-Iron (stone shops)
142	KBU MALL 597	RHS	12+200	-Perimeter wall , electric grilled fence
143	N/N/1762	RHS	12+220	-Billboard
144	N/N/1749	RHS	12+230	-3 Storey
145	N/N/2515	RHS	12+260	-Mabati shops /stalls
146	N/N/2514	RHS	12+280	-4 Storey
147	N/N/942	RHS	12+300	-Single storey
148	UNKNOWN	RHS	12+325	Trees
149	UNKNOWN	RHS	12+325	Trees
150	N/N/4155	RHS	12+330	Trees
151	N/N/4589	RHS	12+350	-Mabati / masonry stalls
152	N/N/4590	RHS	12+360	Mabati structures /stone built shops , containers
153	N/N/5921	RHS	12+375	-Mabati structures/ stone-built shops , containers
154	N/N/5914	RHS	12+415	-Mabati structures/stone-built shops , containers
155	N/N/5907	RHS	12+450	-Mabati structures /stone-built shops , containers
156	N/N/4139	RHS	12+500	-Mabati structures / stone-built shops, containers
157	N/N/4140	RHS	12+550	-Go down , grilled fence
158	N/N/1087	RHS	12+620	-1 Storey building
159	N/N/1086	RHS	12+660	-3 Storey flat
160	N/N/500	RHS	12+700	-Mabati / masonry structures
161	N/N/443	RHS	12+750	-Mabati structure
162	N/N/360	RHS	12+800	-Mabati / masonry

				structures
163	N/N/627	RHS	12+875	-Mabati stalls
164	N/N/4859	RHS	12+910	-Perimeter wall ,mabati structures , container stalls
165	N/N/4870	RHS	12+930	-Mabati structure
166	N/N/2630	RHS	12+960	-Mabati structure
167	N/N/844	RHS	12+980	Trees
168	N/N/644	RHS	13+010	-Single storey rentals, perimeter wall
169	N/N/643	RHS	13+040	-4 Storey residential building , perimeter wall
170	N/N/731	RHS	13+075	Trees and perimeter wall
171	N/N/952	RHS	13+100	-Masonry shops
172	N/N/954	RHS	13+115	-4 Storey residential building
173	N/N/874	RHS	13+130	-Mabati fence ,razor ,gate
174	N/N/6605	RHS	13+155	-Mabati fence ,gate
175	N/N/6593	RHS	13+200	Trees
176	N/N/1054	RHS	13+225	Trees
177	N/N/1894	RHS	13+275	-Stone/ mabati shops
178	N/N/357	RHS	13+325	-Container stalls
179	N/N/356	RHS	13+400	-Live fence , mabati structures
180	N/N/6929	RHS	13+475	Trees
181	N/N/3585	RHS	13+500	-Perimeter wall, grilled, 1 storey stone building
182	N/N/3934	RHS	13+525	-Mabati stalls
183	N/N/1996	RHS	13+550	-Mabati stalls
184	N/N/2796	RHS	13+575	-4 Storey building,

				perimeter wall
185	N/N/2795	RHS	13+580	-Mabati stalls
186	N/N/2795	RHS	13+590	-Mabati stalls
187	N/N/2794	RHS	13+600	-Stone building stall
188	N/N/2940	RHS	13+625	Trees
189	N/N/203	RHS	13+650	Coffee bushes
190	N/N/3229	RHS	13+750	-Stone house , gate , perimeter wall
191	N/N/4391	RHS	13+775	Trees
192	N/N/2955	RHS	13+800	-1 Storey stone house
193	N/N/2956	RHS	13+810	Stone house , gate , perimeter wall
194	N/N/1540	RHS	13+850	-2 Storey stone building -3 storey under construction ,perimeter wall ,gate
195	N/N/2857	RHS	13+880	-Container stall ,stone building
196	N/N/2856	RHS	13+900	-Single storey stone building ,mabati fence
197	N/N/2855	RHS	13+925	-perimeter wall ,electric laser ,under construction
198	N/N/2461	LHS	13+900	-Mabati houses
199	N/N/2460	LHS	13+910	-Mabati houses , gate
200	N/N/2459	LHS	13+925	Trees
201	N/N/2458	LHS	13+940	-Live fence
202	N/N/3760	LHS	13+960	Stone house , gate , perimeter wall
203	N/N/3759	LHS	13+975	2 Storey stone house under construction, mabati

				fence , gate
204	N/N/3758	LHS	13+980	-Stone house building (rentals)
205	N/N/3757	LHS	14+000	Trees
206	N/N/3753	LHS	14+010	-2 Storey stone house under construction, mabati fence , gate
207	N/N/3752	LHS	14+030	-Mabati house , grilled fence
208	N/N/2480	RHS	14+025	Trees
209	N/N/2479	RHS	14+050	-Stone house building (rentals)
210	N/N/2478	RHS	14+100	-2 Storey under construction
211	N/N/1494	RHS	14+125	-Stone house building (rentals) and trees
212	N/N/3984	RHS	14+160	-Stone shop , bananas , trees
213	N/N/1836	RHS	14+180	-Single storey shops , gate
214	N/N/1835	RHS	14+190	-Single storey shops , gate
215	N/N/1834	RHS	14+200	-Single storey building , gate
216	N/N/1833	RHS	14+210	-Timber house 1 storey , gate , mabati fence
217	N/N/3096	RHS	14+225	-Single storey shops , gate and trees
218	N/N/4293	RHS	14+250	Trees
219	N/N/3094	RHS	14+260	Trees
220	N/N/3298	RHS	14+290	-Mabati fence , grilled , razor
221	N/N/3297	RHS	14+310	-1 Storey stone shops

222	N/N/3296	RHS	14+325	-1 Storey stone stalls
223	N/N/3708	RHS	14+330	-2 Storey shops & residential
224	N/N/3714	RHS	14+350	Trees
225	N/N/4059	RHS	14+360	-5 Storey under construction
226	N/N/2717	RHS	14+380	-1 Storey rentals
227	N/N/3283	RHS	14+400	-Container stalls
228	N/N/2035	RHS	14+425	-Mabati house , 1 storey
229	N/N/1716	RHS	14+450	-Parking lot
230	N/N/1074	RHS	14+500	-Container stalls
231	N/N/2311	RHS	14+520	-Stone shops
232	NDUMBERI STADIUM		14+550	-Tank,trees,grilled fence
233	N/T/613	LHS	14+700	-3 Storey flats
234	N/T/542	LHS	14+880	-Double stack containers ,timber stalls
235	N/T/541	LHS	14+910	-Mabati fence
236	N/T/540	LHS	14+950	-Perimeter wall , containers
237	N/T/539	LHS	14+975	-1 storey & gate -2 storey commercial/residential
238	N/T/538	LHS	15+000	-Green house & life fence
239	N/T/537	LHS	15+050	-Trees (bananas)
240	N/T/536	LHS	15+075	-Parking(cabro)
241	N/T/450			-Trees , land
242	N/T/427			-Trees , land
243	N/T/972			-Permanent buildings ,

				trees , land
244	N/T/434			-Buildings , trees , land
245	N/T/424			-Land , trees
246	N/N/97	RHS	15+300	- Gate,containers,perimeter wall -2 storey mabati structure -Trees ,life fence
247	N/N/154	RHS	14+425	-2 gates,wall,trees
248	N/N/3353	RHS	15+525	-Trees
249	N/N/3352	RHS	15+530	-Fence(stone),gate -1 storey rentals
250	3351	RHS	15+560	- Trees
251	N/N/150	RHS	15+600	-Life fence
252	N/N/644	LHS	15+450	-1 storey, coffee bushes
253	N/N/160	LHS	15+525	-Single storey stone shops -wooden structure -stone single storey shop
254	N/N/4754	LHS	15+650	-Mabati structure(Redeemer healing ministry)
255	N/N/4743	LHS	15+675	-Stone shops
256	N/N/1221	LHS	15+700	-Single storey stone shops -2 storey stone shops &rentals
257	N/N/1222	LHS	15+720	Trees
258	N/N/1668	LHS	15+730	Trees
259	N/N/1669	LHS	15+775	Trees
260	N/N/1241	LHS	15+800	-Mabati structures

261	N/N/1240	LHS	15+820	-Mabati structures
262	N/N/1239	LHS	15+830	-Masionette, gate,perimeter wall & gate
263	N/N/1238	LHS	15+850	Trees
264	N/N/1237	LHS	15+870	-2 storey mabati structure -perimeter wall &gate
265	N/N/2949	LHS	16+275	Coffee bushes
266	N/N/2260	LHS	16+300	Trees
267	N/N/2259	LHS	16+325	
268				

EASTERN BYPASS				
1	Ndumberi/Riabai/693	LHS	0+050	
2	Ndumberi/Riabai/2811	RHS AND BOTH SIDES	0+050 AND 0+075	-Bungalow ,Trees ,mabati fence
3	Ndumberi/Riabai/2810	BOTH SIDES	0+100	Trees
4	Ndumberi/Riabai/2809	BOTH SIDES	0+120	Mansionette,gate,perimeter wall & gate
5	Ndumberi/Riabai/2808	BOTH SIDES	0+130	Trees
6	Ndumberi/Riabai/2807	BOTH SIDES	0+150	-Stone house(rentals) -mabati gate -water tower
7	Ndumberi/Riabai/2806	BOTH SIDES	0+160	-Mabati structure -mabati gate
8	Ndumberi/Riabai/1581	BOTH SIDES	0+180	Trees
9	Ndumberi/Riabai/1580	BOTH SIDES	0+210	Trees
10	Ndumberi/Riabai/1579	BOTH SIDES	0+240	Trees
11	Ndumberi/Riabai/1578	BOTH SIDES	0+260	-3 storey residential flat -Perimeter wall
12	Ndumberi/Riabai/1577	BOTH SIDES	0+280	-Stone structures
13	Ndumberi/Riabai/683	BOTH SIDES	0+300	-1 Storey stone structures(rentals) -Steel gate
14	Ndumberi/Riabai/684	BOTH SIDES	0+350	-1 Storey stone structures(rentals)

15	Ndumberi/Riabai/685	BOTH SIDES	0+400	Trees
16	Ndumberi/Riabai/2442	RHS	0+450	Trees
17	Ndumberi/Riabai/2443	LHS	0+450	Trees
18	Ndumberi/Riabai/1878	BOTH SIDES	0+500	Trees
19	Ndumberi/Riabai/295	BOTH SIDES	0+550	-Mabati structures
20	Ndumberi/Riabai/363	LHS	0+600	-1 Storey stone building
21	Ndumberi/Riabai/400	RHS	0+625	-Steel gate
22	Ndumberi/Riabai/571	LHS	0+650	-1 Storey stone building -steel gate
23	Ndumberi/Riabai/2593	LHS	0+675	-1 Storey stone building
24	Ndumberi/Riabai/2592			Trees
25	Ndumberi/Riabai/2591			Trees
26	Ndumberi/Riabai/754	LHS	0+800	-Steel gate
27	Ndumberi/Riabai/753	LHS	0+825	-Water tower -concrete & steel gate
28	Ndumberi/Riabai/707	RHS	0+800	-1 Storey building -perimeter wall & gate
29	Ndumberi/Riabai/708			Trees
30	Ndumberi/Riabai/709			Trees
31	Ndumberi/Riabai/918	LHS	0+875	-Mabati Structure
32	Ndumberi/Riabai/1885			Trees
33	Ndumberi/Riabai/2089			Trees
34	Ndumberi/Riabai/208	RHS	0+950	-1 Storey stone building

	8			-Steel gate
35	Ndumberi/Riabai/2087	RHS	0+960	-1 Storey stone building -Mabati gate
36	Ndumberi/Riabai/2086	RHS	0+975	-Stone fence -steel gate
37	Ndumberi/Riabai/			Trees
38	Ndumberi/Riabai/5478			Trees
39	Ndumberi/Riabai/621	RHS	0+980	-Perimeter wall -Steel gate
40	Ndumberi/Riabai/620	RHS	1+000	-Life fence
41	Ndumberi/Riabai/5472	LHS	1+025	-Mabati houses -Mabati gate
42	Ndumberi/Riabai/376	RHS	1+025	-Perimeter wall, stone toilet, stone shop, steel gate -mabati structure, mabati gate -single storey stone shops, perimeter wall, stone structure
43	Ndumberi/Riabai/9	LHS	1+060	-Mabati houses -stone shop -Mabati gate
44	Ndumberi/Riabai/373	RHS	1+125	-Single storey stone house(rentals) -Stone toilet -stone structure, mabati structure
45	Ndumberi/Riabai/639	LHS	1+160	-1 Storey stone building
46	Ndumberi/Riabai/4097			Trees
47	Ndumberi/Riabai/4098			Trees
48	Ndumberi/Riabai/4099			Trees
49	Ndumberi/Riabai/410			Trees

	0			
50	Ndumberi/Riabai/697	RHS	1+300	Trees
51	Ndumberi/Riabai/3124			-Perimeter wall -steel gate
52	Ndumberi/Riabai/3123	RHS	1+375	-3 Storey building(rentals) -Mabati fence
53	Ndumberi/Riabai/2922	RHS	1+400	-1 Storey stone building
54	Ndumberi/Riabai/2921	RHS	1+425	-1 Storey stone building
55	Ndumberi/Riabai/2254			Trees
56	Ndumberi/Riabai/2253	RHS	1+550	-Stone foundation
57	Ndumberi/Riabai/2559	LHS		-Single storey stone house
58	Ndumberi/Riabai/5950	RHS		-Single storey rentals
59	Ndumberi/Riabai/5949	RHS		-Single storey , mabati fence
60	Ndumberi/Riabai/2252			Trees
61	Ndumberi/Riabai/4576	RHS	1+580	-Bungalow -Perimeter wall
62	Ndumberi/Riabai/4575	RHS	1+600	-Perimeter wall
63	Ndumberi/Riabai/4949	RHS	1+610	-Single storey stone house
64	Ndumberi/Riabai/5951			Trees
65	Ndumberi/Riabai/5950	RHS	1+640	Single storey , mabati fence

66	Ndumberi/Riabai/5949	RHS	1+650	-Bungalow -Perimeter wall
67	Ndumberi/Riabai/3004	RHS	1+675	Single storey rentals
68	Ndumberi/Riabai/638			Trees
69	Ndumberi/Riabai/637	LHS	1+230	--Stone wall -Steel gate
70	Ndumberi/Riabai/636	LHS	1+260	-Stone wall -Steel gate
71	Ndumberi/Riabai/3582	LHS	1+275	Single storey , mabati fence
72	Ndumberi/Riabai/4186	LHS	1+300	-Single storey stone building(rentals)
73	Ndumberi/Riabai/4185	LHS	1+325	-Bungalow -Mabati gate
74	Ndumberi/Riabai/4181	LHS	1+330	-Mabati fence
75	Ndumberi/Riabai/290	LHS	1+400	-Bungalow, mabati structure, stone foundation, stone shop, mabati fence, steel gate, perimeter wall
76	Ndumberi/Riabai/5176			Trees
77	Ndumberi/Riabai/5175			Trees
78	Ndumberi/Riabai/5174			Trees
79	Ndumberi/Riabai/4166			Trees
80	Ndumberi/Riabai/3141	LHS	1+675	-Bungalow, mabati structure, stone foundation, stone shop, mabati fence, steel gate, perimeter wall
81	Ndumberi/Riabai/4075	LHS	1+700	-Bungalow, mabati structure, stone foundation, stone shop, mabati fence, steel

				gate, perimeter wall
82	Ndumberi/Riabai/4156			Trees
83	Ndumberi/Riabai/483	Both Sides	1+725	-2 Storey building, perimeter wall -Mabati(church), Tanks, Steel gate -Classrooms ,water tank ,Green house
84	Ndumberi/Riabai/2081			-Steel gate , wooden structure
85	Ndumberi/Riabai/2080			Trees
86	Ndumberi/Riabai/2079			Trees
87	Ndumberi/Riabai/2078			Trees
88	Ndumberi/Riabai/390			Trees
89	Ndumberi/Riabai/5610			Trees
90	Ndumberi/Riabai/1956			Trees
91	Ndumberi/Riabai/1955			Trees
92	Ndumberi/Riabai/1954			Trees
93	Ndumberi/Riabai/3448	RHS	1+950	2 storey stone building
94	Ndumberi/Riabai/3449			Trees
95	Ndumberi/Riabai/5160			Trees
96	Ndumberi/Riabai/5152			Trees
97	Ndumberi/Riabai/514	RHS	2+100	Single story stone building

	9			
98	Ndumberi/Riabai/5134	LHS	2+100	-Perimeter wall ,pit latrine
99	Ndumberi/Riabai/5366	RHS	2+130	Single story stone building
100	Ndumberi/Riabai/5365			-Mabati wall ,steel gate
101	Ndumberi/Riabai/3311	RHS	2+175	-Stone wall , mabati fence
102	Ndumberi/Riabai/3311			Trees
103	Ndumberi/Riabai/660	LHS	2+080	-Stone building(shop)
104	Ndumberi/Riabai/659	LHS	2+090	Trees
105	Ndumberi/Riabai/384			Trees
106	Ndumberi/Riabai/5238			Trees
107	Ndumberi/Riabai/5237			Trees
108	Ndumberi/Riabai/5236			Trees
109	Ndumberi/Riabai/5235			-Stone pump house ,steel water tower ,mabati structure
110	Ndumberi/Riabai/5149	RHS	2+100	--2 Steel gates ,perimeter wall ,mabati house
111	Ndumberi/Riabai/562	RHS	2+230	--2 Steel gates ,perimeter wall ,mabati house
112	Ndumberi/Riabai/921			Trees
113	Ndumberi/Riabai/5213	RHS	2+350	
114	Ndumberi/Riabai/4009			

115	Ndumberi/Riabai/4815			Trees
116	Ndumberi/Riabai/5149			Trees
117	Ndumberi/Riabai/4689			Trees
118	Ndumberi/Riabai/4829			-Stone shops ,mabati structure
119	Ndumberi/Riabai/5233			Trees
120	Ndumberi/Riabai/2374	RHS	2+425	-Perimeter wall ,steel gate ,stone structures
121	Ndumberi/Riabai/2373	RHS	2+450	-Mabati structures(houses)
122	Ndumberi/Riabai/2372	RHS	2+460	-Mabati houses
123	Ndumberi/Riabai/2371	RHS	2+475	-Mabati houses
124	Ndumberi/Riabai/2412	RHS	2+500	-Single storey stone houses
125	Ndumberi/Riabai/2411	RHS	2+510	-Single storey stone houses
126	Ndumberi/Riabai/2410	RHS	2+525	-Single storey stone houses
127	Ndumberi/Riabai/4922	LHS	2+400	-Single storey stone building
128	Ndumberi/Riabai/6294	LHS	2+425	-3 Storey building under construction
129	Ndumberi/Riabai/4915	LHS	2+450	-3 Storey building under construction
130	Ndumberi/Riabai/6087	LHS	2+475	-Single storey stone building
131	Ndumberi/Riabai/608	LHS	2+480	-Single storey stone building

	6			
132	Ndumberi/Riabai/6085	LHS	2+500	-Stone wall , mabati fence
133	Ndumberi/Riabai/6084	LHS	2+510	-Single storey stone building
134	Ndumberi/Riabai/6083	LHS	2+525	-Stone wall , mabati fence
135	Ndumberi/Riabai/6082			Trees
136	UNKNOWN			Trees
137	UNKNOWN			Trees
138	UNKNOWN			Trees
139	UNKNOWN			Trees
140	Ndumberi/Riabai/2554	RHS	2+775	-Stone shop
141	Ndumberi/Riabai/2553	RHS	2+780	-Stone building
142	Ndumberi/Riabai/1349			Trees
143	Ndumberi/Riabai/1348			Trees
144	Ndumberi/Riabai/1347			Trees
145	Ndumberi/Riabai/1346	RHS	2+850	-Single storey stone building
146	Ndumberi/Riabai/1345	RHS	2+860	-Bungalow ,Mabati gate
147	Ndumberi/Riabai/1354			Trees
148	Ndumberi/Riabai/1353	RHS	2+880	-Mabati structure ,stone building

149	Ndumberi/Riabai/1795	RHS	2+900	Mabati structure ,stone building
150	Ndumberi/Riabai/1794	RHS	2+925	Mabati structure ,stone building
151	Ndumberi/Riabai/1793	RHS	2+950	-Perimeter wall ,steel gate
152	Ndumberi/Riabai/1155	RHS	2+975	-Steel gate
153	Ndumberi/Riabai/235	BOTH SIDES	2+550	-Stone shop ,mabati gate ,mabati shop ,mabati house ,mabati gate
154	UNKNOWN	RHS	2+600	-Mabati house ,wooden 2 storey building ,mabati structure, stone shop ,mabati house
155	UNKNOWN	RHS	2+650	-Mabati structure
156	UNKNOWN	RHS	2+700	-Mabati houses , perimeter wall
157	UNKNOWN	LHS	2+725	-Single storey stone building
158	UNKNOWN	LHS	2+750	-Mabati houses , perimeter wall
159	Ndumberi/Ndumberi/0294			Trees
160	Ndumberi/Ndumberi/1166			Trees
161	Ndumberi/Ndumberi/NL007			Trees
162	Ndumberi/Riabai/1159	LHS	2+760	-Mabati house -Stone house
163	Ndumberi/Riabai/1916	LHS	2+780	-Bungalow ,steel gate ,wooden fence
164	Ndumberi/Riabai/2607	LHS	2+800	-Single storey stone building
165	Ndumberi/Riabai/2606	LHS	2+825	-Mabati house -Stone house
166	Ndumberi/Riabai/138			Trees

	0			
167	Ndumberi/Riabai/1379			Trees
168	Ndumberi/Riabai/4328			Trees
169	Ndumberi/Riabai/3703			Trees
170	Ndumberi/Riabai/1376	LHS	2+925	-Single storey stone building
171	Ndumberi/Riabai/3288			Trees
172	Ndumberi/Riabai/4043			Trees
173	Ndumberi/Riabai/4042			Trees
174	Ndumberi/Riabai/3614			Trees
175	Ndumberi/Riabai/174	LHS	3+125	-Mabati house -Stone house
176	Ndumberi/Riabai/1212	LHS	3+200	-Mabati house -Stone house
177	Ndumberi/Riabai/2751			Trees
178	Ndumberi/Riabai/2559	RHS		Single storey stone building (rentals
179	Ndumberi/Riabai/1155			-Steel gate
180	Ndumberi/Riabai/2888	RHS	3+025	--2 Storey mabati building ,perimeter wall ,bungalow
181	Ndumberi/Riabai/2887	RHS	3+050	-Mabati house ,mabati gate ,steel gate
182	Ndumberi/Riabai/2886	RHS	3+075	-Mabati house ,mabati gate ,steel gate

183	Ndumberi/Riabai/2885	RHS	3+080	-Unfinished stone building
184	Ndumberi/Riabai/232	RHS	3+100	-Mabati structure ,stone building,steel gate
185	Ndumberi/Riabai/1176	RHS	3+200	-Single storey stone building (rentals)
186	Ndumberi/Riabai/4275			Trees
187	Ndumberi/Riabai/4633			-Mabati structure , fence
188	Ndumberi/Riabai/3699	RHS	3+300	-2 Storey stone rentals ,single storey stone structure
189	Ndumberi/Riabai/3698	RHS	3+325	Mabati structure , fence
190	Ndumberi/Riabai/236	RHS	3+350	-Single stone structures ,fence single storey under construction, shops(stone) ,steel gate
191	Ndumberi/Riabai/259	RHS	3+425	Single storey stone shop and mabati structure
192	Ndumberi/Riabai/299	RHS	3+500	Gate ,perimeter wall
193	Ndumberi/Riabai/2562	LHS	3+250	-Bungalow , gate
194	Ndumberi/Riabai/4633	LHS	3+275	-Mabati structure & fence (ACK St Mary's Kiriguini parish church)
195	Ndumberi/Riabai/3483			Trees
196	Ndumberi/Riabai/2792			Trees
197	Ndumberi/Riabai/2793	LHS	3+320	-Mansionette
198	Ndumberi/Riabai/3020	LHS	3+325	-Gate ,perimeter wall
199	Ndumberi/Riabai/260	LHS		-Mabati gate

	6			
200	Ndumberi/Riabai/3019			Trees
201	Ndumberi/Riabai/3018	LHS	3+350	- Single storey stone shops
201	Ndumberi/Riabai/3017	LHS	3+360	- Single storey stone shops
203	Ndumberi/Riabai/2226	LHS	3+375	-Steel gate ,perimeter (electric & laser)
204	Ndumberi/Riabai/1895	LHS	3+380	-Stone structured & 2 steel gates
205	Ndumberi/Riabai/1894	LHS	3+400	-2 Storey building
206	Ndumberi/Riabai/1893	LHS	3+425	-Stone fence & gate
207	Ndumberi/Riabai/219	LHS	3+425	-3 Storey under construction ,bungalow ,stone fence ,steel gate
208	Ndumberi/Riabai/4633	RHS	3+490	-ACK , St Mary's mabati church , pit latrines , mabati gate
209	Ndumberi/Riabai/2371			Trees
210	Ndumberi/Riabai/2370	LHS	3+525	-Bungalow
211	Ndumberi/Riabai/2369			Trees
212	Ndumberi/Riabai/3105			Trees
213	Ndumberi/Riabai/282	RHS	3+550	-2 Storey stone building ,mabati shades
214	Ndumberi/Riabai/174	LHS		-Single storey stone shops
215	Ndumberi/Riabai/New Rd	RHS	3+600	Mabati structures
216	Ndumberi/Riabai/121	LHS		-Mabati house , gate

	2			
217	Ndumberi/Riabai/2534	RHS	3+625	-Mabati structures
218	Ndumberi/Riabai/1993	LHS	3+600	-Mabati structures
219	Ndumberi/Riabai/2927			Trees
220	Ndumberi/Riabai/2926			Trees
221	Ndumberi/Riabai/2925			Trees
222	Ndumberi/Riabai/2924			Trees
223	Ndumberi/Riabai/2921			Trees

WESTERN BYPASS				
1	Kiambaa/Kanunga/377			-Land
2	Kiambaa/Kanunga/402			- Land , trees
3	Kiambaa/Kanunga/376			-Land , wire mesh
4	Kiambaa/Kanunga/402			-Land & trees
5	Kiambaa/Kanunga/493	RHS	1+650	-Mabati gate , timber house , 2 stone houses , latrine
6	Kiambaa/Kanunga/824	LHS	1+625	-Mabati houses
7	Kiambaa/Kanunga/823			-Land hedge
8	Kiambaa/Kanunga/822	LHS	1+650	-Land hedge
9	Kiambaa/Kanunga/821			Trees
10	Kiambaa/Kanunga/400	LHS	1+700	-Hedge ,trees ,steel gate , mabati structure
11	Kiambaa/Kanunga/2785			-Mabati structure, hedge -Mabati gate
12	Kiambaa/Kanunga/2786	RHS	1+760	-steel gate hedge
13	Kiambaa/Kanunga/2787	RHS	1+775	-Mabati house
14	Kiambaa/Kanunga/2788	RHS	1+790	-Bananas
15	Kiambaa/Kanunga/2789	RHS	1+800	-Mabati gate , fence
16	Kiambaa/Kanunga/2790	RHS	1+825	-Bananas
17	Kiambaa/Kanunga/2791	RHS	1+830	-Steel gate ,mabati structure
18	Kiambaa/Kanunga/1076	LHS	1+830	-Mabati structure
19	Kiambaa/Kanunga/1077			-Land hedge
20	Kiambaa/Kanunga/1078			-Land hedge
21	Kiambaa/Kanunga/1079			-Land hedge
22	Kiambaa/Kanunga/539	RHS	1+850	-Mabati structure ,mabati gate ,hedge

23	Kiambaa/Kanunga/540			-Mabati house
24	Kiambaa/Kanunga/398	LHS	1+900	-Mabati structure
25	Kiambaa/Kanunga/1332	RHS	1+950	-Mabati house
26	Kiambaa/Kanunga/1333	RHS	1+960	-Mabati house
27	Kiambaa/Kanunga/1334	RHS	1+975	-Land
28	Kiambaa/Kanunga/1296			-Land
29	Kiambaa/Kanunga/1297			-Land
30	Kiambaa/Kanunga/1298			-Land
31	Kiambaa/Kanunga/1299			-Land
32	Kiambaa/Kanunga/951			-Land ,Trees
33	Kiambaa/Kanunga/1300			-Land
34	Kiambaa/Kanunga/1301	LHS	2+125	-Steel gate , mabati house
35	Kiambaa/Kanunga/952			-Mabati structure, steel gate
36	Kiambaa/Kanunga/396	LHS	2+150	-Mabati gate ,mabati house, steel gate
37	Kiambaa/Kanunga/52			-Land ,steel gate ,wire mesh
38	Kiambaa/Kanunga/42	RHS	2+250	Mabati structure, steel gate
39	Kiambaa/Kanunga/2396	LHS	2+225	-Land
40	Kiambaa/Kanunga/2397			-Land
41	Kiambaa/Kanunga/394	LHS	2+325	-Stone house
42	Kiambaa/Kanunga/242			-Coffee
43	Kiambaa/Kanunga/315	RHS	2+400	-Mabati house
44	Kiambaa/Kanunga/1313			-Land
45	Kiambaa/Kanunga/1314			-Land
46	Kiambaa/Kanunga/1315			-Land
47	Kiambaa/Kanunga/936	LHS	2+600	-Hedge , stone house ,mabati structure

48	Kiambaa/Kanunga/937			-Hedge
49	Kiambaa/Kanunga/938			-Barbed wire fence
50	Kiambaa/Kanunga/1196			-Bananas , stone house
51	Kiambaa/Kanunga/1197			-Bananas
52	Kiambaa/Kanunga/1198			-Barbed wire fence
53	Kiambaa/Kanunga/703			-Barbed wire fence
54	Kiambaa/Kanunga/1169	LHS	2+620	-Steel gate ,wire mesh fence ,stone house
55	Kiambaa/Kanunga/1589	LHS	2+625	-2 Storey building , steel gate
56	Kiambaa/Kanunga/704			-Hedge , coffee
57	Kiambaa/Kanunga/479, 1693&1694	RHS	2+650	-2 steel gates -stone house
58	Kiambaa/Kanunga/2494	RHS	2+725	-Stone house , mabati structure ,steel gate
59	502	BOTH SIDES	2+850	-Hedge ,Kiambaa coffee growers Co-Op society factory structures ,steel gate ,Trees
60	Kiambaa/Kanunga/2495			-Land ,Trees
61	Kiambaa/Kanunga/502			-Hedge ,Kiambaa coffee growers Co-op society factory structures
62	Kiambaa/Kanunga/160			Trees
63	Kiambaa/Kanunga/502a			-Kiambaa coffee growers Co-op Society factory structures ,Trees
64	Kiambaa/Kanunga/164			-Hedge ,Trees
65	Kiambaa/Kanunga/469			-Land , Trees
66	Kiambaa/Kanunga/522			-Land , Trees

67	Kiambaa/Kanunga/179			Trees
68	Kiambaa/Kanunga/956			Trees
69	Kiambaa/Kanunga/1552			Trees
70	Kiambaa/Kanunga/214			-Hedge , Trees
71	Kiambaa/Kanunga/2061			-Coffee , hedge , trees , barbed wire fence
72	Kiambaa/Kanunga/1270			-Hedge , Trees
73	Kiambaa/Kanunga/1269			-Hedge , Trees
74	Kiambaa/Kanunga/1268			-Hedge , Trees
75	Kiambaa/Kanunga/1267			-Hedge , Trees
76	Kiambaa/Kanunga/1266			-Hedge , Trees
77	Kiambaa/Kanunga/1265			-Hedge , Trees
78	Kiambaa/Kanunga/217			-Hedge , Trees , Land
79	Kiambaa/Kanunga/158			-Mabati fence , mabati structures, mabati gate , trees
80	Kiambaa/Kanunga/218			-Hedge , land , trees
81	Kiambaa/Kanunga/470			-Land , Trees
82	Unknown	RHS		Trees
83	Unknown	RHS		Trees
84	Unknown	RHS		Trees
85	Unknown	RHS		Trees
86	Unknown	RHS		Trees
87	Unknown	RHS		Trees
88	Unknown	RHS		Trees
89	Unknown	RHS		Trees
90	Unknown	RHS		Trees
91	Unknown	RHS		Trees

92	Kiambaa/Kanunga/220			-Hedge , land , trees , steel gate
93	Kiambaa/Kanunga/47			-Hedge , structure
94	Kiambaa/Kanunga/138			-Hedge , land
95	Kiambaa/Kanunga/137			-Land , hedge , trees
96	Kiambaa/Kanunga/26			-Stone gate stands , land
97	Kiambaa/Kanunga/19			-Land
98	Kiambaa/Kanunga/251	RHS		-Steel gate , perimeter wall, stone house, mabati structure
99	Kiambaa/Kanunga/22			-Mabati structure
100	Kiambaa/Kanunga/235	LHS		-Mabati gate,trees
101	Kiambaa/Kanunga/511			-Mabati structures , trees , mabati fence
102	Kiambaa/Kanunga/501			-Stone house
103	Kiambaa/Kanunga/463			-Mabati gate ,trees , steel gate , mabati structure
104	Kiambaa/Kanunga/255			-Land , trees , bananas
105	Kiambaa/Kanunga/493			-Mabati gate ,timber house ,2 stone houses , latrine
106	Kiambaa/Kanunga/252			-Stone house ,hedge , steel gate
107	Kiambaa/Kanunga/256			-Land , bananas
108	Kiambaa/Kanunga/259			-Steel gate , hedge , trees
109	Kiambaa/Kanunga/Nl1			-Wooden mabati houses , mabati gate
110	Kiambaa/Kanunga/253			-Mabati structure , steel gate
111	Kiambaa/Kanunga/261			-Mabati gate , single storey stone house , 2 storey stone

				house
112	Kiambaa/Kanunga/66			-Bananas
113	Kiambaa/Kanunga/510			-Single storey stone house (church)
114	Kiambaa/Kanunga/263			-2 storey building , mabati structure , mabati gate
115	Kiambaa/Kanunga/265			Trees
116	Kiambaa/Kanunga/235			-Mabati structures
117	Kiambaa/Kanunga/545			-Mabati structure
118	Kiambaa/Kanunga/269			-Land
119	Kiambaa/Kanunga/299			-Mabati structure ,hedge , single storey stone house , mabati gate
120	Kiambaa/Kanunga/271			-Steel gate , trees , bananas
121	Kiambaa/Kanunga/298			-Stone house ,trees , hedge
122	Kiambaa/Kanunga/297			-Hedge , land , bananas , steel gate
123	Kiambaa/Kanunga/296			-perimeter wall , stone house , steel gate
124	Kiambaa/Kanunga/273			-Stone house ,trees , steel gate , hedge
125	Kiambaa/Kanunga/276			-Stone house , mabati house ,perimeter wall ,steel gate
126	Kiambaa/Kanunga/295			-Hedge , mabati house, trees , mabati structure
127	Kiambaa/Kanunga/1694			-Coffee ,hedge, trees
128	Kiambaa/Kanunga/294			-Mabati fence ,trees , single storey house , mabati gate

129	Kiambaa/Kanunga/1693			-Semi stone house
130	Kiambaa/Kanunga/293			-Hedge , trees
131	Kiambaa/Kanunga/278			-Stone house , mabati fence , steel gate
132	Kiambaa/Kanunga/281			-Hedge , land
133	Kiambaa/Kanunga/496			-Stone house (church)
134	Kiambaa/Kanunga/284			-Hedge , trees
135	Kiambaa/Kanunga/292			-Life hedge , trees
136	Kiambaa/Kanunga/233			-Communication mast , perimeter wall , trees
137	Kiambaa/Kanunga/291			-Mansionette ,perimeter wall mabati structure , steel gate , trees
138	Kiambaa/Kanunga/503			-Mabati structure , single storey stone building , grill fence , bungalow ,perimeter wall ,water tank

Appendix 9: PPM Minutes

MINUTES OF PUBLIC PARTYICIPATION FORUMHELD ON18TH JUNE, 2019 AT OUR LADY OF ROSARY CATHOLIC CHURCH, RIDGEWAYS

ATTENDANCE:

List attached

AGENDA:

1. Introduction
2. Design presentation
3. Questions from the public and responses
4. Closure

MIN	ITEM	ACTION
01.00	**Introduction** The meeting was called to order by a representative from Ridgeways Catholic Church who offered a word of prayer at 1100hrs. Dr. Margret Gichuhi started by thanking everyone for attending the meeting, and assured the members that the team will try to be as forthcoming and try to answer all the questions directed to the team. She mentioned that the main reason for the meeting was to disseminate and inform the stakeholders on detailed design of Muthaiga-Kiambu-Nduberi road. She mentioned that it was important to be able to gather comments and concerns so as to incorporate the information gathered into the final design. She welcomed any positive and negative impacts of the project so as to inform the mitigation measures to be applied during project implementation. She invited Eng. Mwitari to present the design to stakeholders.	

02.00	**Design Presentation** Engineer Mwitari started by clarifying to the stakeholders that the project with be confined within KENHA road reserve and therefore there will be minimal acquisition of private land. He presented a detailed design of the project from Muthaiga were the projects starts to Nduberi, were the project ends. He also presented to the members the proposed bypasses and explained how they are going to ease traffic within Kiambu town	
03.00	**Questions from the public and responses** **Question:** How will congestion in Kiambu town be addressed? ***Response**: There are two proposed bypasses and Kiambu town has six lanes; two express lanes and four service lanes. The town loops will be improved to link up with the KERRA roads* **Question:** What are you doing with the interchange at Pangani which is affecting Kiambu-Muthaiga road? ***Response**: This has been captured and the client will be advised appropriately.* **Question:** Why an underpass after Muthaiga North Road? ***Response**: To take care of the traffic towards different directions.* **Question:** How will you take care of diversions and traffic flow during construction? ***Response**: The diversions will be maintained to reduce air pollution while the rest of the traffic will use the existing pavement.* **Question:** And what will happen to the houses from Jacaranda to the Interchange? ***Response**: The design of the road is defined within the road corridor. One house near the interchange and next to the river will be affected.* **Question:** Does shack Palace need a BRT station compared to Muthaiga North/Coffee road?	

	***Response**: The BRT has to be positioned on a level ground which happens to be next to Shacks Palace.* **Question:** Has land at Tala interchange been acquired? ***Response**: The old Kiambu road reserve will cater for the interchange.* **Question:** What are the design timelines? ***Response**: Design of the road should be ready by October 2019, to be followed by the procurement process and project implementation.* **Question:** How will you take care of the access to Our Lady of Rosary Church and parking? ***Response**: The design is restricted to road reserve should the parking be within the road reserve they shall be affected.* **Question:** Why has the northern bypass interchange pushed to the north of the existing pavement? ***Response**: This has been considered as the best alternative of saving most of the developments on the lower side of the pavement.* **Question:** Where is the turn off to Four Ways Estate? ***Response**: Next to Evergreen Shopping Center.* **Question:** How wide is the road and where are the beacons? ***Response**: The existing road reserve varies between 25M to 60 m and KeNHA has put demarcations on the same. The dual carriage way will be built to TI standards where express traffic will have minimal interruptions. It is based on traffic count and projections for the next 20 years.* **Question:** Is it possible to connect Kigwa road to the Northern by-pass? ***Response**: This is beyond the project's jurisdiction.* **Question:** Is the Northern by-pass interchange the same as the one being designed by GIBB International? ***Response**. There have been engagements between APEC and GIBB international to*	

	harmonize the designs. **Question:** Have you considered pedestrian lanes for none motorists in the design? ***Response**: Pedestrian lanes will be provided 2.5 meters on either side of the road* **Question:** Are there plans to improve Kamiti and Njathaini roads? ***Response**: Other institutions are addressing this issue.* **Question:** Have the design team considered the traffic count at Tala Road? ***Response**: The traffic surveys have been undertaken.* **Question:** Have you provided for acceleration? ***Response**: The two inner lanes are for acceleration.* **Question:** How soon will compensation be done? Will valuation be done by a private entity or by government? ***Response**:* The compensation will be undertaken by government valuers in collaboration with NLC. **Question:** Is it possible to hive off part of the forest to avoid compensation? **Response**: This will be complicated since the forest is gazetted as a natural resource. **Question:** Which survey plans are being used? **Response:** The survey plans/mapsare from survey of Kenya.	
04.00	**Closure** There being no other business, the DCC Kasarani thanked the public for turning in good numbers and expressing their concerns in a good way. The meeting ended at 1330hrs	

Confirmation of Minutes:

Organization	Name	Designation	Signature	Date

Appendix 10: PPM Minutes Thindigua

MINUTES OF PUBLIC PARTYICIPATION FORUMHELD ON19TH JUNE,2019 AT ACK THINDIGUA

ATTENDANCE:

List attached

AGENDA:

1. Introduction
2. Design presentation
3. Comments/Proposals from the public and responses
4. Closure

MIN	ITEM	ACTION

01.00	**INTRODUCTION** The meeting was called to order by the area chief who promised support for the exercise till the end.The area chief mentioned that people's major interests are the bypasses. MR. Mwenga introduced the ESIA team and welcomed Dr.Margret Gichuhi for a brief introduction of the main agenda. Dr. Margaret Gichuhi started by thanking everyone for attending the meeting, and assured the members that the team will try to be as forthcoming and try to answer all the questions directed to the team. She mentioned that the main reason for the meeting was to disseminate and inform the stakeholders on detailed design of Muthaiga-Kiambu-Nduberi road. She mentioned that it was important to be able to gather comments and concerns so as to incorporate the information gathered into the final design. She welcomed any positive and negative impacts of the project so as to inform the mitigation measures to be applied during project implementation. She invited Eng. Mwitari to present the design to stakeholders.	
02.00	**Design Presentation** Engineer Mwitari started by clarifying to the stakeholders that the project with be confined within KENHA road reserve and therefore there will be minimal acquisition of private land. He presented a detailed design of the project from Muthaiga were the projects starts to Nduberi, were the project ends. He also presented to the members the proposed bypasses and explained how they are going to ease traffic within Kiambu town	

03.00	**<u>Comments/Proposals from the public and responses</u>** **Proposal:** Is it possible to improve Thindigua-Windsor to Northern By-pass and Garden Estate? **Response:** Many roads within Kiambu are being addressed by other Road agencies as per the road classification, however this will be forwarded to the client for consideration. **Proposal:** Consider how to address storm water from Delta petrol station to the river. **Proposals**: Consider a footbridge at Kasarini primary school next to paradise lost. Also loops within Thindigua to serve the Health center and the primary school. BRT and PSV laybys along the service lanes. Traffic will be separated into local (service lanes) and express (fast lanes). When will the Tala road to Limuru road be done? **Response:** The client will determine the implementation time. **Question:** Have you taken care of Njathaini in the design? **Response:** The traffic to Njathaini will use the Kirigiti interchange. **Question:** What is the road reserve in Kiambu town? **Response:** The road reserve within Kiambu town varies between 25m and 30m **Question:** Has there been a traffic census of Thindigua to inform on footbridges? **Response:** yes **Proposals:** Consider shelter at bus stops, plant grass and trees to have picnic areas by the road sides and to improve the visual and scenic outlook. **Question:** What is the overall plan for waste management? **Response:** The BRT will be designed to take care of waste management and public rest rooms	
04.00	**<u>Closure</u>** Having no other business, the meeting ended with a word of prayer from a community member.	

Minutes Confirmation:

Name	Organisation	Date	Signature

Appendix 11: PPM Minutes Kirigiti Chief's Camp

MINUTES OF PUBLIC PARTYICIPATION FORUM HELD ON 20TH JUNE, 2019 AT KIRIGITI CHIEF'S CAMP

ATTENDANCE:

List attached

AGENDA:

5. **Introduction**
6. **Design presentation**
7. **Comments/Proposals from the public and responses**
8. **Closure**

MIN	ITEM
01.00	**INTRODUCTION** The meeting started at 1100hrs with a work of prayer led by a community member. Mr. Mwenga welcomed the members and introduced the area chief. He also urged members to be positive and voice their concerns on the proposed design of Muthaiga-Kiambu-Nduberi road. He informed members present that the area MP was around and will be given a chance to raise his concerns after design has been presented. MR. Mwenga introduced the ESIA team and welcomed Dr. Margret Gichuhi for a brief introduction of the main agenda. Dr.Margret Gichuhi started by thanking everyone for attending the meeting, and assured the members that the team will try to be as forthcoming and try to answer all the questions directed to the team. She mentioned that the main reason for the meeting was to disseminate and inform the stakeholders on detailed design of Muthaiga-Kiambu-Ndumberi road. She mentioned that it was important to be able to gather comments and concerns so as to incorporate the information gathered into the final design. She welcomed any positive and negative impacts of the project so

	as to inform the mitigation measures to be applied during project implementation. She invited Eng. Mwitari to present the design to stakeholders.
02.00	Design Presentation Engineer Mwitaristarted by clarifying to the stakeholders that the project with be confined within KENHA road reserve and therefore there will be minimal acquisition of private land. He presented a detailed design of the project from Muthaiga were the projects starts to Nduberi, were the project ends. He also presented to the members the proposed bypasses and explained how they are going to ease traffic within Kiambu town
03.00	**Comments/Proposals from the public and responses** **Question:** Where is the detailed design for the road starting from Kirigiti Junction (RUUI) through Riabai? **Response:** The road is being designed by a different entity and not APEC. **Question:** Why was the road through Eden ville to Ngegu and Raini not considered as a bypass and yet it off loads the jam from Kiambu road? **Response:** The proposal will be communicated to the client (KeNHA). **Question:** Why has there been no public participation for the Riabai-Kwa Maiko Road? **Response:** This will be addressed by the entity designing the road. **Proposal:** Young people should be absorbed as workers during the project implementation. **Question:** Is there any foot bridge at Riabai? **Response:** This will be considered in consultation with the other entity designing the Riabai-Lioki road. **Views and proposals by the area MP Hon.Jude Njomo:** • There should be a detailed design of the by-passes showing footbridges and affected businesses

	• The road from banana through the Indian Bazaar to the governor's office should be improved • Kasarini primary/Secondary school should have a foot bridge • Pangani interchange bottleneck should be addressed • The Sasini area should have an interchange and not a round about • The persons affected by the project should receive immediate compensation • Kiambu High school should have a foot bridge • Thidigua road to Windsor is being funded by World Bank. A follow up should be undertaken • Lower by-pass is partially tarmacked so part of the funds can be used to tarmac other other loops • Road to Kihingo-Ndumberi can be considered a second by-pass • Plant trees, have street lights and adequate space for other services **Response by Eng. Matu** Eng. Matu in response reiterated that Pangani Interchange will be re-designed and the challenge will be addressed once and for all. Engineer Matu also made it clear to the public that all premises will be accessible through Service roads provided. Engineer Matu also clarified that Ruaka interchange will be addressed by the Western by-pass road designers.
04.00	**Closure** Having no other business, the meeting called off with a word of prayer from a community member.

Minutes confirmation;

Appendix 12: PPM Minutes Kiambu Municipal Hall

MINUTES OF PUBLIC PARTYICIPATION FORUMHELD ON 21ST JUNE, 2019 AT KIAMBU MUNICIPAL HALL

ATTENDANCE:

List attached

AGENDA:

9. Introduction
10. Design presentation
11. Comments/Proposals from the public and responses
12. Closure

MIN	ITEM	ACTION
01.00	**INTRODUCTION** The meeting was called to order by the Senior Assistant Chief Mr. Stephen Gachugu who promised support for the exercise till the end.The area chief mentioned that people's major interests are the bypasses. MR. Mwenga (APEC Sociologist) introduced the ESIA team together with Engineers and welcomed Dr. Margret Gichuhi for a brief introduction of the main agenda. Dr.Margret Gichuhi started by thanking everyone for attending the meeting, and assured the members that the team will try to be as forthcoming and try to answer all the questions directed to the team. She mentioned that the main reason for the meeting was to disseminate and inform the stakeholders on detailed design of	

	Muthaiga-Kiambu-Nduberi road. She mentioned that it was important to be able to gather comments and concerns so as to incorporate the information gathered into the final design. She welcomed any positive and negative impacts of the project so as to inform the mitigation measures to be applied during project implementation. She invited Eng. Stanley Kanyua to present the design to stakeholders.	
02.00	**Design Presentation** Engineer Kanyuastarted by clarifying to the stakeholders that the project will be confined within KENHA road reserve and therefore there will be minimal acquisition of private land. He presented a detailed design of the project from Muthaiga were the projects starts to Nduberi, were the project ends. He also presented to the members the proposed bypasses and explained how they are going to ease traffic within Kiambu town	
03.00	**Comments/Proposals from the public and responses** **Question:** Nginyo: I) What is the width of the road reserve? II) Will busineses in Kiambu town be affected? **Response**: The road reserve in Kiambu town varies between 25-30 m **Response:** No businesses will be affected or demolished within the road reserve. **Question**: Jane I. Can the Riabai road to the Mall be improved? II. Also the Kiambu – Kamiti Road intersection have a service lane and a foot bridge? III. Can the Edenville to Turitu be considered as a by-pass? **Response**: The road through Kihingo will be improved	

	Response: The proposed round about, service lane and footbridge are in the design **Response:** The Edenville –Turitu will be considered. **Question:** Will the turning points be on the service lanes or main/ express highway? **Response:** The turning points directly to the main road will pass over or under the main road. **Question:** How will the Muthaiga bottle neck be addressed? **Response:** This issue is being addressed in another forum **Question:** How is the interchange at KIST affecting the Institution? **Response:** The location of the main gate will be discussed with the KIST management. Part of the farm will be acquired following the governments laid down procedures. **Question:** Stephen Njuguna: The turning points of entry and exit are not clear. **Response**: These will be designed to give adequate length for acceleration/ Deceleration. **Comment**: In high traffic areas, service lanes are blocked by PSVs **Response**: The NTSA should enforce law and PSV drivers should exercise discipline on the roads. Signage will be put as per the design and requirements. **Question:** Matthew Mbugua: Does the Ndumberi roundabout have a provision for a footbridge? **Response:** yes, all issues on Ndumberi will be addressed. **Question:** The road to githirwa was designed in 1974, will it be affected? **Response**: KURA will address this issue. The Mushroom-Kugeria road request has been noted.	

	Question: Why is the section to the Attorney General's office not part of the design? **Response:** This could be considered as a request. **Question:** Kariuki Kinyua: Since Kiambu town is very busy, why not raise the express highway? **Response:** Friendly environmental facility that would reduce traffic. Back lanes and loops will help ease the traffic. The corridor will cater for the express traffic and service lanes. Multilevel roads are very expensive and this may hinder the implementation of the project. **Question:** Moses Mburu-Can the Kiambu police station-Kirigiti be improved since it serves all government installations? **Response:** The road will be considered for NMT and other improvements. The County government should be consider Mass Rapid Transport (MRT) for Kiambu Town. **Question:** George Wainaina: When will the project be implemented? Will businesses be interrupted? **Response**: KeNHA will fast track the implementation process. During construction traffic will be managed to have minimal impact on businesses. Social experts to work with the local affected persons to mitigate on the negative impacts. **Question:** Geoffrey Njihia- How will the concerns of the riparian be addressed at the BRT station along the river next to Kirigiti junction. **Response:** The River will be channelized and the environmental concerns will be addressed. Soft landscaping will be undertaken along the entire road. **Question:** Francis Mbatia: How will you address the parking issue in Kiambu town? **Response:** The 30m Corridor is capable of accommodating six lanes. One lane will be considered redundant for use as temporary parking for access to the businesses	

	along the project route. **Question:** How have you addressed the residents in apartments? **Response:** Some area shave intermittent parkings along the road. **Question:** Murage: Have you considered the footpaths and bodaboda riders in the design? **Response:** These will be separated.	
04.00	**Closure** There being no other business the meeting was called off by the Area chief and a word of prayer was offered.	

Confirmation of minutes:

Name	**Organisation**	**Date**	**Signature**

Appendix 13: PPM Ndumberi Stadium

MINUTES OF PUBLIC PARTYICIPATION FORUMHELD ON22ND JUNE, 2019 AT NDUMBERI STADIUM

ATTENDANCE:

AGENDA:

1. Introduction
2. Design presentation
3. Concerns from the public and responses
4. Closure

MIN	ITEM	ACTION
01.00	**INTRODUCTION** The meeting was called to order by the Senior Assistant Chief who welcomed all stakeholders to the meeting. Eng. Mwitari introduced the ESIA team together with Engineers and welcomed Dr. Margaret Gichuhi for a brief introduction of the main agenda. Dr. Margaret Gichuhi started by thanking everyone for attending the meeting, and assured the members that the team will try to be as forthcoming and try to answer all the questions directed to the team. She mentioned that the main reason for the meeting was to disseminate and inform the stakeholders on detailed design of Muthaiga-Kiambu-Nduberi road. She mentioned that it was important to be able to gather comments and concerns so as to incorporate the information gathered into the final design. She welcomed any positive and negative impacts of the project so	

	as to inform the mitigation measures to be applied during project implementation. She invited Eng. Mwitari to present the design to stakeholders	
02.00	**<u>Design Presentation</u>** Engineer Mwitari started by clarifying to the stakeholders that the project will be confined within KENHA road reserve and therefore there will be minimal acquisition of private land. He further clarified that the meeting is not about land acquisition and compensation but to appreciate the design and give proposals. He presented a detailed design of the project from Muthaiga were the projects starts to Nduberi, were the project ends. He also presented to the members the proposed bypasses and explained how they are going to ease traffic within Kiambu town	
03.00	**<u>Comments/Proposals from the public and responses</u>** **Q1.**John Ngugi: Will buildings be demolished? **Response:** The road reserve will be used for the design. Any acquisition will be compensated asper the governments regulations. **Q2. George:** Will there be interruptions from the service providers? **Response:** The government will take responsibility. **Q3.**Will the old Kiambu road be improved? **Response:** The design arteries will improve access within the town. **Q4**. Has the design accommodated disasters such as dam overflow and floods? **Response:** All culverts and bridges will have constructed as per the required diameters to mitigate against such disasters. Otherwise the public should be alert on early warnings as issued by the relevant government agencies.	

	Q4. Will the remaining section from Ndumberi to Sasini be dualled? How about the use of bumps for safety purposes? Emma **Response:** The funds will be used to build the Sasini bypass section. The section will be considered for future expansion though it will be improved in the current project. The proposal will be forwarded to the client. Footbridges would be preferred to bumps to avoid traffic snarl ups. **Q5.** How have you addressed the access to both side of the road in Kiambu town? **Response:** The design will be aesthetic in that there will not be any wall separating the two side. Also footbridges will be provided at the most convenient designated points. **Q6.** What is the width of the road reserve? **Response:** Muthaiga to Kirigiti = 60m. The rest of the road is between 25-30m. **Q7.** Njenga: Question on Muthaiga bottleneck has been addressed earlier. **Q8.** What are the actual turning points? Drainage from Ndumberi town? Will the beacons be marked? **Response**: These are at Gachue and Karunga-Mahigaini. Drainage will be addressed in the design. KenHa will indicate the corridor boundary. **Q9**. Will the roads within Ndumberi be improved? Can the roundabout be moved elsewhere? **Response**: Some of the roads will addressed by KURA and the County government. The dual carriage has to be terminated with a roundabout. **Q10.** Will the road be constructed well? Response: The quality of construction will be up to standard. **Q11.** Will demolitions be partisan?	

	Response: The law that governs demolition will be non-partisan. The policy to be used is to work within the road reserve and to avoid demolition but if necessary the compensation will be undertaken. **Q12**. Gichuru Njoroge: Will the project have any Corporate Social Responsibility (CSR)? How will the Proposed BRT station at the Kirigiti Junction address the issue of deforestation and ecosystem destabilization? **Response**: CSR will come with project implementation. The afforestation will be undertaken along the sides of the road in form of landscaping with suitable trees and grasses. Along the sides of the channelized river, riparian vegetation will replanted. **Q13.** Moses Mburu: Proposal to consider Kiratina-Raini and Kirigiti-Ruthiruini sections. He commended the good working relations with all arms of government in Kiambu Town Constituency.	
04.00	**Closure** There being no other business the meeting was called off by the Area chief and a word of prayer was offered.	

Confirmation of Minutes:

Name	Organisation	Date	Signature

Appendix 14: PPM Paradise Lost Request

Eng Ndoria,

APEC Engineers. 9th July 2019

RE: Dualing of Kiambu Road in Particular Paradise Lost Junction

Introduction:

It was quite clear during the public hearing on 18th June and the subsequent engagements that the stakeholders are in support of the planned project.

Given the number of attendees not all issues could be captured. As agreed with the team the undersigned was requested to document the contribution from stakeholders on the Paradise Lost junction.

Numerous engagements have taken place internally and below is a brief report of what has come up for your serious consideration.

The issues:

Paradise lost road is about 5km long it is motor-able right through but only 2 km are paved in bitumen and paving blocks by local developers who joined hands.

This road serves the following;

International Schools and Insitutions

a) Sabis international school
b) Brookhouse international school
c) GEMS international school
d) The Wadi Degla World Class Sports complex

National school and church

a) Kasarini Primary and secondary schools
b) PCEA Karasini Church

Residential Gated communities including

a) Mumwe Runda 261 unit
b) Mhasibu Sacco 250 units
c) Kencom Sacco Ph 1 340 units
d) Hiden Park 20 units
e) Runda Palm Gardens 40 units
f) Palm Valley Development 50 units
g) Runda Paradise 60 units

h) Iguta Development 90 units
i) 5 Star Paradise Estate 240 units

Subdivisions are going on and what is captured above is just estimated. They are upmarket units comprising of at least 2 vehicles per unit and excluding delivery/shuttle vehicles.

Recreational Parks

a) Paradise Lost
b) Paradise Gardens

Un-development Land totaling approx. 2,000 acres

Due to the above mentioned developments, there is a high number of vehicles at this junction throughout the day. With peaks at 0600 to 0900, then 1200 to 1400 and 1630 to 2100. Saturday whole day.

The numbers are bound to increase in coming years to over 4 fold as new developments take place in the undeveloped land.

There is no other entry into and out of this area. The roads in Runda are small, residential/light roads. They are not designed to handle large traffic. Only limited access is provided through farm paths.

Road Safety

This road also serve and the pedestrian passage of the work force to all these establishments all the way to Two River Mall and beyond.

Many fatal accidents (12 deaths in the last 40 months) have happened at this junction, Pedestrians crossing the road or vehicles veering off the road to avoid collision with other road users

Recommendation of stakeholders:

During Construction:

1. Construct light bitumen passage on either of main Kiambu carriage way to manage the traffic and resultant dust nuisance.
2. Open service Road to Northern Bypass on the Western side next to Kigwaru and join Northern Bypass at Two Rivers. This will also serve as permanent alternative route to ease traffic from the new road of completion.

Design of Junction:

1. Provide half clover interchange at Paradise Lost Road.
   This should be is harmonized with Thindigua junction at Quickmart Supermarket. The area is developing very fast on either side.
2. Provide Pedestrian crossing bridge
3. Upgrade Paradise Road to permanent 7m bituminous carriageway westward to join Northern bypass at Two Rivers road about. This will be similar to planned roads KIST and Kirigiti junction.

We are requesting you to acknowledge this note and also keep us posted so as to manage expectations on both sides. Once again thank for the Stakeholders presentations in June.

Yours faithfully,

Eng Isaac Gitoho, 0722-776597. isaac.gitoho@ecoenergy.co.ke

Appendix 15: PPM Kiambu Road Property Owners

Kiambu Road Property Owners
P.O. Box 47972 - 00100, GPO
Nairobi, Kenya
Email: jgw@ppdconsult.com Tel: 0722789722

Tuesday, July 09, 2019

Mr. Isaac Gitoho
Director Projects Development
Eco Energy Group
Nairobi, Kenya
Isaac.gitoho@ecoenergy.co.ke

Dear Isaac:

Ref: Dualling of Muthaiga – Kiambu-Ndumberi Road (B32)

We spoke, thank you for taking up the responsibility of assisting the residents that use the above referenced road by providing inputs that will ensure that the road design will meet the current and future needs of the users. In particular we are happy that you have suggested the need to have an interchange at the Paradise Lost Junction on Kiambu Road. This interchange is critical especially because of the number of residents that use the junction. We join you in support of this because of the high population that the junction serves. Also in its current state the junction has claimed many lives of pedestrians, boda boda riders as well as motorists.

For information, currently the junction serves the following establishments....Runda Palms Estate, Sabis School, Mbugua Kibathi Estate, Brookhouse School, Runda Paradise Estate, Kencom Estate, Upcoming Five Star Paradise Estate, Wadi Degla Sports Club, Palm Valley Estate, Mhasibu Sacco Estate, Paradise Lost, Kasarini PCEA Church, Kasarini Primary School, William Kabogo upcoming estate and it is also used by Runda Mumwe as a direct access to Kiambu Road. Conservative estimates indicate that the junction serves a population of more than 10,000 people.

In addition, it is also our view that during the construction phase of this project, the number of people living in this area will provide a traffic bottleneck on Kiambu road resulting in serious loss of man hours, pollution from emission and high energy costs. We therefore propose that a decongestion plan during construction be put in place. One way of decongesting is by upgrading of the Paradise lost to road all the way to Kigwaru to join the Bypass into Limuru Road. I believe this is approximately a 4km road.

We are also interested to know from the road designers how the entrance to Runda Evergreen has been catered for in the design. The design team has agreed to make a presentation next week on Tuesday 16th July 2019 at 10 am at Runda Evergreen PCEA church on the same. If you are available you would help us strengthen our submissions to them.

Again, thank you for taking up this matter.

Yours Sincerely

James Wachira
Lead Representative, Kiambu Road Property Owners

Appendix 16: KIST PPM Minutes

A. **KIST PPM VIEWS AND COMMENTS: 28/06/2019**

Members accepted the second option which has the sausage round about.

Q1. How much acreage will be acquired from KIST?

Response: The amount will be calculated by the valuer and NLC after the final design is submitted.

Q2. How does one access Njathaini road? Will the current design be in charge of Njathaini road?

Response: Access to Njathaini road is through the service lanes. Other contractors have been awarded this road. However, the junction will be incorporated into the Kiambu road design.

Q3. What provisions have been put in place for boda boda riders?

Response: The riders are part of the motorized traffic though there is no designated lane.

Proposal: That the design should consider a designated boda boda rider lane like in the case of Ngong road and for easier management of traffic and safety reasons.

Q4. Is the road design considering the location of sewerage lines and the waste water treatment plant?

Response: Ducts will be provided for services. The design has indicated the existing portable water pipeline from Ndakaini and the sewer lines for the contractor. The expansion of the sewer and waste water treatment plant could be under the County government.

Q5. How many people will the road project serve knowing that there is rapid expansion and change of land use to commercial use?

Response: Projections have been made using the existing population data. Other roads are also being improved to ease the congestion on Kiambu road.

Q6. What is being done to address traffic from Edenville and Five Star? Can there be a turn off before KIST?

Response: This will be looked into or the sausage roundabout can be extended to Edenville/Five star section.

Proposal: Kugeria-Mushroom crescent should be improved. That the peripheral bypasses should be improved to ease traffic from the proposed road.

Q7. Proposed timeline? After submission of the preliminary design, the client will move to the stage of contracting to be followed by implementation.

Q8. Where are the car parks at the Kirigit BRT station?

Response: Both private and PSV vehicle parking are incorporated into the BRT parking. To the northern side of the proposed road is also a triangle which could also be considered for parking.

Q9.Most of the underpasses are contributing to traffic jam. What have you done to address this problem?

Response: The proposed design separates the movement of vehicles in the underpass with a demarcation.

Q10. The Kirigiti junction riparian land has a lot of spoil from previous construction and it is being used as a car bazaar. The river is also highly polluted from upstream. How will you address this issue?

Response: This needs a concerted effort and collaboration with the county government to enforce the polluter pay principle and waste management from the source.

Q11. What will happen to the trees in the riparian land and the natural spring next to the KIST workshops?

Response: The Bill of Quantity (BQ) has been calculated for reforestation, greening and beautification of the road corridor. This will improve the aesthetics and take care of carbon sequestration. Monitoring and evaluation to ensure this is done will take place during the project implementation. The natural springs will be preserved for the current and future generations.

Q12. How about the rest of the town which is being turned into a concrete jungle?

Response: The residents should be encouraged to plant trees in most spaces that do not have concrete to green Kiambu town. The riparian vegetation should be preserved as per the recommended 30m zone.

Proposal: Foot bridges should not be far from the KIST entrance for easy access by the student population

Appendix 17: MUTHAIGA GOLF CLUB PPM VIEWS AND COMMENTS

27/06/2019

Agenda:

Update of the Muthaiga-Kiambu-Ndumberi Road Design

Proposal 1 from Muthaiga residents: Remove the underpass at the river and use Wambui road to the Utalii underpass at Thika Super Highway. Or use the oil Libya Overpass through City Park to Limuru road.

Response: This will deny the golfers from Kiambu and other people access to Muthaiga Golf Club and the residential area. It will also be difficult for other publics to access Karura Health Center.

Proposal 2: Wambui road to remain at the same location but Muthaiga golf club to cede part of the land to compensate.

Agreed:

- The proposed overpass is acceptable
- The overpass shall be exclusive for the club
- The club to trade off the land on the other side of the road to save the current parking which is on the road reserve.
- The footbridge about 5 metres high to be located near the police station right at the boundary to help pedestrians crossing over to and from MGC
- The proposed service lane along the old Kiambu road to remain as proposed. Muthaiga Golf Club members will support the acquisition of the section next to Karura Forest old gate towards Kiambu road in case of any objection on the same.
- Mua road turn off to remain free for access to the public
- PPM for Muthaiga residents Association; representative to request for an appropriate date through APEC
- Culverts to be redone to accommodate flood waters
- Proposed sewer lines to the new buildings be accommodated into the design through ducts. The club to provide a map and a 2D design to APEC.

APPENDIX 18: PPM DCI

B. DIRECTORATE OF CRIMINAL INVESTIGATIONS (DCI) VIEWS AND COMMENTS: 27/06/2019

Members present:

1. Mr. Geoge M. Kinoti-Director of Criminal Investigations.
2. Eng. D.W Njora-APEC
3. Eng. James M. Karanja- APEC
4. Eng. James N. Mwitari
5. Justin Thiong'o- APEC
6. Mwendwa Kiko-SPAN
7. Dr. Margaret W. Gichuhi-APEC
8. Nicholas Tanui- (IP) DCI
9. Peninah Mwangi- (SSE) SDPW
10. Ann Gachengi- (D/AS) ADM
11. Sarah Muriithi- (S.ACCT)Accounts
12. Amos Omuga- (SSP) LCA
13. Mutugi Mugambi- Hsc (DCI
14. Samuel Nyabenga-(AIG) DCI

Proposal 1: The distance from DCI Main Gate to the proposed road should be 30-40 meters.

Response: The additional corridor is not yet provided. A request to KFS (Karura Forest) to cede some land to accommodate the road design to be moved into the forest for security reasons.

Proposal2: The foot bridge to be located further down towards Nairobi before the KFS gate and away from the armoury and the forensic lab. This was agreed by the two parties.

Proposal 3: Deceleration and acceleration required for entering into the DCI offices.

Response: The highway section from the DCI offices towards Kiambu can be straightened to create more space for a service lane and for DCI parking. Angle parking would be the most appropriate.

Comments from the Director of DCI: He indicated that in all designs security should be given paramount consideration. At the same time risk assessment and analysis should also be undertaken to inform the outcome of designs. An artist impression would be easier to understand for a lay person. He gave the design team a freehand to decide on the best option in case the option of acquiring land from Karura Forest turns out to be complicated and delays the implementation of the project.

Appendix 19: Primate Fatalities along Kiambu Road

Friends of Karura Forest

24th February 2020,

Dr. Margaret W. Gichuhi,

APEC CONSORTIUM LIMITED &SPAN ENGINEERS JV, P O BOX 3786-00100,
Nairobi.

Dear Madam,

REF Primates Fatalities Data along Kiambu Road

The following is a recorded mortality of Monkeys along Kiambu Road. Note that these are only fatalities that have been observed by the Karura staffs. There might be a lot of others that are not recorded.

Year	No. of Monkeys
2014	7
2015	18
2016	7
2017	15

2018	19
2019	8

The following are coordinates that we have observed monkeys crossing along Kiambu Road and it is the same spots we have recorded mortality among our primates on being hit by the vehicles. The coordinates are in UTM.

i. 37M 0260045, 9863392
ii. 37M 0260289, 9862136
iii. 37M 0260438, 9861857
iv. 37M 0260267, 9861531
v. 37M 0260111, 9862786
vi. 37M 0260155, 9862429

Please, do not hesitate to get in touch if you need more information.

Yours Sincerely

Peter Njui,
Operations Manager.

APPENDIX 20: EIA Lead Expert License

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

Telcom Wireless: 020-2183718, 020-2101370, 020-2103696
Mobile Line: 0724 253 398, 0723 363 010, 0735 013 046
Incident Line: 0786 101 100

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

Ref: *NEMA/5/3/VOL.II* ***Date:*** *16th April, 2020*

TO WHOM IT MAY CONCERN

This is to confirm that **Dr. Margaret Wachu Gichuhi** NEMA Expert **Reg. No 0657** of P.O. Box 54346-00200, Nairobi, has renewed her license to practice as a Lead Expert for the year 2020.

The Practicing License is being processed and will be produced in due course.

NEMA therefore recognizes the Expert as duly legible to practice in accordance with the provisions of the Environmental Management and Coordination Act (EMCA CAP 387), and Environmental (Impact Assessment and Audit) Regulations of 2003.

ANNE MACHARIA
For: DIRECTOR GENERAL