CERTIFICATION

I, **Tom Omenda**, hereby submit this Environmental Impact Assessment (EIA) Study Report, for the dualling of the Kenol – Sagana – Marua (A2) Road in Muranga, Kirinyaga and Nyeri Counties. The EIA Report has been carried out in accordance with the Environmental Management and Coordination Act, 1999 and Environmental (Impact Assessment and Audit) Regulations, 2003.

Signature:……..……..…

On this 23rd Day of February 2015

Mr. Tom Omenda
LEAD EXPERT – EIA/EA
Nema Reg. 0011

The Proponent's Declaration:
As the proponent of the proposed project, we confirm that the information given in this ESIA Study report is true to the best of our knowledge.

Name……..

Designation……..Signature……

Date……..…

LIST OF ACRONYMS

ADT	Average Daily Traffic
AfDB	African Development Bank
AIDS	Acquired Immuno-Deficiency Syndrome
ASAL	Arid and Semi-arid Lands
BOQ	Bill of Quantity
CBO	Community Based organization
CO	Carbon monoxide
CPP	Consultative Public Participation
CRC	County Resettlement Committee
DC	District Commissioner
DOHS	Directorate of Occupational Health and Safety
DSC	Design and Supervision Consultant
EMCA	Environmental Management and Coordination Act
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental/Social Management Plan
ESO	Environmental & Social Officer
FGD	Focus Group Discussions
FIDIC	International Federation of Consulting Engineers
GoK	Government of Kenya
HH	Household Head
HIV	Human Immuno-deficiency Virus
ISS	Integrated Safeguard System
KeNHA	Kenya National Highways Authority
KFS	Kenya Forest Services
KIHBS	Kenya Integrated Household Budget Survey
Km	Kilometre
KNASP	Kenya National Aids Strategic Plan
KNBS	Kenya National Bureau of Statistic
KRB	Kenya Roads Board
KWS	Kenya Wildlife Service
m	Metre
masl	meters above sea level
MCA	Member of the County Assembly
MDG	Millennium Development Goals
NEMA	National Environmental Management Authority
NGOs	Non-governmental Organisations
NMT	Non-Motorized Transport
NOx	Oxides of Nitrogen
OD	Origin and Destination
OSHA	Occupational Health and Safety Act
PAP	Project Affected Persons
PAPC	Project Affected Persons Committee
PI	Public Involvement
PIU	Project Implementation Unit
PM	Particulate Matter
PPE	Personal Protective Equipment
PSV	Public Service Vehicles
RE	Resident Engineer
RHS	Right Hand Side
RMI	Roads Maintenance Initiative
RUC	Road User Costs
SO2	Sulphur dioxide
STI	Sexually Transmitted Infections
ToR	Terms of Reference
VOCs	Vehicle Operating Cost
WUA	Water Users Association

EXECUTIVE SUMMARY

Introduction

This Environmental and Social Impact Assessment Sudy report is for the proposed dualling of the 84 km road from Kenol to Marua. The road is currently a single lane road supporting heavy traffic. The Kenol – Sagana – Marua Road is part of the "Great North Road" from Mombasa, through Nairobi and on to Moyale - and hence to Ethiopia and Addis Ababa. It forms part of the 800km stretch between Nairobi and Moyale and is situated in the three counties of Muranga, Kirinyaga and Nyeri Counties.

Description of the road sections

The road between Kenol and Marua are divided into the following two sections for purpose of Design and Contract Packaging:

Contract	Section	Length
1	Kenol – Sagana	47 km
2	Sagana – Marua	37 km

The whole road section between Kenol and Marua has recently been applied with an overlay and therefore a fair riding surface.

Location

The project road is situated in the former Central Province. It traverses the counties of Murang'a, Kirinyaga and Nyeri starting at Kenol, Maragua District, then on through the towns of Sagana in Kirinyaga County, and Karatina in Nyeri County before finally terminating in Marua town also in Nyeri County. The Kenol – Sagana – Karatina – Marua Road Project is located along the A2 international trunk road, starts approximately 16 km north of Thika town, and ends approximately 15 kms south -east of Nyeri Town.

Project Cost

The proponent avers that total estimated project cost is **KSh. 19,357,283,702.00 (Kenya Shillings Nineteen billion, Three Hundred and Fifty Seven Million Two Hundred and Eighty Three thousand Seven Hundred and Two)** (See Annex for summary of costs).

Study Methodology

The study involved field studies, interviews, literature survey and and public consultations to obtain data on the baseline conditions of the general study area. Threats to the environment were identified and this was followed by related impact assessments and finally the compilation of a comprehensive report on the current status of the environment; possible positive and negative impacts that the project is likely to cause and the development of an ESMP.

This ESIA was conducted by a team of experts who through public consultations and field visits, collected baseline information of the project area.

Policy Legal and Institutional Framework

This Environmental and Social Impact Assessment report is guided by a number of environmental legislations, the primary one being the Environmental Management and Coordination Act (EMCA, 1999). This Act makes Environmental and Social Impact Assessments a legal requirement. The ESIA is also guided by a number of subsidiary legislations under EMCA. Other Acts include the Lands Act, Water Act, among other pertinent legal and institutional framework guiding road development projects.

In addition, there are several social instruments that are relevant to this project including the National Policy on Gender and Development, sexual offences Act and the National Aids Strategic Plan (KNASP). The Sexual Offences Act is particularly relevant in guiding the sexual conduct of the workers. The Children's Act prohibits child labour and exploitation of children in any form.

Scope and Objectives of the study

The Environmental and Social Impact Assessment study is normally carried out before the initiation of a project. The study aims to define baseline conditions of the study area, the potential environmental impacts that the proposed project is likely to pose; both positive and negative, as well as the possible mitigation measures to the probable impacts. The assessment also comes up with an Environmental Management Plan which the proponent is supposed to adhere to in order to avoid adverse impacts of the project on the environment.

The scope of this ESIA thus included a study of the following:

- Proposed reclamation of the 7 m road reserve
- Proposed improvement of the drainage system in the proposed roads through installation of new drainage structures except bridges
- Evaluation of the potential impacts of the proposed project on soil, flora and fauna of the area
- Development of conservation and mending up measures to be implemented during and after completion of maintenance works
- Degradation of physical environment through excavations, clearing of vegetation cover and material sourcing
- Air and noise pollution
- Potential impacts on the socio-economic aspects within the project area

However, the identified potential negative impacts can be mitigated by implementing the proposed Environmental and Social Management Plan (ESMP) which aims at having a sound environmental project.

Baseline Conditions

Bio-physical conditions

The project region is very diverse with physiography that includes high elevation mountaneous landscape of Nyeri to lowland plains in parts of Muranga. Variations in altitude, rainfall and temperature between the highland and lowland coupled with the differences in the underlying geology of both volcanic and basement system rocks give rise to a variety of soil types. Highland areas have rich brown loamy soils suitable especially for coffee. Coffee, maize and dairy farming are practiced. Soils in the lower areas are predominantly black cotton clay soils with seasonal impended drainage.

The area has a mean annual rainfall of about 1500 mm and is well-suited for mixed coffee in the mid altitude zones and mixed crops of maize and other subsistence crops in the lowlands. Other important agricultural products found in the area include dairy, bananas. The area is interspersed with woodlots of Eucalyptus and *Grevillea robusta*

The key socio-economic activities in the project area is agriculture and livestock keeping. This is mainly carried out in small holdings with few large-scale plantations. Population density is relatively high compared to the rest of the country with poverty levels at around 27% with Nyeri having the lowest poverty rates amongst the three counties traversed by the project.

Land Degradation

There are concerns of land degradation due to cultivation on river banks and over cultivation due to small land sizes. Soil erosion is prevalent and is exacerbated by the steep terrain characteristic of the middle agro ecological zone (sub-tropical) associated with coffee growing around Marua in Nyeri County. Waste from pulping of coffee berries into the rivers has caused sporadic pollution as exemplified by high turbidity of river flows downstream. Quarrying in the region also causes run off that increases sedimentation of rivers. Landslides are common due to the over saturation of andosol soils during the wet season and the rugged terrain.

Hydrology, Drainage and Water resources

There are a number of rivers in the project region with River Tana catchment forming the dominant drainage system in the area.

Vegetation/Agriculture

The project region is generally covered with exotic trees. Some indigenous trees are also found conserved along some riverine corridors. Agricultural activities are predominant and constitute the main economic activity. The major cash crops grown in the project area are Coffee, pineapples and horticultural crops mostly on small scale farms.

Socio-economic conditions

From the Kenya Population and Housing Census 2009 report, the population of the three counties stood at 2,164,193 consisting of 1,058,219 males (or 0.49%) and 1,105,974 (or 0.51%) females. The dominant ethnic group in the project area is the Kikuyu who consists of several clans. However, there are other ethnic groups mainly concentrated in urban areas including Asians.

Land in the project area is highly potential and is used primarily for agricultural purpose. Guaranteeing adequate land holding/ownership is therefore considered important. 72.3% of land owners in the project counties have title deeds. These are distributed as follows: 64.9% in Murang'a, 67% in Kirinyaga and 85% in Nyeri.

The average Human Development Index in the project counties is 0.6% while with Human Poverty Index standing at 27.1% and Gender Development Index at 0.5%. Interms of individual counties, among the project counties, Nyeri has higher welfare standards followed by Kirinyaga and Murang'a.

The average literacy level across all the counties is 80.1%. Nyeri has the highest literacy level of 91.8% followed by Kirinyaga with 78.4% while Murang'a has the lowest of 70.1%. School enrollment rate stands at 98% while dropout rate is 4.6%. The project counties have a total of 8218 education institutions, majority being primary schools and with Nyeri leading

Agriculture is the most important activity in the project counties with 87 percent of the total population deriving their livelihood from the sector and accounting for 72 percent of household income. Trade and commerce along the project road includes industrial processing, wholesaling, retailing, hotel and lodging/bars (Troters Hotel, Kwasamaki Hotel, Jungle mans curio shop), petrol stations as well as transport and communications. The trading centres found along the project road include Kenol, Kambiti, Makutano, Sagana, Kibirigwi and Karatina.

The main gender issues arise from customary practices where the male vests ownership and control of productive assets. Women constitute about 51% of the population and contribute to 60 -80% of the total agricultural labour. Women in the counties are faced with a number of challenges

including inadequate access to credit, lack of technical skills, multiplicity of roles for women and inadequate access to education and training

Summary of Potential Environmental Impacts

Environmental parameter	Potential impact	Proposed mitigation measures
Drainage and Soil erosion	New bridges are expected across the many Large and Medium size river crossings mainly Muri / Kakuzi River, Saba Saba River, Sagana/Tana River, Murangu/Kiruara River, Ruamuthambi River, Ragati River, Galchamuki River and Hohwe River. Construction works at the new bridges could lead to localized erosion. Furthermore, excavations could lead to enhanced erosion during March-May heavy rains especially between Karatina and Nyeri which has rugged terrain and higher rainfall. New drainage outfalls onto farms on the lower catchment of the road could lead to erosion and gully formation within the receiving farms. *Soil may erode along the road alignment, particularly during the wet season (March through May) in the initial years after decommissioning.*	• Optimized new drainage structure positions and improved capacities of the structures used in combination with specific erosion protection works • Culvert outfall should be lined for an appropriate distance, especially north of Makutano • Scour checks should be constructed alongside drains on steep slopes • Establish retention ditches at the new drainage outfall locations. If water volume and velocity is deemed too high for retention ditches, then the drainage channel should be lined with velocity dissipation surfaces up to the point where the water can be discharged without serious consequences. • Inform the farmers whose farms are likely recipients of cross-drainage outfalls of the actions proposed for mitigating the impact and potential consequences should the mitigation measures fail.
Water Quality	There are many water bodies within the area of influence of the road. These include wetlands, streams and springs. These could be impacted through sediment laden flows from cleared areas and excavated sites during construction. There are about	• Construction activities should kept to the project footprint and avoid excavations and clearances beyond the project footprint that can generate soil erosion. • Extra care will be required during the wet season.
Air quality	During construction dust pollution could be significant within the Towns, institutions close to the road and adjoining settlements. The study identified 47 air quality receptors mainly comprising learning institutions, places of worship, health facilities all within 200 m of the road. Also commercial centres are also regarded as areas of air quality concern	• Use dust suppressants as far as possible, especially within the towns. • All workers should wear dust masks at all times when at the sites of high dust generation • Engage the management of the identified air quality receptors on possible air quality issues should mitigation measures fail to cope.
Soil pollution	The possibility of occurrence of this impact and the magnitude is dependent to a large extent on the location and management of contractor's camps. Potential source of impacts include accidental oil spills, release of petroleum products and bitumen (amongst other liquid waste) on the environment. These releases	• The most important measure is best engineering practice that is cognisant of environmental responsibilities. • Mitigation actions will mainly involve maintenance of machinery, bunding the garage, and directing spills to an oil sump which should be emptied into a designated final disposal site

	infiltrate into soils and cause soil pollution.	
Construction water sources	There are enough water resources in the project area, so conflicts with the local water users are not foreseen. However, consultations are needed prior to commencement of water abstraction.	• Acquire WARMA permit for water abstractions. • Consult Water Users Association to gain their support prior to abstraction
Roadside vegetation resources	Other than short re-alignment sections and the bypasses at Karatina, the rest of the road will be restricted to the current road reserve. In all cases land cover will be transformed to permanent paved surface, leading to permanent and irreversible loss of vegetation cover. Loss of vegetation will also lead to loss of income through loss of fodder planted within the road reserve, loss of grazing area and farmlands.	• Value the vegetation resources to be affected that are outside the road reserve for appropriate compensation • Consider planting appropriate trees within the road median and other suitable areas as compensation for the permanent loss of vegetation cover.
Noise and ground vibration	This impact can be of concern only at construction sites within the larger urban environments of Kenol, Makutano, Sagana and Karatina. There are over 30 noise-sensitive institutions that are within 300m of the road that include schools, health facilities, colleges and places of worship. Where explosives will be used, especially at quarries, there will be serious noise and vibrations in the vicinity of the site.	• At commencement of construction works, map all noise sensitive receptors and prepare a construction plan that avoids excessive noise within proximity of the receptors as appropriate • Avoid loud noise during school hours close to learning institutions • Warn residents within 300m of quarries of intention to blast and the exact blasting time
Visual intrusion	On the whole, there are few scenic sites, but opened up quarries and borrow pits could be of visual intrusion	• The contractor is to prepare a detailed borrow pit management and rehabilitation plan once these are identified. • Progressively rehabilitate quarries and borrow pits as work progresses and as per site specific material site rehabilitation plan
Waste Management	Construction waste could be a health hazard in the area. These include waste from the contractor's camp – both effluents and solid waste.	• Develop a waste management plan for use during the entire construction period • Identify waste disposal sites and ensure the sites are registered with NEMA and the relevant County Government
Urbanization	The road could trigger rapid development of urban centres, increase of property values and could promote ribbon settlement pattern along the new road.	• Proactive physical planning for the area by the three Counties, especially Muranga County
Socio-cultural impacts	Enhanced social interaction and networking that will further erode the Kikuyu traditional ways of life as many adapt to hybrid cultures. In addition, there will be cultural diffusion and to some extent, erosion of some values and practices.	• This may be a positive impact and could also be a negative impact depending on standpoint of an individual. • The County authorities may need to be informed of this potential impact

Family graveyards and individual graves	Relocation of graves could be a major concern especially the road sections from Sagana to Marua and the Karatina bypass.	• Involve key players in relocating graves to include among others the affected household, religious leaders, community leaders, the County governments and the public administration. • Relocation of graves and compensation should be discussed with each family.
Resettlement and compensation	There will be land acquisition and property acquisition to allow for re-alignments, interchanges and bypasses. The most affected sections will be Karatina Town due to the Karatina bypass, the road section between Sagana and Marua and the two interchanges at Makutano and Marua	• A resettlement action plan has been separately undertaken and reported in a separate volume.
Public Health	The indirect impacts of the project on health and safety are associated primarily with human behaviour, and this includes the potential for transmission of HIV-AIDS and other STIs	• Integrate HIV AIDS and STIs preventive and awareness programme amongst the workers. to include issuance of free condoms to workers • Establish a clinic within the Contractors' camp
Road safety	The road is designed for high speed motoring hence road safety concerns	• Install elaborate road safety signs along the entire road; • Construct foot bridges and under-passes at strategic points along the road. • To the extent possible, avoid zebra crossings along the entire road **or** use zebra crossings alongside speed calming humps and additional signages.
Separation of communities	The road will act as an enhanced barrier to community interactions between residents on either side of the road.	• Construct foot bridges and under-passes across carefully determined points to enhance safe movements of people across the road

Conclusions and recommendations

The ESIA study has found that the project will have fundamental social impacts within the project's area of influence, most of which are related to land acquisition and property compensation. These could in turn impact on the livelihoods of the poor especially roadside traders and farmers. These concerns are well covered in the resettlement plan and a detailed compensation mechanism has been proposed. If the RAP recommendations are followed, then the livelihood impacts will be fully mitigated. The other social impacts include potential segmentation of communities across the road, land and property acquisition and socio-cultural impacts such as relocation of graveyards and cultural erosion over time. Some of these socio-cultural and socio-economic impacts can be fully mitigated through compensation and proper design of the road. Foot bridges and underpasses could be incorporated to mitigate community segmentation and to enhance road safety. The above potential socio-economic impacts notwithstanding, overall the socio-economic impacts will be positive as it is for the larger societal good. The other tangible benefit is the projected rapid appreciation of property values especially in Muranga, between kenol and Makuyu.

Impacts on the bio-physical environment are medium to low and most of them can be avoided or mitigated. The most important impact relates to expanded impervious surface that will double the

run-off from the pavement. It is estimated that on average additional 756,000 m2 of paved surface will be created. This will increase the amount of run-off that will require to be channelled in a way it does not lead to new erosion and gullies. This could be mitigated through proper channelling of run-off and vegetating outfalls. Material sites especially quarries and borrow pits could alter the general landscape and also lead to land degradation. This is a major impact considering that very large quantities of materials will be needed for construction.

Cumulative impacts will only occur during the construction phase if the construction of other nearby projects coincides with that of the proposed road project. If this is the case, even greater attention should be paid to the proposed mitigation measures to ensure the cumulative impact of the construction works is minimised. More importantly there is possibility of the new developments that may be triggered by the project to source construction materials from the same quarries. This is difficult to estimate at this time.

During operation, cumulative impacts will be significant within farmlands and urban fringe between Kenol and Makuyu resulting in a gradual change of character. Landscape changes may contribute to a potential future cumulative urbanising impact changing the character of the area from rural to urban edge. Due to expected future residential and commercial developments along Contract 1, cumulative impacts relating to land use and noise and vibration are expected.

The climate change predictions indicate that the central region could experience a reduction in rainfall by up to 150mm. In this regard we do not expect that the drainage structures would be inadequate within the design life of the road. It is therefore our opinion that with the prediction of slight reduction of rainfall in the central region, the design factors are sufficient to accommodate future changes in flows. We conclude that climate change could have low to insignificant impacts when the most critical factor, drainage is considered.

Impacts on gender issues are adjudged to be overally positive as the road will trigger a range of benefits including employment opportunities and income generation, experience and socializing, easing road congestion, reduced accidents, reducing maintenance of vehicles, psychological satisfaction. Some potential negative impacts on either gender will include business disruption, public health concerns, relocation of business premises, increase in accidents due to speeding of vehicles on the newly constructed road and immorality associated with construction workers. In our assessment the road will not have particular advantage or disadvantage to either gender and is therefore neutral in its impacts.

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1 INTRODUCTION

The Government of the Republic of Kenya has obtained a loan from the African Development Fund (ADF), the lending arm of the African Development Bank (ADB) towards the feasibility study, environmental and social impact assessment, preliminary and detailed engineering design for dualling the road from Kenol to Marua. This road forms part of the road corridor from Mombasa through Nairobi to Addis Ababa.

The Government of Kenya, through its implementing agency, the Kenya National Highways Authority (KeNHA) engaged Egis Consulting Engineers to carry out a feasibility study, environmental and social impact assessment and preliminary engineering design of the dualling of Kenol-Sagana-Marua road.

1.1 Project Justification

The Kenol – Sagana – Marua Road is part of the "Great North Road" from Mombasa, through Nairobi and on to Moyale - and hence to Ethiopia and Addis Ababa. It forms part of the 800km stretch between Nairobi and Moyale and is situated in the three counties of Muranga, Kirinyaga and Nyeri.

The road starts at the junction with C71 (Kenol) and traverses through the trading centres of Makutano (Junction A2/B6), Sagana, Karatina before terminating at Marua (Junction A2/B5).

The existing road is a single carriageway to bitumen standards. It is a constriction – an impediment to flow of the high traffic experienced between Nairobi and Isiolo/Nyeri towns. The road therefore requires upgrading to dual carriageway. The route from the Port of Mombasa to Addis Ababa, via Nairobi, Isiolo and Moyale, hold economic advantages for Kenya in her trade with Ethiopian.

It has been envisaged that any development of this route corridor could help in solving Ethiopia's import problems and at the same time bring business opportunities, employment, and increased economic prosperity to Kenya as a whole.

The section of road from Isiolo to Merille River has recently been upgraded to bitumen standards while sections of Merille River to Moyale are at different stages of construction to bitumen standard.

On completion of construction of this section of the corridor, the proposed section for dualling is expected to be even busier than it is currently.

1.2 Location

The project road is situated in the former Central Province. It traverses the counties of Murang'a, Nyeri and Kirinyaga starting at Kenol, Maragua District, then on through the towns of Sagana, Kirinyaga District, and Karatina, Nyeri District before finally terminating in Marua town, Nyeri County. The Kenol – Sagana – Karatina – Marua Road Project is located along the A2 international trunk road, starts approximately 16 km north of Thika town, and ends approximately 15 kms south -east of Nyeri Town.

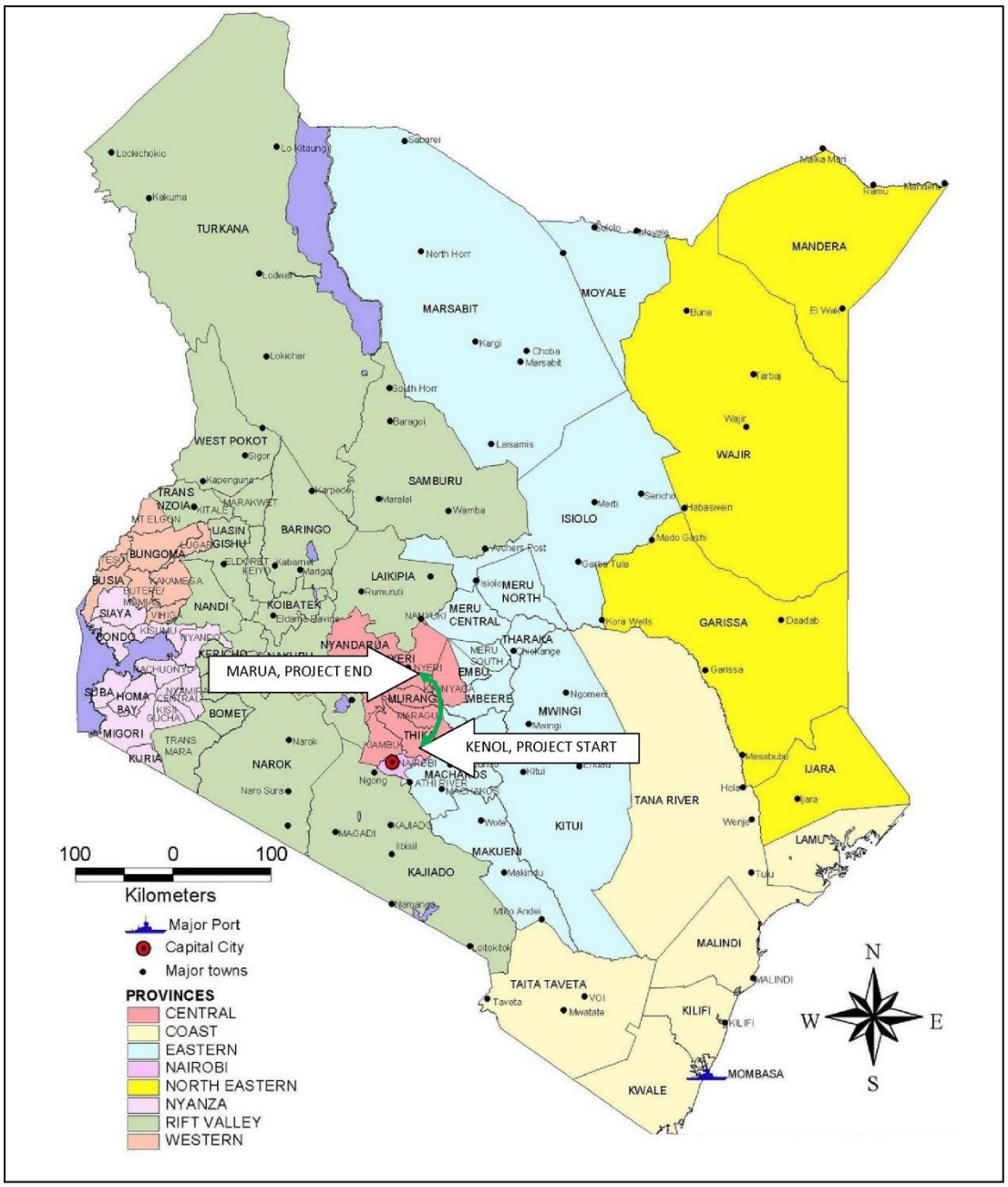


Figure 1: Project Location in the Kenyan Context

1.3 Scope and Methodology

Bio-physical environment

Studies of the biophysical environment provide a profile of the study area, with special emphasis on:

- Relief
- Soils
- Climate
- Drainage patterns
- Ecological resources

It is upon these topics that possible environmental impacts of the project were evaluated. The assessment of impacts was, therefore, carried out in the following sequence:

- Qualitative and quantitative assessment of the current state of the environment in the project area;
- Identification, prediction and evaluation of positive and negative environmental impacts;

- Identification of mitigative measures for adverse environmental impacts;

The above process was augmented by:

- Review of previous reports, published and unpublished works on the environment of the study area;
- Field investigations and
- Collation of baseline data on the environmental conditions of the project area.

Finally, formulation of an environmental management and monitoring plan based on proposals for preventive, compensatory and mitigative measures during project implementation and during the lifespan of the road was done.

Field survey techniques

The field survey adopted various techniques of baseline data collection on the existing environmental conditions, namely:

- Field observations and recordings including photography along the proposed route and its vicinity.
- Use of checklists for determining potential environmental impacts of the proposed project.
- Discussions with key informants along the road and its vicinity.

Checklists

Checklists are study instruments that aid in assessing possible environmental impacts during both construction and operational phases of a project. In this study, checklists were utilized to:

- Facilitate identification of potential environmental impacts;
- Provide a means of comparing the predicted environmental impacts;
- Indicate the magnitude of both positive and negative environmental impacts;
- Indicate possible adverse environmental impacts that are potentially significant but about which sufficient information can be obtained to make a reliable prediction;
- Indicate negative potential environmental impacts in the project area, which merit mitigation measures and monitoring during project implementation.

Social Impact Assessment

The Social Impact Assessment study assessed the current socio-economic situation under the prevailing road conditions as well as the impacts of the road improvement. The socio-economic impact assessment focused on evaluating the impacts of the road on community social and economic well-being. Identification of the anticipated impacts was determined on the basis of the social and economic baseline conditions established and information obtained from the documents reviewed. Among the broad focal areas addressed included;

(i) Social and cultural issues (social indicators such as health and safety, cross-cutting issues of gender, poverty and HIV/AIDS, demographic aspects, land use and urban trends, Typical modes of transport, welfare indicators including education, labour force, poverty and income levels, Resettlements activities)

(ii) Economic issues (economic activities, tourism activities, trade and industry, acquisitions and compensations)

(iii) Administrative and institutional arrangement (development actors and their roles in the project area notably line ministries, local authorities, state corporations and religious organizations among others, local, regional and international linkages to the project area, grassroots' administrative divisions traversed/covered by the road and Conservation institutional structures),

The steps undertaken to determine the socio-economic feasibility for the proposed road project included

i. Documentary (Literature) Review

Relevant documents were reviewed to obtain information on the baseline information in the project counties of Muranga, Kirinyaga and Nyeri in general and the road corridor in particular. This documentary review provided understanding on local micro (social and economic) conditions, data on demographic trends, land use sizes and practices, development strategies and plans (local and

national). Intensive documentary review included the area maps, County Development Plans and socio-cultural profiles of the residents in the project area of influence

ii. Observations and field Assessment

Detailed field observation assessment was undertaken to enable determination of the exact socio-economic activities within the proximity of the road. Among the broad focal areas for which observation was done included settlement patterns, farming, institutional presence, commerce, trade and industry among others.

iii. Consultations and public participation

Public consultations were conducted along the whole project corridor to capture the major concerns associated with the project from the communities living along the route as well as all the relevant stakeholders. The exercise was carried out inform of detailed consultative meetings by members of the public and stakeholder meetings bringing together representatives of key sectors in the project area of influence

1.4 The ESIA Process

The ESIA has been conducted through a three step process.

Phase 1: Screening

The first step was the screening stage which essentially assisted with determining the extent (level of detail) to which the ESIA was required.

Phase 2: Scoping for Environmental and Social issues

Scoping is an important the initial phase of the EIA process. During scoping, main environmental and social issues were identified. In the Scoping Phase, key issues to be investigated and assessed during the subsequent phases of the process were identified, and the range and extent of the studies to be conducted determined. The primary Project stakeholders were also identified during this Phase. Desktop analyses, stakeholder interviews, and public meetings were conducted.

Phase 3: Detailed Environmental and Social Impact Assessment

This was the main Study Phase of the ESIA process. In this Phase, desktop and field studies were conducted to evaluate the key issues identified during the Scoping Phase. The goals of this Phase were to provide a detailed description of the affected area and establish the environmental and social baseline that will be used in the Impact Assessment and conduct detailed environmental and social impact analysis.

2 DESCRIPTION OF THE PROJECT

2.1 Description of the road sections

The road between Kenol and Marua are divided into the following two sections for purpose of Design and Contract Packaging as explained in the ToR:

Contract	Section	Length
1	Kenol – Sagana	47 km
2	Sagana - Marua	37 km

The whole road section between Kenol and Marua has recently been applied with an overlay and therefore a fair riding surface.

The existing road (approximately 84 km in length) starts in Kenol at the junction with C71 (approximately 1500m above sea level) and traverses through the trading centers of Makutano, Sagana, Karatina before terminating at Marua (junction A2/B5) located at 1650 m above sea level.

The first 60 km are considered as rolling with a low point located at Chainage 28+000 where the road crosses Sagana (Tana) River at an elevation of 1050m above sea level. The road reserve between Kenol to Sagana and Sagana to Marua is 60m and 40m respectively.

2.1.1.1 The start point

The start point is in the Maragua District, at the bridge located at the junction between the road A2 (THIKA ←→ NYERI) and the road C71 (starting from KENOL to MURANG'A). This point marks the end of the dual carriageway road from THIKA to KENOL. The dual carriageway road starts to narrow at the bridge location and ends to a single carriageway road about 250 m ahead.

Figure 2: Start Point Map

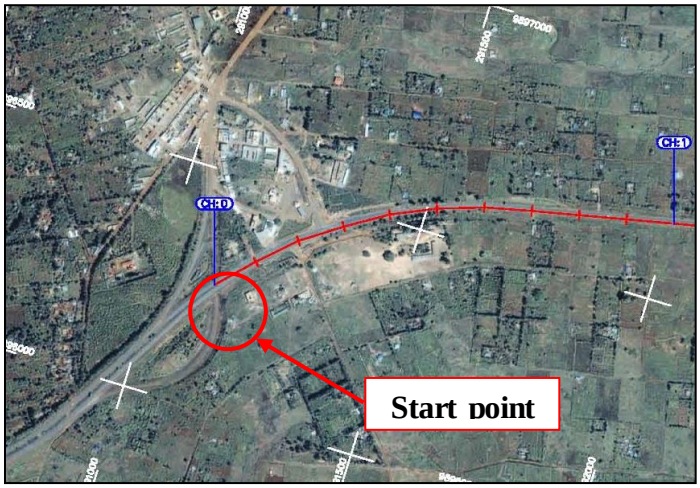


Figure 3: Start Point Satellite Image

Plate 1: Start Point Photo

2.1.1.2 The first section

The first section of the project road is between KENOL and SAGANA. Its length is about 47.00 km.

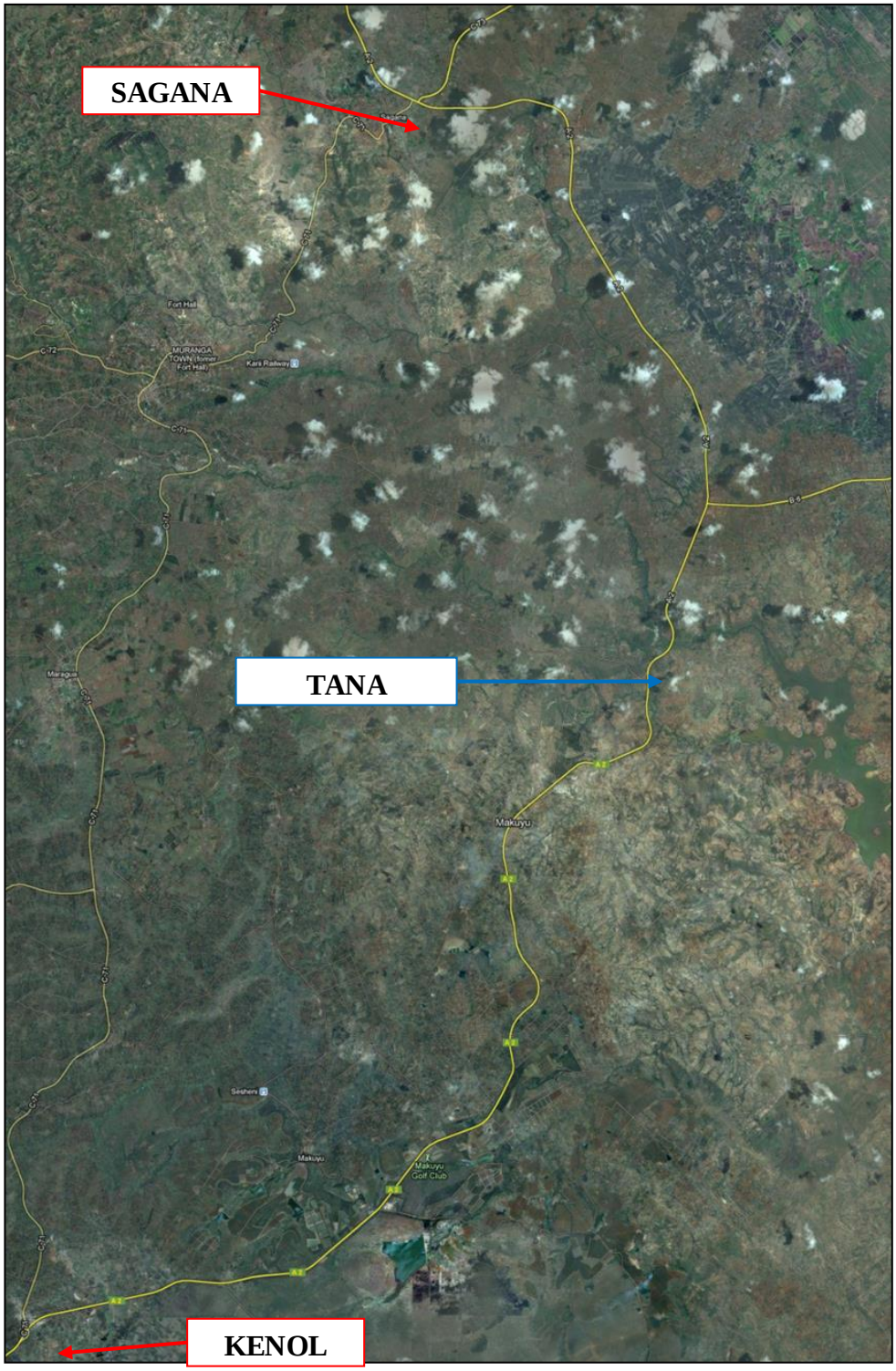


Figure 4: Google Earth Overview Section 1

2.1.1.3 The second section

The second section of the project road is between SAGANA and MARUA. Its length is about 37.00 km.

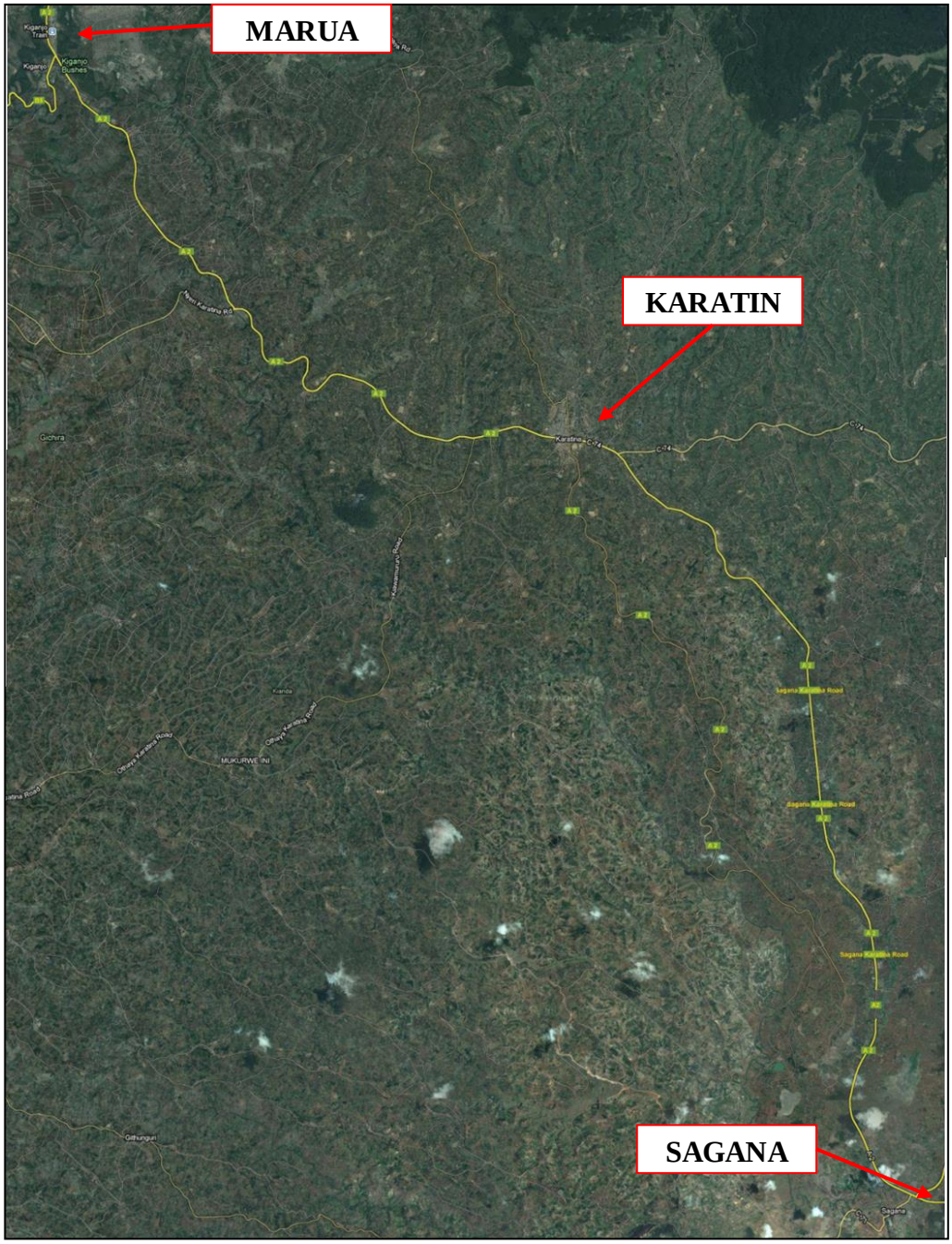


Figure 5: Google Earth Overview Section 2

The end point is in the Nyeri District, 500 m after the junction of road A2 (THIKA ←→ NANYUKI) and the road B5 (MARUA ←→ NYERI).

Figure 6: End Point Map

Figure 7: End Point Satellite Image

Figure 8: End Point Picture

2.2 Road alignment

The existing road (approximately 84 km in length) starts in Kenol at the junction with C71 (approximately 1500 m above sea level) and traverses through the trading centers of Makutano, Sagana, Karatina before terminating at Marua (junction A2/B5) located at 1650 m above sea level.

The first 60 km are considered as rolling with a low point located at Chainage 28+000 where the road crosses the Tana River at an elevation of 1050 m above sea level.

2.3 River crossings

The project road traverses the Sagana (Upper Tana) River drainage systems, that rises from the Aberdare and Mount Kenya.

The existing alignment passes over Large and Medium size river crossings like Muri / Kakuzi River, Saba Saba River, Sagana/Tana River, Murangu/Kiruara River, Ruamuthambi River, Ragati River, Galchamuki River and Hohwe River, which are currently being crossed using concrete bridges or culverts.

There are several small and other medium drainage channels currently crossed using Single and multiple cells Pipe and Box culverts.

Generally most of the crossings have hydraulically deteriorated overtime, some of the small and medium size crossings are either silted, clogged at the entrance and the exits are determinate.

2.4 Outline of the Construction of the Road

2.4.1 Construction Overview

A pre-qualified contractor capable of carrying out roads construction will undertake construction of the road and associated works. The construction will require a number of temporary facilities such as equipment & workshop yard, labour camp and site offices.

The Construction contract will be based on FIDIC (International Federation of Consulting Engineers) conditions which stipulates that the Contractor must provide a performance bond as well as the following insurances:-

I. Insurance of Works and Contractors Equipment

II. Third Party Insurance

Ground Investigations

Prior to actual construction works, the Contractor will undertake additional ground investigations over and above the one done by the Consultant. These additional ground investigations will be more elaborate. Samples from test pits will be subjected to both visual observations and laboratory tests.

Demolition and Site Clearance

This will include general site clearance of vegetation including their disposal. Where necessary, trees may be cut, their stumps removed and resulting holes backfilled. Where the road requires slight realignment, or there is need to clear the entire width of the road reserve, existing structures, which are in the way of the construction, will be demolished and disposed. This is likely to be intense in the project towns where there is substantial encroachment into the road reserve. The demolished elements will include brickwork, concrete, masonry blocks, metal (largely steel) and timber.

Concrete Works

There will be concrete works at certain sections of the road that require reinforcement. In addition new culverts and other drainage structures will be required.

Earthworks

Earthworks operations will be for preparation of road sub grade and drainage, in addition to auxiliary works within the road corridor. Earthworks will include:-

- Site Survey and Setting out.
- Excavation by cutting into topsoil, normal soil, rock or artificial material.
- Trimming some excavated surfaces and disposing of excavated material(s).
- Filling to Embankment and General Filling with imported natural material other than topsoil. These natural materials include rock; sand and other approved naturally occurring materials.
- Scarifying, watering and compaction of fill layers or in situ road formation level.
- Providing, placing and lapping geo textile materials.

Roads and Paving

The Roads Pavement comprises of the following: -

- Construction of the carriageway

- Precast Concrete Kerbs and Channels to act as restraint to road edges
- Non Illuminated Traffic Signs
- Reflective Road Studs along centre line of carriageway
- Road Markings to designate carriageway from shoulders

Steel Works

The steel works in the Project are in the viaduct bridge guardrails and related subsidiary works of site bolts.

2.4.2 Commissioning (Operation and Maintenance)

Structural and Civil Engineering Works

These types of works are usually ready for use after construction and construction testing. These works will be commissioned if and when, their functionality can be substantially achieved.

As a part of the commissioning activity, the Consultant will prepare and finalize as built drawings for the entire structural and civil engineering works.

Site Reinstatement

Prior to the commencement of the reinstatement program, the contractor will be required to develop a project specific reinstatement plan.

Reinstatement Philosophy

The reinstatement of the Project will be based on the following principles:-

- Disturbed areas which are not permanent works, will be reinstated to pre construction conditions to the greatest practicable extent
- Disturbed areas will be stabilized to protect the integrity of permanent works.
- Disturbed areas will be re-vegetated to achieve good and natural landscape ambience.
- Regular monitoring of reinstated areas will be undertaken until environmental requirements and goals have been achieved.

Timing of Reinstatement

Reinstatement of the Project area will be undertaken on a sequential basis dependent on the completion of construction and testing in each area. The site will be cleared of residual construction debris, construction signs and equipment as part of activities associated with reinstatement.

Site Clean Up

Prior to de-mobilization of construction personnel and equipment, cleanup activities will be carried out in accordance with environmental standards and industry best practice. Cleanup activities will consist of the removal and/or disposal of temporary structures, equipment, tools and excess material brought on site or generated during the construction and commissioning program.

Permanent Reinstatement

Permanent reinstatement will be undertaken in all the areas that have been subjected to disturbance by the roads and viaduct bridge construction.

To facilitate natural re-vegetation of disturbed areas, the separately stockpiled excavated material and topsoil will be spread back in the reverse order in which they were excavated.

The key reinstatement principles are summarized below:-

- Minimize reduction in soil quality and structure during construction
- Reinstate all third party assets affected by project activities in accordance with the construction contract documents and other pre-entry agreements.
- Carry out site landscape on the basis of a landscape plan prepared by a landscape professional.
- A target minimum cover of pre-existing ground vegetation established within one year of final reinstatement will be set.
- An aftercare monitoring and corrective action program will be developed and implemented based on examining the bio-restoration process periodically after reinstatement.
- Any fences, services, structures or other facility affected by the construction works will be repaired or replaced to a condition that is at least as good as that found prior to construction.

2.4.3 Decommissioning and Abandonment Plans

Decommissioning of Existing Facilities

Decommissioning of the road is not foreseen, however, decommissioning of related facilities especially contractor's camps and workshops are inevitable. Further, decommissioning of quarries and borrow sites will be done upon completion of construction works.

Legal Basis

For the components that will require decommissioning, the proponent will prepare a written abandonment plan within 30 days of determining decommissioning. The Plan will detail how the decommissioning will be carried out.

The abandonment plan will be subject to approval by NEMA. An Environment Project Report (EPR) will be prepared prior to implementation of this plan, to assess and minimize potential environmental and social impacts arising from the abandonment operations. This abandonment EPR Study should be submitted to NEMA for consideration.

Upon completion of the abandonment operations, an assessment of contaminated land will be prepared recording the final contamination status of the location of the project facilities. This assessment will be subjected to NEMA approval.

Technical Solutions for Abandonment

The exact details of how facilities will be abandoned will be determined prior to abandonment and agreed with the Government. Therefore it is not possible to determine at this stage exactly what techniques will be used. However this will be in accordance with recognized international standards.

3 ANALYSIS OF ALTERNATIVES

3.1 This Project

For any given road whose pavement structure has badly deteriorated and is, hence, in poor condition, the higher order functions suffer first. In the case of the Kenol - Sagana - Marua road, its international function is to some extent compromised and requires improvement. The same is true of its national role within the Kenyan economy and transport system. What remains, and even that is severely constrained, is the project road's local function. That is, facilitating relatively short local trips along its length linking local communities and settlements such as Nairobi to Nyeri, Nairobi to Embu, Thika to Karatina and so on.

The project road forms an integral section of the main road from port of Mombasa to Addis Ababa in Ethiopia via Nairobi, Isiolo and Moyale. In recent years the international route from Mombasa to Addis Ababa, has taken on a new potential importance. Following the Ethiopia /Eritrea war of 1999/2000 and the resulting loss of use by Ethiopia of the Eritrean ports after Eritrea's independence, all imports by sea to Ethiopia used the Port of Djibouti. But the Djibouti port has natural restrictions to its expansion and an alternative port has become increasingly desirable to Ethiopia.

The route from the Port of Mombasa to Addis Ababa, consequently hold economic advantages for Kenya – given the Ethiopian situation. It has been envisaged that the development of any section of this route could help in solving Ethiopia's import problems and at the same time bring business pportunities, employment, and increased economic prosperity to Kenya and Ethiopia. Thus, this benefit would be realised by the dualling of the section between Kenol and Marua.

Kenol - Sagana - Marua road is part of the National trunk road A2 which links the capital city Nairobi to some of the major commercially and agriculturally rich towns of Central province, Upper eastern region and the Northern Kenya including Isiolo, Marsabit and Moyale.

The upper eastern region of Kenya is known for the production of the highly valuable and perishable Miraa crop which has been rated as high foreign exchange earner for the country. The project road in its current state has been used by Miraa farmers as the major link road from the farm to Nairobi where the crop is repackaged for transportation overseas via the international Airport. Unless an international Airport will be constructed in this region, the project road would still play this important role. The current state of the road (as two way single carriage way) has continued to pose a great challenge to the these farmers resulting into high production cost in terms of high vehicle operation cost and Longer travel times despite the perishability of the crop. Dualling of this section of the road, therefore, would bring about improved economic benefit to these farmers.

The Arid and Semi-Arid region of the northern Kenya, (the greater Marsabit and Moyale region) rely heavily on food products and commercial products emanating from the countries productive regions. In the absence of alternative means of bulk transport like rail or sea, the trunk road A2 is the major bulk transport means available for the transportation of these products. Most of the country's industries are concentrated within Nairobi and its environs with northern Kenya being part of the targeted market.

Administratively, the A2 road to which the project road forms part of is the major link between the county governments of Nyeri, Meru, Isiolo and Marsabit counties with the National government. The project road traverses the averagely rich and populous counties of Muranga, Embu, Kirinyaga and Nyeri.

These counties have vibrant economies stemming from the economic activities as listed above and these activities involve mobility and accessibility of goods and services within the individual counties and within the different counties. This has resulted into high number of local traffic being served by the project road.

Given its proximity to the capital Nairobi, the project road also provides local link between these counties and Nairobi. It is believed that most of the region's economic products find their market in Nairobi with high number of locally generated traffic using the road on daily basis to and from Nairobi.

3.2 NO PROJECT ALTERNATIVE

This alternative means fore-going all the potential benefits of the project listed in the section above. Below is a synthesis of additional direct benefits that will be fore-gone:

1. Despite the fact that the existing road is in fairly good condition allowing good average speeds overall, dualling definitely allows unimpeded progress on a new pavement and thus higher speeds since traffic is completely segregated in each direction.

The traffic counts below give an idea of the volumes

No.	Station	No.	Direction	Orient-ation	M/Cycle Tuk tuk	Medium Car	4x4	Pick-up	Large Bus	H. Tr. 3 axle	Articu. Tr.	TOTALS	
1	Makuyu	1	Kenol/Marua/Kenol	Nbound	33	1,516	621	325	78	139	91	4,581	8,926
	Makuyu	1a		Sbound	66	1,337	538	302	87	93	100	4,346	
2	Makutano J.	2	Makuyu/Sagana/Makuyu	Nbound	59	899	415	179	40	67	74	2,641	5,344
	Makutano J.	2a		Sbound	50	812	367	281	54	55	62	2,703	
2	Makutano J.	3	Makuyu/Embu/Makuyu	Nbound	178	638	212	216	34	47	20	2,202	3,934
	Makutano J.	3a		Sbound	126	442	163	170	16	63	34	1,732	
2	Makutano J.	4	Embu/Marua/Embu	Nbound	86	91	24	39	1	7	5	391	751
	Makutano J.	4a		Sbound	160	65	18	27	1	6	0	360	
3	Sagana St.	5	Kenol/Marua/Kenol	Nbound	336	517	271	141	52	64	60	2,097	4,625
	Sagana St.	5a		Sbound	421	650	340	162	37	80	70	2,528	
3	Sagana St.	6	Kenol/Kerugoya/Kenol	Nbound	107	245	78	64	2	16	4	767	1,543
	Sagana St.	6a		Sbound	115	270	75	67	2	12	4	777	
3	Sagana St.	7	Kerugoya/Marua/Kerugoya	Nbound	398	305	66	68	10	13	5	1,134	2,407
	Sagana St.	7a		Sbound	488	332	64	86	11	12	4	1,273	
3	Sagana St.	8	Kenol/Murang'a/Kenol	Nbound	499	336	76	88	5	17	8	1,227	2,584
	Sagana St.	8a		Sbound	531	350	88	107	3	19	11	1,357	
3	Sagana St.	9	Murang'a/Marua/Murang'a	Nbound	356	143	29	49	4	5	3	730	1,428
	Sagana St.	9a		Sbound	350	133	22	42	3	14	6	698	
4	Karatina J.	10	Sagana/Marua/Sagana	Nbound	358	718	291	189	49	50	78	2,851	5,339
	Karatina J.	10a		Sbound	335	672	268	178	64	72	44	2,488	
4	Karatina J.	11	Sagana/Kerugoya/Sagana	Nbound	77	106	23	103	0	13	2	482	739
	Karatina J.	11a		Sbound	87	85	11	26	0	0	1	257	
4	Karatina J.	12	Kerugoya/Marua/Kerugoya	Nbound	240	419	76	96	9	1	1	1,170	2,100
	Karatina J.	12a		Sbound	223	313	48	72	6	7	2	931	
5	Marua J.	13	Karatina/Isiolo/Karatina	Nbound	40	335	199	73	19	101	51	1,315	2,653
	Marua J.	13a		Sbound	34	311	214	115	25	64	44	1,338	
5	Marua J.	14	Karatina/Nyeri/Karatina	Nbound	76	647	206	154	21	20	14	1,759	3,528
	Marua J.	14a		Sbound	45	661	215	132	43	13	17	1,769	
5	Marua J.	15	Isiolo/Nyeri/Isiolo	Nbound	64	89	26	25	0	2	0	282	501
	Marua J.	15a		Sbound	58	68	21	22	1	2	0	220	

2. The new road will improve travel times and if travel times decrease passengers would be expected to increase their trip frequency (i.e. demand for travel would go up) in all directions and for all trips that include wholly or partially the project road in their itinerary (provided the decrease represented a significant portion of current travel time).

   So for example trips using the project road along its entire length from, say, Kenol to Marua, would experience a perceptible improvement after dualling. Trips that use the project road up to, say, Makutano Junction or Karatina before turning off towards Embu or Kirinyaga, Muranga etc. would experience a lower proportional decrease but still much more than trips originating in, say Mombasa or Kisumu.

3. Road User Costs (RUCs) and Road Agency Costs (RACs). ***Savings (reductions) in RUCs and RACs are considered as 'benefits'.*** When a road improvement is undertaken road users whether as vehicle owners or passengers benefits from reduced vehicle operating costs or reduced travel time costs. These effects are known as Road User Costs and they are composed of Vehicle Operating Costs (VOCs) plus Value of Travel Time costs. In the project area in particular, where road condition is relatively poor, the bulk of benefits is made up of Vehicle Operating Costs savings.

4. Accident reduction benefits are a useful measurable addition to overall benefits of the project. In the project area however there are no reliable statistics on which to base any sort of conclusion.

Qualitatively there will be a reduction in the accident rate. Numbers of accidents are measured as a rate per million veh-kms. This means that in absolute numbers the number of accidents will increase as there will be much more traffic on the project road. However in terms of accidents per million veh-kms there will be a reduction

These benefits that will be foregone must be looked at in the framework of Kenya's overall economic ambitions in the future. Being an important artery to trade and social benefits in the region and nationally, this alternative would be a major drawback.

4 RELEVANT LAWS, POLICY, REGULATORY AND ADMINISTRATIVE FRAMEWORK IN KENYA

4.1 The Kenyan Constitution

Section 42 of the Constitution states that every person has the right to a clean and healthy environment, which includes the right a) to have the environment protected for the benefit of present and future generations through legislative and other measures, particularly those contemplated in Article 69, and b) to have obligations relating to the environment fulfilled under Article 70.

Chapter five of the new constitution covers "Land and Environment" and includes the aforementioned articles 69 and 70. The Chapter seeks to eliminate processes & activities likely to endanger the environment. Article 69 states that 1) The State shall a) ensure sustainable exploitation, utilisation, management and conservation of the environmental and natural resources, and ensure the equitable sharing of the accruing benefits; b) work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya; c) protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities; d) encourage public participation in the management, protection and conservation of the environment; e) protect genetic resources and biological diversity; f) establish systems of environmental impact assessment, environmental audit and monitoring of the environment; g) eliminate processes and activities that are likely to endanger the environment; and h) utilise the environment and natural resources for the benefit of the people of Kenya.

4.2 Legislative Framework

4.2.1 Environmental Management and Coordination Act No 8 of 1999

This ESIA report has been undertaken in accordance with the Part VI of EMCA 1999 and its subsequent supplements. Part II of the Act states that every person is entitled to a clean and healthy environment and has the duty to safeguard the same. An improvement in the drainage system and road curvature whose current status is very poor will, for example ensure that this Section of the Act is well adhered to. The Act also proposes that projects listed under the Second Schedule of the Act must undergo an Environmental and Social Impact Assessment. This Schedule listing includes, amongst others the establishment of roads (No. 3(a).)

Section 73 requires that all operators of projects which discharge effluent or other pollutants to the environment submit to NEMA accurate information on the quality and quantity of the waste thereof. In this respect, it is noteworthy to mention that materials used in road construction have the potential of intoxicating both the above and underground water bodies and as such it is recommended that the project meets the pertinent requirements of the Act which aims to reduce environmental pollution by appropriate controls.

The Section herein below reviews the relevant statutes that guide the development and management of roads projects, so as to ensure environmental and socio-economic sustainability.

4.2.2 Environmental (Impact Assessment and Audit) Regulations, 2003

These Regulations guides on the procedures of conducting an ESIA study by detailing the parameters to be evaluated during the Assessment. It also provides for guidelines on the payment of the ESIA license fees, conducting of environmental audits and development of project monitoring plans. It is also important to note that the legal ESIA license application fee was reviewed from 0.1% to 0.05% vide Legal Notice No. 30 published in the Kenya Gazette Issue Number 14 and that the maximum payable fee is now limited to Kshs. 1million.

This ESIA, as done is in compliance with the requirements of the regulation. It is therefore recommended that the subsequent requirements of the Regulations which include the conducting of continuous monitoring and annual audits be fully observed.

4.2.3 EMCA (Waste Management) Regulations, 2006

These Regulations guides 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, 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 minimum.

As regards waste reduction, it is recommended that the 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 kept 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;

1. NOT allow disposal of any wastes on the highway, street, road, recreational area and public places;
2. Encourage segregation of wastes and grouping them according to their similarity, for example plastics, toxics, organics, etc;
3. Ensure all wastes are deposited in designated dumping sites are approved by the local authority;
4. Ensure all waste handlers engaged by the proponent are licensed by NEMA and possess all relevant waste handling equipment and documentations, such as waste transport license, tracking documents, license to operate a waste yard, insurance cover, and vehicle inspection documents, amongst others;
5. Implement cleaner production principles of waste management namely reduce, reuse and recycle;
6. 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. As regards, road projects involve use of inputs which are likely to generate the fore-mentioned wastes and thus, these will need to be handled as required of by the regulations.

4.2.4 EMCA (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 a minimum of 6m from 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 on the requirements of this regulation and appropriately incorporate the regulations in the project design document.

4.2.5 EMCA (Controlled Substances) Regulations, 2007

These Regulations controls the production, and consumption, as well as exports and imports of controlled substances. As regards, controlled substances are herein grouped into three lists, as below:

- Group 1 list consists of halogenated flourochemicals with ozone depleting substances
- Group 2 list consist of hydrobromoflourocarbons with ozone depleting substances
- Group 3 list consist of bromochloromethane 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 project use.

4.2.6 EMCA (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 regulation warns on operating beyond the permissible noise levels while Section 6 gives guidelines on the control measures for managing excessive noises. 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 institutions, and worship places, amongst others. These areas are permitted exposure to Sound Level Limits of not exceeding 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 regulation gives guidelines on noise and vibration management from different sources. Sections 11, 12 and 13 of the stated part 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.

It is anticipated that the proposed project will generate excessive noise and/or vibration due demolition of structures which have encroached into the road reserves. This noise will essentially originate from the construction equipment and machinery. The above time limits must therefore be observed.

4.2.7 EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006:-

The Regulations requires proponents to conduct 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 regulation provides guidelines on Conservation of threatened species and Part III of the regulation guides on the access to genetic materials. The Section 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 programmes should involve use of certified plant species to prevent them from affecting project area negatively in terms of invading wetlands, vegetation and even farmlands.

4.2.8 EMCA (Fossil Fuel Emission Control) Regulations, 2006

This Regulation aims at eliminating or reducing emissions generated by internal combustion engines to acceptable standards. The Regulations provides 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 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.

4.3 The National Land Commission Act, 2012;

The Act establishes the National Land Commission. The National Land Commission (the "Commission") will have 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.

4.4 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.

Where there is a dispute in the amount awarded, the Commission is required to place the compensation awarded in a special account, which will earn interest at prevailing bank interest rates, before taking possession of the land. This is a new requirement aimed at making the process of compulsory acquisition more just and fair.

4.5 Public Health Act Cap 232

Part IX Section 115 of the Act states that no person or institution shall cause nuisance or condition 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 that local Authorities to take all lawful necessary and reasonable practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to injuries or dangerous to human health. Part XII Section 136 states that all collections of water, sewage, rubbish, refuse and other fluids which permits or facilitate the breeding or multiplication of pests shall be deemed as nuisance.

The Act addresses matters of sanitation, hygiene and general environmental health and safety which is directly related to road projects and associated activities. It is therefore recommended that measures be taken in accordance to the Act in order to safeguard the health of the workers and the public at large.

4.6 Public Roads and Roads of Access Act (Cap. 399)

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 effect this.

4.7 Sexual Offences Act No. 3 of 2006

An Act of Parliament to make provision about sexual offences, their definition, prevention and the protection of all persons from harm from unlawful sexual acts, and for connected purposes.

Section 8, (1) asserts that "A person who commits an act which causes penetration with a child is guilty of an offence termed defilement". Sub section 2 further explain that if the person commits an offence of defilement with a child aged eleven years or less shall upon conviction be sentenced to imprisonment for life. Section (3) clarifies that any person who commits an offence of defilement with a child between the age of twelve and fifteen years is liable upon conviction to imprisonment for a term of not less than twenty years. The Act on section 23 gives more details on any one in 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 to both. This Act therefore gives the public and the workers of the road project the right to report any indecent behaviour to a court of law and protects children and young girls from defilement.

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 willfully 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,

The Act prohibits a wide range of sexual offences including rape of all kinds, indecent acts, incest, pornography, child trafficking, etc.

4.8 Water Act 2002

The Act provides guidelines on use and management of the of the water resources in the country. This Act prohibits the pollution of water. Part II, Section 3 of this Act states that "every water resource is hereby vested in the state, subject to any rights of user granted by or under the Act or any other law". The Act and its subsequent supplementary, namely the Water Regulations of 2007 requires that, any organization/person intending to abstract water for supply to over twenty (20) users should obtain a permit from the Water Resource Management Authority via a Water Users Association (WUA). The Act further notes that, the issuance of the permit is subject to public consultation as well as an Environmental and Social Impact Assessment. It is recommended that abstraction in all water bodies during the road project must involve the local users to avert any possible water related conflicts.

4.9 The Kenya Roads Act, 2007

The Act established the Kenya National Highways Authority in addition to other Authorities with clear and separated mandates. The Kenya National Highways Authority has the responsibility for the management, development, rehabilitation and maintenance of all public roads of class C and above.

For the purposes of discharging its responsibility, the Authority shall have the powers and duties to construct, upgrade, rehabilitate and maintain roads under its control.

4.10 Traffic Act, Chapter 403

This Act consolidates the laws relating to traffic on all public roads. It also prohibits the encroachment on and damage of roads including land reserved for roads. The proposed project is essentially under the provision of this Act.

4.11 Work Injury compensation Benefit Act 2007

This Act provides guidelines for compensating employees on work related injuries and diseases contacted 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.

4.12 The Occupation Safety and Health Act, 2007

This Act applies to all workplaces and workers associated with it; whether temporary or permanent. The main aim of the Act is to safeguard the safety, health and welfare of workers and non-workers.

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

4.13 Labour Relations Act No. 14 2007

This is an Act of Parliament that seeks to consolidate the law relating to trade unions and trade disputes, provide for the registration, regulation, management and democratization of trade unions and employers organizations or federations, promote sound labour relations through the protection and promotion of freedom of association, encourage effective collective bargaining and promotion of orderly and expeditious dispute settlement, conducive to social justice and economic development.

4.14 The Employment Act, 2007

The Act focuses on legislation on matters concerning employment relationship, protection of wages and rights and duties in employment, termination and dismissal, protection of children, insolvency of employer, employment records, employment management, foreign contracts of service and disputes settlement procedures in Kenya.

4.15 Explosives Act Cap 115

Explosives are classified into seven classes under this Act. They include gunpowder, nitrate mixture, nitro-compounds, chlorate mixture, fulminates, explosives of the ammunition group other than ones covered by the Firearms Act and fireworks. The project is expected to use explosives at hardstone quarries. This Act requires the explosives manager of any mine, quarry, excavation or other project in relation to which explosives are used to, inter alia —

I. be responsible for the safety and security of all explosives used, transported or stored, except when the explosives have been handed to the blaster for use;

II. be responsible for the safety of every person not the holder of a valid permit to use blasting materials who may be employed or working on the project, whether under his direct supervision or not, unless he can prove that the person was operating under the direct supervision and control of the holder of such a valid permit at the time of any contravention of these Rules or of any special rules, or accident;

III. be responsible for the enforcement of any special rules made for the regulation, safety and proper discipline of persons employed or for the security of the explosives under his control;

4.16 Kenya National HIV/AIDS Strategic Plan, KNASP 2005/06-2009/10

The plan is linked with the National Development Plan and the National Poverty Eradication Plan 1999 – 2015. The overarching theme is Social Change to reduce HIV/AIDS and Poverty. The goal of the KNASP 2005/06-2009/10 is to reduce the spread of HIV, improve the quality of life of those infected and affected

and mitigate the socioeconomic impact of the epidemic at individual, community, sector and national levels. The priority areas for KNASP 2005/06-2009/10 are three-fold:

- Priority Area 1: Prevention of New Infections
    - The objective of this priority area is to reduce the number of new HIV infections among both vulnerable groups and the general population
- Priority Area 2: Improve the Quality of Life of People Infected and Affected by HIV/AIDS
    - The objective of this priority area is to improve the treatment and care, protection of rights and access to effective services for infected and affected people by HIV/AIDS in Kenya.
- Priority Area 3: Mitigation of Socio-Economic Impact
    - The objective of this priority area is to adapt existing programmes and develop innovative responses to reduce the impact of the epidemic on communities, social services and economic productivity.

4.17 Compliance to the stated legislation

Legislation	Compliance to the legislation
Water Act, 2002	The proposed project does not include any disturbance of jurisdictional waters. However, there will be need to design and implement an effective drainage and sediment control plan to contain excessive sediments that may be washed into the adjacent seasonal stream.
Traffic Act	Engineering design will include road furniture that will assist motorists comply with the Act. The design is based on Kenyan Roads Design Manual
Environmental (Impact Assessment and Audit) Regulations, 2003:-	This ESIA report as done is in compliance with the requirements of the regulation. It is therefore recommended that the subsequent requirements of the Regulations which include monitoring and annual audits be fully observed.
EMCA (Waste Management) Regulations, 2006:-	It is recommended that the 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 kept minimal It is further recommended that the proponent considers the use of recycled or refurbished construction materials including those excavated from the existing roads Ensure all waste handlers engaged by the proponent are licensed by NEMA and possess all relevant waste handling equipment and documentations, such as waste transport license, tracking documents, license to operate a waste yard, insurance cover, and vehicle inspection documents, amongst others
EMCA (Water Quality) Regulations, 2006:-	The contractor must obtain abstraction permits before commencement of the project. In addition he should adhere to the recommended quantities to avert any possible conflicts with local users
EMCA (Controlled Substances) Regulations, 2007:-	It is recommended that the contractor of the proposed road project ensures that equipment, machinery, vehicles and chemicals containing such components are not imported for project use.

EMCA (Noise and Vibration Control) Regulation, 2009:-	The project team should observe the noise regimes for the different zones especially so for working in areas termed as silent zones which include proximity to educational and health institutions. Construction sites near the silent zones should be allowed maximum noise level of 60 dB (A) during the day, whilst night levels are maintained at 35 dB (A).
EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006:-	Landscaping programmes should involve use of certified plant species to prevent them from affecting project area negatively in terms of invading wetlands, vegetation and even farmlands. Erosion prevention techniques used by the contractor should not involve use of untested exotic plant species that might eventually colonize the project area
EMCA (Fossil Fuel Emission Control) Regulations, 2006:	The contractor must use clean fuels, as well as use of catalysts and inspection procedures for engines and generators must be observed at all times All equipments and machinery used by the contractor must be kept to manufacturers specification so as to discourage incomplete combustion resulting from poorly maintained machinery
Relevant Lands Acts	Although the Acts allow the government to use any land for public good, where local land owners are required to ease their land, adequate notice must be issued prior to any demolitions For those who have obstructed the right of way, prior notice should be served on the intention to demolish while those who will be required to ease their land, compensation by the proponent must follow.
Public Health Act Cap 232	The contractor must ensure all collection of water, sewage, rubbish, refuse and other fluids which permits or facilitate the breeding or multiplication of pests are avoided especially at workmen camp site. The contractor must provide sanitary facilities to prevent open defecation in the project area
Public Roads and Roads of Access Act (Cap. 399)	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 effect this
Physical Planning Act, 1999	Section 30 states that any person who carries out development without development permission will be required to restore the land to its original condition. The project road already exists and therefore no conflicts are expected as far as the Act is concerned
Work Injury compensation Benefit Act 2007	All workers contracted during the project implementation phase must have the required insurance covers so that they can be compensated in case of injuries while working. The contractor must provide for compensating employees on work related injuries and diseases contacted in the course of employment and for connected purposes
Use of Poisonous Substances Act, Cap 247	All machinery / equipment imported by the contractor must be free from poisonous substances. Workers who shall be contracted by the contractor must be protected against risks of poisoning by toxic substances arising from the use, storage, importation, sale, disposal and/or transport
Forest Act, Cap 385	There exists no major forest cover in the project area. However, the contractor is advised against firewood collection to be used on workmen camp on any patch of vegetation along the road corridor.

Sexual offences Act	Code of conduct for contractors are necessary and HIV and AIDS prevention measures are mandatory

4.18 National Environmental Administrative Framework

4.18.1 The National Environment Council

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

4.18.2 The National Environment Management Authority

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 shall review the ESIA report for the proposed project, visit the project site to verify information provided in the report and issue an ESIA license if it considers that all the issues relevant to the project have been identified and mitigation measures to manage them proposed.

4.18.3 The Standards and Enforcement Review Committee

In addition to NEMA, the Act provides for the establishment and enforcement of environmental quality standards to be set by a technical committee of NEMA known as the Standards and Enforcement Review Committee (SERC). NEMA through EMCA has established standards for the various environmental parameters that require management and these include the water quality standards, noise and vibration control standards, and the waste management standards, amongst other. The committee through the Compliance and Enforcement Department of NEMA monitors the compliance level of various projects to ensure pollution control standards are implemented. The committee also follows on pollution complaints reported by the public.

4.18.4 The County Environment Committees

The County Environment Committee contributes to decentralization of activities undertaken by NEMA and thus enables local communities to have access to environmental management information. It also enables the County Environment Committees to conduct quick site visits and review reports of localized proposed project on time.

4.19 Relevant National Social Policies

4.19.1 The National Poverty Eradication Plan (NPEP)

The objective of the NPEP is to reduce the incidences of poverty in both rural and urban areas by 50 percent by the year 2015, as well as to strengthen the capabilities of the poor and vulnerable groups to earn income. It also aims to narrow the gender and geographical disparities as well as create a healthy, better-educated and more productive population. This plan has been prepared in line with the goals and commitments of the World Summit for Social Development (WSSD) of 1995. The plan focuses on the four WSSD themes of poverty eradication; reduction of unemployment; social integration of the disadvantaged people and creation of an enabling economic, political, and cultural environment which can be achieved through developing the transport and communication sector. The plan is implemented by the Poverty Eradication Commission (PEC) formed in collaboration with Government ministries, Community Based Organization (CBO), private sector, Non-Governmental Organization (NGO), as well as bilateral and multilateral donors. Through employment opportunities, the contractor is expected to positively contribute to poverty eradication while free flow of goods and services during operation will enhance timely profits.

4.19.2 Kenya National Aids Strategic Plan (KNASP III)

The communication strategy aims at supporting KNASP III to achieve its results through advocacy, information dissemination and social mobilisation. The strategy focuses on communicating KNASP III to stakeholders and providing guidelines for programmatic communication programmes. In this regard, the communication strategy targets a wide range of audiences including policy makers, development partners, implementing organisations, the media and key institutions coordinating the national response. The key components of this strategy are as follows:

1. KNASP governance, financing and strategic information: This component lays out strategies for communicating KNASP III, the coordination structures and strategic information, leadership, roles and policies and the KNASP III resources mobilisation and allocation.

2. Advocacy, communication and social mobilisation for the National HIV and AIDS Programme component which provides guidelines for communication programmes for HIV prevention, treatment and care and social protection programmes.

3. This strategy provides guidelines for development of communication programmes and tools. The stakeholders should use it as a guide. It is mean to support programming of communication programmes and mainstreaming communication in service provision.

4.19.3 The National Policy on Gender and Development

The overall objective of the policy is " to facilitate the mainstreaming of the needs and concerns of men and women in all areas in the development process in the country. To this end, the policy identifies eight critical areas of concern: the economy; poverty and sustainable livelihoods; law; political participation and decision-making; education and training; health and population; the media; and policy implementation framework and resource mobilisation.

The policy has made several important suggestions in respect of legal, regulatory and institutional reforms that can be undertaken to ensure that obstacles to equitable sustainable development are removed. The policy arose from the Government's realisation that without a coherent and comprehensive overall framework for guiding the different sectors and agencies involved in development, tremendous resources may continue to be lost unless the thrust of mainstream development directly addresses gender concerns. The Policy recognises traditional development theories have not facilitated the participation of women in strategic areas and positions of power and influence because they are based on traditional assumptions of the roles and responsibilities of women and men. The approach also recognises that without quality gender disaggregated data, the planning and programming process cannot be efficient and productive.

With regard to the environment, the policy advocates for programmes that take into consideration environment and natural resource management issues that concern women, men, girls and boys. The Government realizes that certain environmental issues have specific relevance to women. This could be through the negative effects of some environmental concerns which could have adverse effects on the female population or some special skills and knowledge women could possess in resolving environmental problems.

For this project, it is foreseen that a majority of jobs would favour men due to the nature of the works (heavy equipment, site clearing, drilling, excavating, blasting and many long hours away from home. Social norms restrict women's sphere of activity but they are also likely to benefit if the contractor employs a quota system that would oversee a certain number of women given employment for unskilled labour. Women are also likely to take advantage of the influx of population in the area to be involved in small and medium enterprise/trade that would boost their economic well-being.

4.20 African development bank safeguard policies

The AfDB safeguards policies aim at identifying potential environmental and social impacts of their funded projects with the aim of preventing and mitigating undue harm to people and the environment in the development process. The policies provide guidelines for the banks and borrowers in the environmental and social management as part of implementation of programs and projects. The borrower is expected to comply with these policies in addition to their own domestic environmental policies and legislation.

4.20.1 AfDB Integrated Safeguard System

The objective of the AfDB's ISS is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for the bank and borrowers in the identification, preparation, and implementation of programs and projects.

The purpose of the ISS is to ensure social and environmental sustainability of projects it supports. The ISS is designed to promote the outcomes by protecting the environment and the potentially adverse impacts of the projects. The safeguards aim to:

Avoid adverse impacts of projects on the environment and affected people, while maximizing potential development benefits to the extent possible. Minimize, mitigate and /or compensate for adverse impacts on the environment and affected people when avoidance is not possible and help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

The bank requires that borrowers/clients comply with safeguards requirements during project preparation and implementation. The Integrated Safeguards Policy Statement sets out the basic tenets that guide and underpin the Banks approach to environmental safeguards.

Operational safeguard 1: Environmental and social assessment- These overarching safeguards governs the process of determining a project's environmental and social assessment requirements.

Operational Safeguard 2: Involuntary resettlement land acquisition, population displacement and compensation- This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement designed to improve the operational effectiveness of those requirements.

Operational safeguard 3: Biodiversity and ecosystem services- This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management into operational requirements.

Operational Safeguard 4: Pollution prevention and control, hazardous materials and resource efficiency-This safeguard covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting ,that other multilateral development banks follow.

Operational Safeguard 5: Labour conditions, health and safety- This safeguard establishes the banks requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development banks.

4.20.2 Environmental Assessment

The principles of the policy require the environmental assessment process to undertake the following:

- Evaluate adequacy of existing legal and institution frameworks, including applicable international environmental agreements. This policy aims to ensure that projects contravening the agreements are not financed.
- Stakeholder consultation before and during project implementation.
- Engage service of independent experts to undertake the environmental assessment.

- Provide measures to link the environmental process and findings with studies of economics, financial, institutional, social and technical analysis of the proposed project.
- Develop programmes for strengthening of institutional capacity in environmental management.

The requirements of the policy are similar to those of EMCA, which aim to ensure sustainable project implementation. Most of the requirements of this safeguard policy have been responded to in this report, by evaluating the impact of the project, its alternatives, existing legislative framework and, conducting public consultations and by proposing mitigation measures for the potential impacts identified.

4.20.3 Involuntary Resettlement

The objective of this policy is to avoid where feasible, or minimize, exploring all viable alternative project designs, to avoid resettlement. This policy is triggered in situations involving involuntary taking of land and property for purposes of re-alignments and RoW preservation. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts.

This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by (a) the involuntary taking of land resulting in (i) relocation or loss of shelter; (ii) loss of assets or access to assets, or (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to project appraisal of proposed projects.

This policy will be triggered as the project causes the involuntary taking of land and other assets resulting in:

1) Relocation or loss of shelter;
2) Loss of assets or access to assets;
3) Loss of income sources or means of livelihood, whether or not the affected persons must move to another location;
4) Loss of land.

4.20.4 Policy on Access to Information

The Bank's policy on access to information allows public access to information in its possession. In disclosing information related to borrowers in the case of documents prepared or commissioned by a borrower (in this instance, safeguards assessments and plans related to environment and resettlement the Bank takes the approach that the Borrower provides such documents to the Bank with the understanding that the Bank will make them available to the public.

1.1.1 Alignment of AfDB and GOK Polices relevant to this ESIA

Both the Bank safeguards and GoK laws are generally aligned in principle and objective:

- Both require Environmental Assessment before project design and implementation (which also includes an assessment of social impacts).
- The Bank requires that stakeholder consultations be undertaken during planning, implementation and operation phases of the project which is equivalent to the EMCA requirements.

- Additionally, statutory annual environmental audits are required by EMCA.

In Kenya, it is a mandatory requirement under EMCA 1999 for all development projects (Schedule Two) to be preceded by an ESIA study. Thus, under the Laws of Kenya, environmental assessment is fully mainstreamed in all development process consistent with AfDB policies.

5 ENVIRONMENTAL BASELINE CONDITIONS

5.1 General

The proposed Kenol-Sagana-Marua dual carriageway road project traverses the three Counties of Murang'a, Kirinyaga and Nyeri and also forming the border between Murang'a and Machakos County before passing through Kirinyaga County. The proposed road will start at Kenol (district headquarters for Makuyu) and end at Marua on the junction to Nanyuki with Nyeri Road (A2) within Nyeri municipality. The road will serve as connection of the central region hinterland and is the road to Ethiopia through Nanyuki, Isiolo and Marsabit.

Plate 2: End of Thika Dual CArriageway and Beginning of Project

The project road, covering a distance of approximately 88 km is a mixed urban/rural road connecting Thika Town with the farming communities of Muranga, Kirinyaga and into Nyeri Municipality with effects fanning out as far as Embu, Meru, Tharaka Counties and beyond. The road project will therefore have immense impacts on the social growth and economic development of these Counties.

The road will create a dependable and efficient road transport infrastructure for access to resources, delivery of farm inputs and produce there from to markets as well as easy access of basic services (health, trading centres, water, etc.) within these counties and beyond. The three counties of Murang'a, Kirinyaga and Nyeri that the road traverses are located in Central Kenya between the Aberdare ranges and Mt Kenya and generally within what is also known as the Upper Tana Catchment.

5.2 Administrative setting

The proposed road passes through 3 counties of Murang'a, Kirinyaga and Nyeri, although it will also pass through the border of Murang'a and Machakos before entering into Kirinyaga and eventually Nyeri County. Murang'a County is located in central Kenya bordering Nyeri County to the North, Nyandarua to the West, Kiambu to the South and Kirinyaga County to the East and has an area of 2,559 km^2. The County has 7 constituencies 7 (Kandara, Kigumo, Maragua, Kangema, Kiharu, Mathioya and Gatanga) capital is in Murang'a Town and 3 districts Muranga North and Muranga South (Maragwa) and Gatanga. There are 5 Local Authorities (Town Councils of Kangema, Maragwa, Kandara, and Makuyu, County Councils of Muranga and Maragwa and Municipal Council of Murang'a) and the county capital located in Murang'a town.

Kirinyaga County is located in central Kenya, and borders the following counties: Meru to the North, Embu to the North East, East and South, Murang'a to the South West, and Nyeri to the West and has an area

of 1,479.1 Km^2. The County has 4 Constituencies (Mwea, Gichugu, Ndia and Kerugoya/Kutus) and the county capital is in Kerugoya Town. The county has 4 districts (Kirinyaga East, Kirinyaga West, Kirinyaga Central and Kirinyaga South) and 3 Local Authorities (Municipal Council of Kerugoya, County Council of Kirinyaga, and Town Council of Sagana).

Nyeri County has an area of 3,337 Km^2 is also located in Central Kenya bordering the following counties; Laikipia to the North, Meru to the North East, Kirinyaga to the East, Muranga to the South, and Nyandarua to the West. There are 6 Constituencies (Tetu, Kieni, Mathira, Othaya, Mukurweini and Nyeri Town) and 6 d**istricts** (Kieni East, Kieni West, Mukurweini, Nyeri East, Central and Nyeri South). The county has 4 Local Authorities (Nyeri County Council, Othaya Town Council, and Municipal Councils of Nyeri and Karatina) with the county capital being in Nyeri Town.

Figure 9: Location of the three counties covered directly by the proposed road

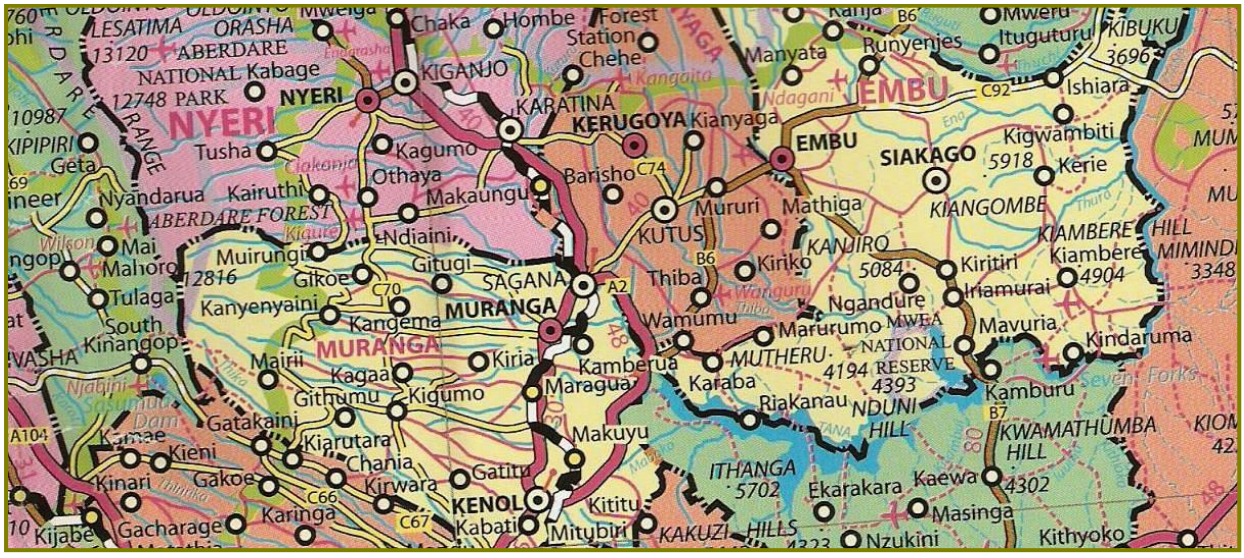


Figure 10: Detailed location of the proposed project area

5.3 Topography and Relief

The Central Kenya region can be subdivided into three distinct but broad topographic units which are related to altitude: (1) the Mt Kenya volcanic summits and the Aberdare ranges; (2) the slopes of Mount Kenya and the Aberdares; and (3) the Mwea-Masinga Plains (Figure 11). The Aberdare ranges (with an altitude of over 2000 m) together with Mount Kenya (a central volcano reaching a height of 5200 m a.s.l.) form major topographic features of the Central Kenya region. The slopes of Mount Kenya and the Aberdares essentially constitute areas lying between 1200 and 2500 m a.s.l.

The Aberdares form a volcanic mountain range stretching 160km and rising to about 4,000m. The mountain range is heavily dissected and characterized by steep slopes roughly above the 2200m contour. Notable slopes are also observed in the transition between the volcanic and basement rock systems. This topography forms the mail catchment of the rivers that cross the project road.

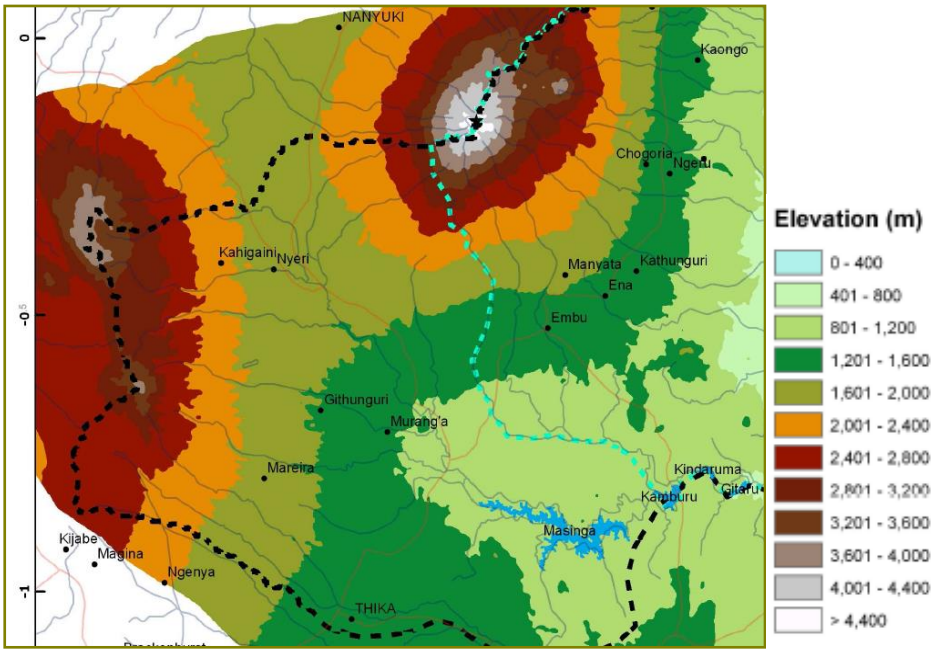


Figure 11: Topography of the central Kenya region and proposed road project areas

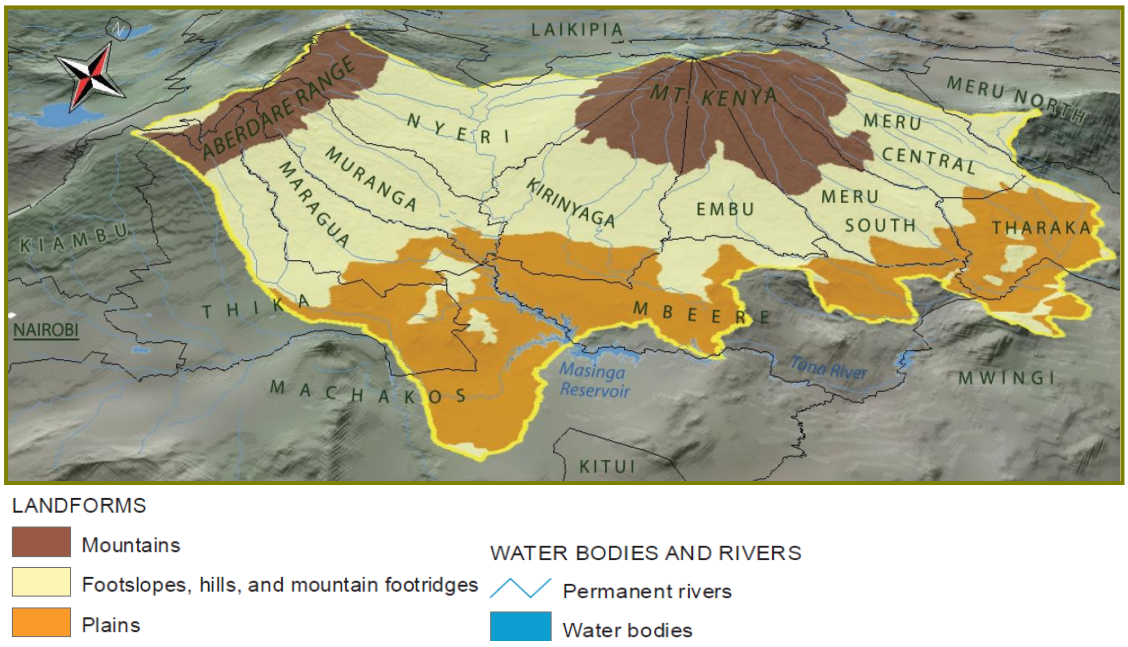


Figure 12: Topographical setting and landforms in the Central Kenya Region

The main streams forming the drainage system in the region include the Chania, Thika, Mathioya, Sagana, Ragati, Thiba, Nyamindi, Murubara and Rupingazi. The cultivated hillslopes of the Mathioya and Sagana basins have mean gradients of 0.24 and 0.27 while the upper cultivated hillslopes of Mount Kenya within the Thiba basin have a mean gradient of 0.15. This indicates that the Mathioya and Sagana sub-basins, and indeed most of the sub-basins draining the Aberdares, have much steeper slopes than the equivalent slopes of Mount Kenya within the Thiba basin. The forested portion of Mount Kenya within the Thiba basin has a mean gradient of 0.14 while the lower cultivated slopes of the Thiba basin exhibit a mean gradient of 0.07.

The Mwea-Masinga Plains occupying the low-lying areas of the southern central Kenya region are generally found at altitudes below 1200 m. In these areas, the hillslopes are long (averaging 1000 m) with low overall gradients and gently concave profiles. They have a mean gradient of 0.04.

5.4 Climate

The climatic conditions in the proposed project region in central Kenya vary widely and respond to the Inter-Tropical Convergence Zone, but considerably also influenced by topography and the relief created by the high land masses in the region i.e. Aberdare Ranges and Mount Kenya. The two land masses mitigate high temperature and influence the amount of rainfall. On the highlands, the temperatures are lower and the rainfall heavier than on the lowlands, in effect dividing the region into two climatic regions.

In general, the proposed project area experiences an equatorial type of climate and tropical weather dominated by seasonal monsoons. The rainfall regime is bimodal with the long rains coming between March and June and short ones between October and December. Between June and September the precipitation mostly falls as drizzle with January and February being the two dry months. The average annual rainfall ranges from as low as 410mm in the lower areas to 2100 mm in Mt. Kenya and the Aberdare ranges. Rainfall increases with altitude and the dry seasons are more marked in the southern and eastern parts of the region.

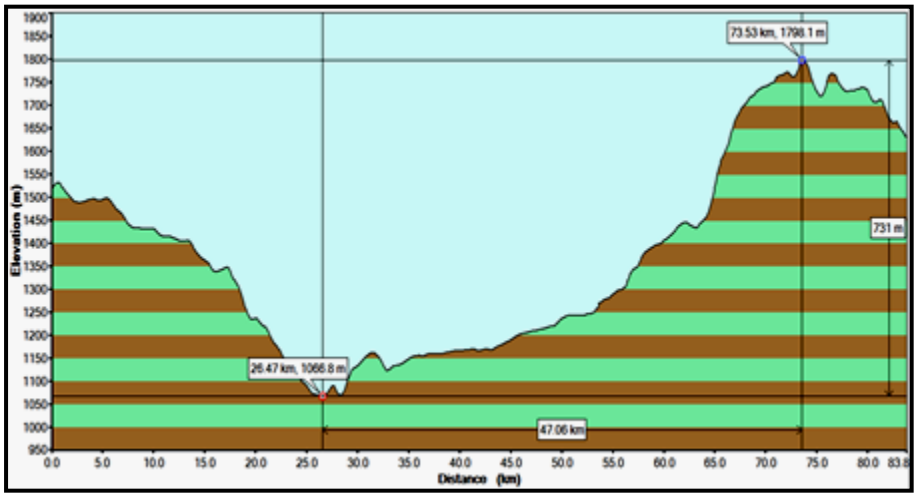


Figure 13: Vertical Profile of the road as determined by hand held GPS

Areas above 1800 m lying on Tertiary volcanics overlain by clay loam soils receive rainfall of well over 1800 mm and support dense evergreen forest which in turn enhances infiltration rates and protects the soil against possible rain-splash erosion. The areas receiving between 1400 and 1800 mm of rainfall lie above 1400 m. These areas with steep cultivated slopes are covered with clay loam soils. Rainfall of these areas continues to decrease from the cultivated slopes of the sub-basins draining the Aberdares to those of the Thiba basin in the Kirinyaga and Embu districts.

Between elevations of about 1100 and 1400 m, rainfall decreases from approximately 1400 mm at 1400 m to 900 mm at 1100 m. Below 1000 m, rainfall is generally too sparse to support anything but marginal

farming and rainfall continues to decrease to less than 500 mm eastwards and southwards to parts of Mbeere and Kamburu respectively.

Apart from the medium and high potential areas where the rainfall is well distributed throughout the year, annual variations in the low rainfall regime areas are relatively large and the rainfall is quite erratic. In the upper parts close to the Aberdares along Murang'a *(*North & South*)* and parts of Nyeri, besides the two seasons, there is short season of light drizzles occurring between July and October.

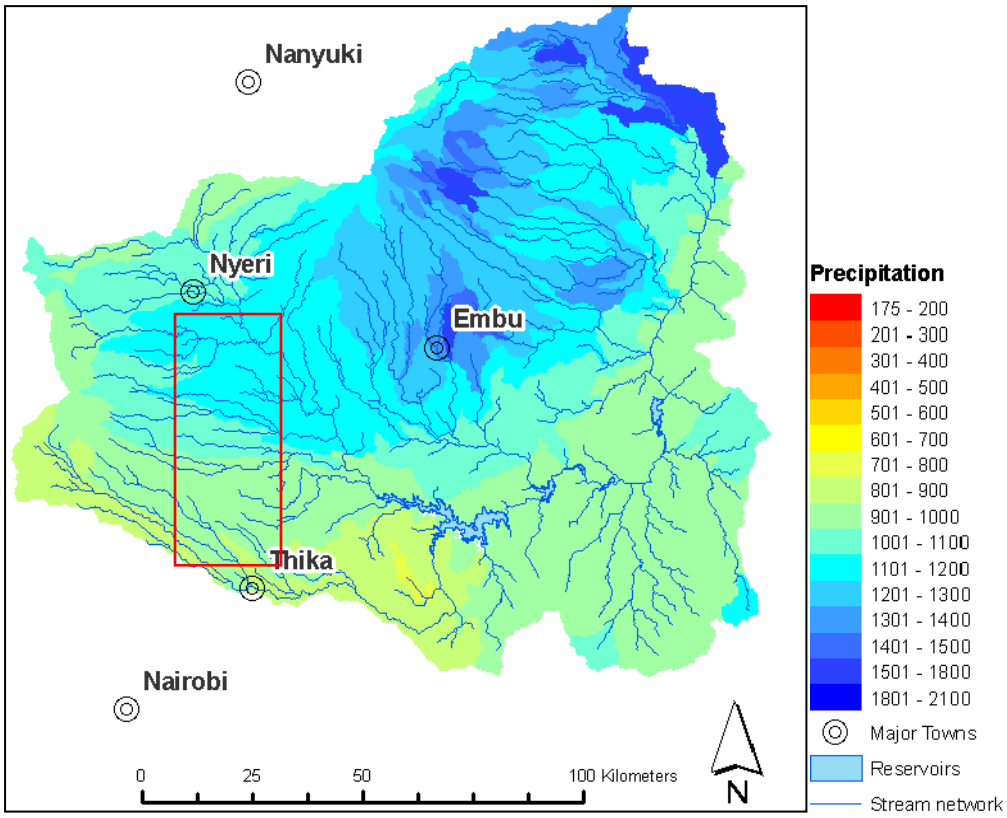


Figure 14: Rainfall distribution in Central Kenya region

5.4.1.1 Potential evapo-transpiration and temperature

The average annual potential evaporation within the central region ranges between 500 mm per year in the mountain regions rising to 1700 mm in the lower areas, meaning that most areas below the forest zone experience a rainfall evaporation deficit. As a consequence, the forest and moorland zones provide most of the discharge of the rivers during the dry periods (Notter *et al*. 2007). Temperatures vary with altitude with the eastern lower altitude areas having a mean annual temperature range of between 26 ^{o}C and 30 ^{o}C. Mt. Kenya and the Aberdare ranges have between 14 ^{o}C and 18 ^{o}C. In the high potential areas, minimum temperature can be as low as 6^{o}C. Temperatures are moderate in medium potential areas. In most parts of the region, July and August are the coldest months of the year while the hottest months are March and October. For the entire central Kenya region, average annual relative humidity ranges from about 70% in the morning hours to about 45% in the afternoons.

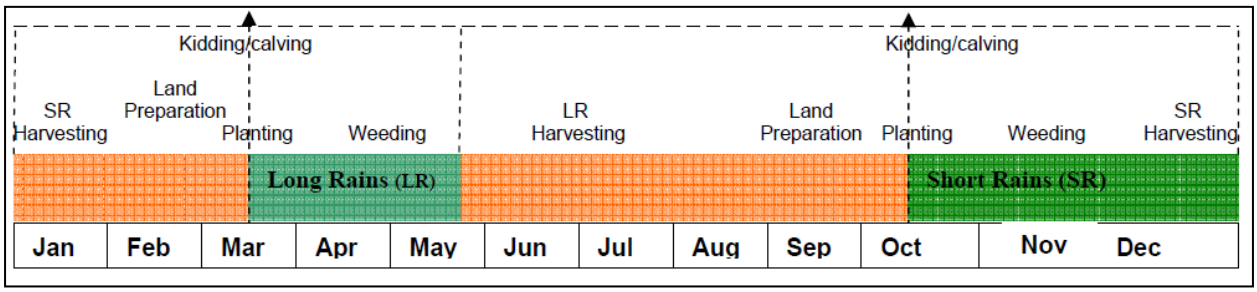


Figure 15: Seasonal calendar in Central Kenya

5.5 Geology and Soils

5.5.1 Geology

The geology of Central Province is complex. The northern central part of the region can be divided in two main geological structures: in the west volcanic rocks of the Cenozoic in the west and metamorphic rocks of the Mozambique belt in the east (Figure 16). Mount Kenya, an extinct volcano formed between 100-4000 million years ago (IFAD/UNEP/GEF, 2004), is located in the northwest of the region. The last eruption was 1.6-3.1 million years ago (Baker, 1967). Around the major lakes in the Upper Tana, patches of Precambrian intrusive rocks occur.

The most obvious geological feature in the south of the region is a line of gneiss hills, running from south-east to north-west. Further, north basement rocks of Precambrian origin are covered by volcanic lavas from Tertiary and recent origin. In contrast to the eastern and southern parts in the western and northern parts the thickness of the volcanic layer rises resulting in hilly country being dissected by a number of rivers and valleys. Volcanic activity in the area is closely connected with the tectonic activities in the Rift Valley system. Streams from the Aberdare Range in the west follow the major geological boundaries and create deeply incised V-shaped valleys. The landscape generally slopes eastwards. The main topographical features are deep valleys with an average height of 50 metres between the crest and the slope base.

Most of Nyeri, Kirinyaga and Muranga Counties are covered with Tertiary volcanic rocks stretching from the Aberdares to Mt. Kenya slopes. A greater portion of the northern part of the county is covered with volcanic Kenyte and Kenyte agglomerates. Basement rocks occur in limited patches to the southeast of Nyeri Town towards Murang'a. Alluvium deposits are found along major river valleys and moraines on mountain slopes around Mt. Kenya. The rest of the county consists mainly of volcanic basalt. Apart from basalts, other tertiary volcanic rocks found in the district are phonolites and trachytes.

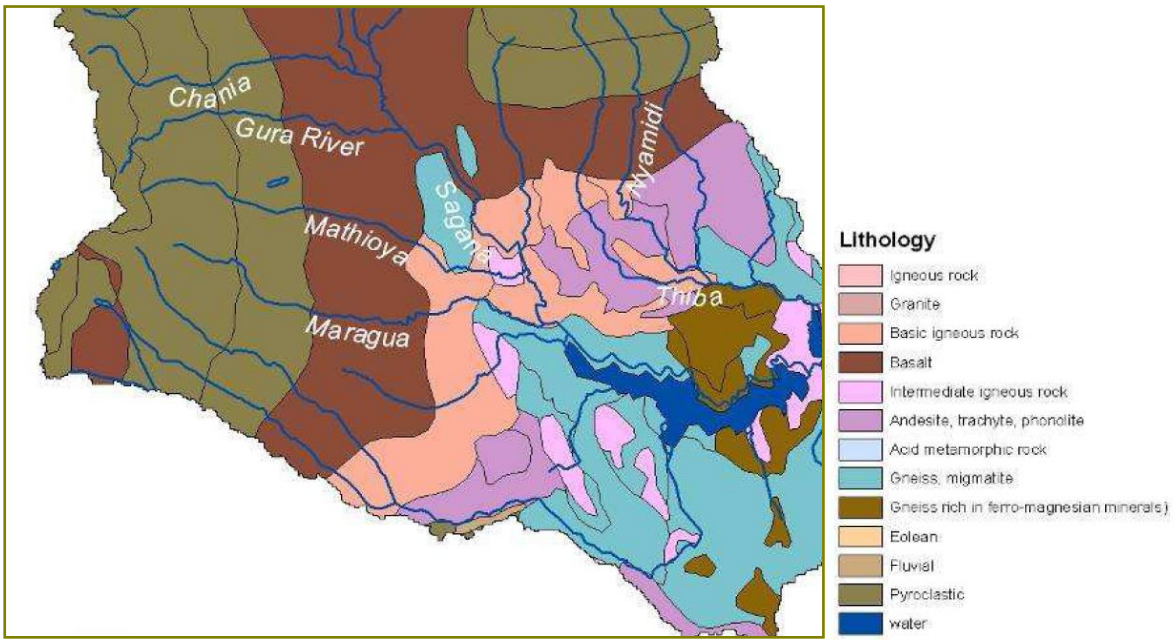


Figure 16: Geological formations in Central Kenya region

The rest of the counties is made up of volcanic rock, Tertiary volcanics on the uppermost reaches of Mount Kenya and on the southern slopes and Quaternary volcanics in the Mount Kenya forest, The upper and middle-slopes of the mountain are underlain by basalts, phonolites and kenytes which flowed from the central and subsidiary vents of the volcano. The northern slopes of the mountain are pock-marked with adventive cones and vents of mid-Pleistocene age. Many of these are above the Mount Kenya forest boundary or are in the northern unpopulated areas.

Geology in relation to the alignment

The first 12.25 kilometres from Kenol through Makuyu, along the project route lies on Tertiary and Pleistocene volcanics, which is overlain by black cotton soils for the first 9 kilomenters and lateritic soils for the rest of the section.

The region from chainage 12+250 to 28+500 is covered with Basement System pediments overlain with variable sandy soils and black cotton soil towards the end of the section.

Chainage 28+500 to 32+500 is covered with the lateritic soils of Kapiti phonolite volcanics and Chainage 32+500 to 47+000 is covered with black cotton soils of Tertiary and Pleistocene volcanics of the Mwea plain.

The above details are illustrated in Figure 17 below.

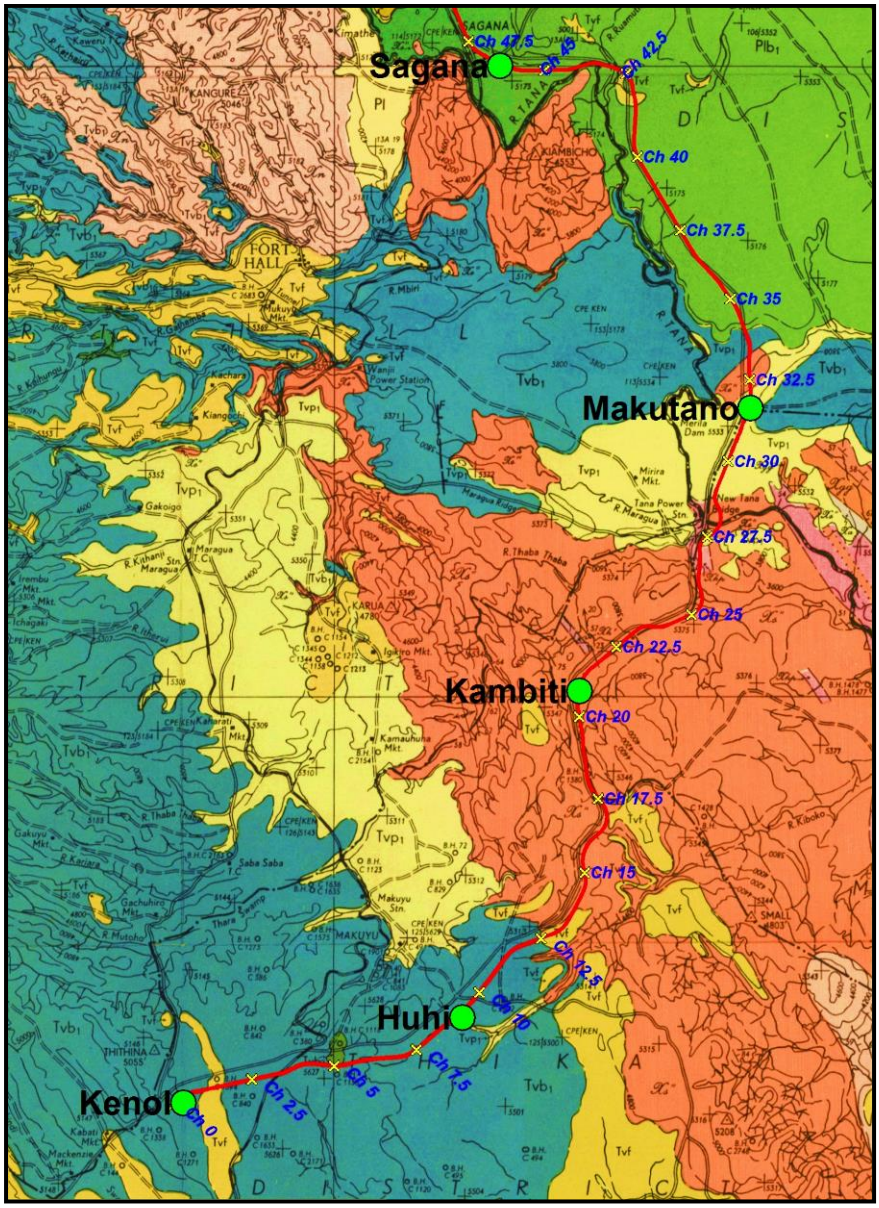


Figure 17: Geological map covering 0+000 to 47+000

Ch = Chainage

T_{vb1} = Tertiary and Pleistocene volcanics

P_{lb1} = Tertiary and Pleistocene volcanics of the Mwea plain

T_{vp1} = Kapiti phonolite

$K_{s"}$ = Basement System Pediments

Contract 2

The first 24.5 kilometres from Sagana through Kibingoti upto Karatina, along the project route is covered with black cotton soils of Tertiary and Pleistocene volcanics of the Mwea plain, followed by 7km of soft, weathered yellowish brown tuffs overlying dark gray trachyte tuff with feldspar and small pumice fragments.

The last section, (4.85km) is made of Basement System inliers beneath the Simbara Series basalt and agglomerates containing olivine basalt, porphyritic basalt and olivine-nephelinite fragments.

The above details are illustrated in Figure 18 below.

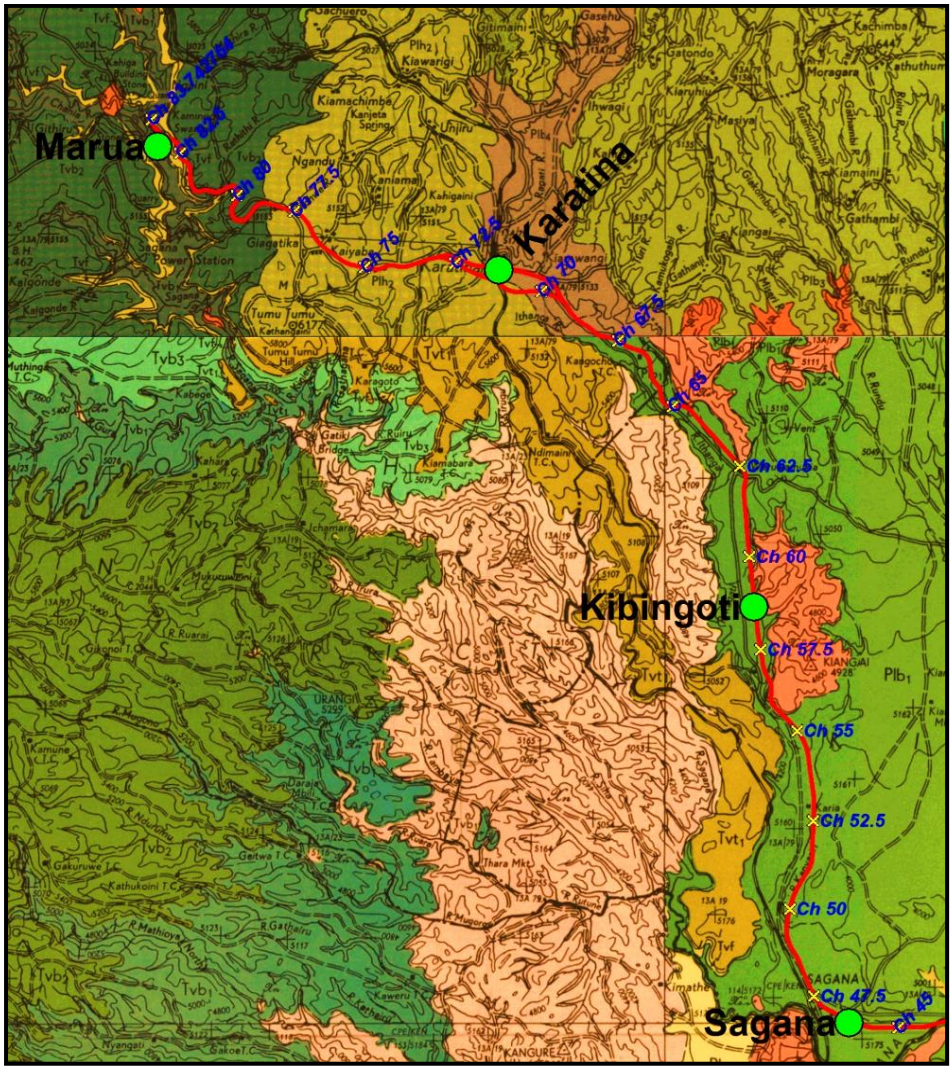


Figure 18: Geological map covering Sagana to Marua

Ch = Chainage

T_{vb2} = Simbara Series basalt and agglomerates

P_{lb1} = Tertiary and Pleistocene volcanics of the Mwea plain

P_{lb4} = Tertiary and Pleistocene volcanics of the Mwea plain

P_{lh2} = Trachyte tuff with feldspar and small pumice fragments

5.5.2 Soils types

The soils of the Mt. Kenya and the Aberdare regions are classified into four broad groups. (Speck, 1978, Sombroek *et al*, 1982): In the highest part of Mt. Kenya (> 4000 m), the soils are shallow and consist of very stony dark loams with high organic matter and low bulk density. They include Leptosols, Regosols and the soils of valley bottom, Greysols (Figure 19). The soils of the upper slopes between 2,400 and 4000m, have dark surface horizons, are rich in organic matter, have low bulk density and are mainly formed from young pyroclastic rocks. These soils include Regosols, Histosols and Andosols.

The soil characteristics of the lower slopes (generally below 2,600m) are influenced by the amount of rainfall received in those areas. Soils in the forested mountain areas with high rainfall amounts are intensively red with considerable amounts of clay. The main soil groups are Nitisols, Cambisols and Andosols. The lower zones of both mountains are mainly basement rocks with some of the areas covered by sediments from the upper zones. The basement system on the Aberdares is exposed up to higher altitudes (c.a. 1500masl) than on Mt. Kenya (c.a. 1200masl).

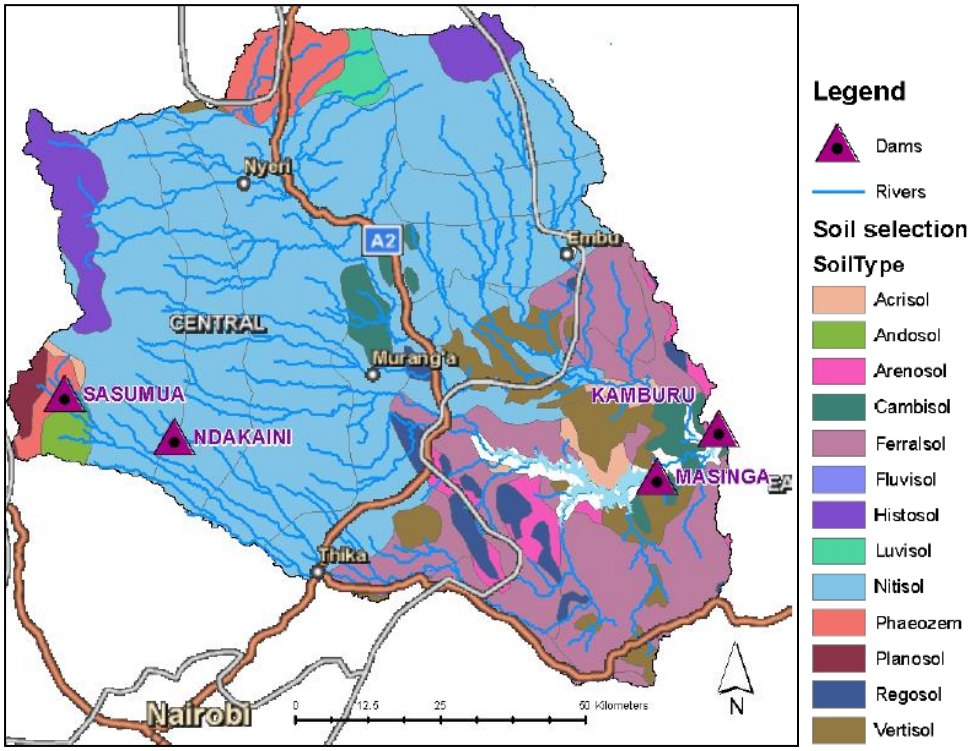


Figure 19: Dominant soil types and main road network from Thika to Nyeri

Recent geological processes in the central Kenya region have been limited to soil formation and excavation of river valleys. Red-brown highly humic soils from volcanic rocks, Nitisols in the east and Andosols in the west, are most common in the area (Sombroek et al. 1982). These soils have developed over deeply weathered volcanic rocks. Due to favourable climatic conditions they are comparatively fertile Humic Nitisols are dominant in the region. They have formed on volcanic deposits at high altitude. In general, these soils are highly resistant to erosion and have good fertility. They are mostly used for the cultivation of coffee and maize. Other soil types in the area include Andosols, Vertisols, Cambisols, Ferralsols and Leptosols (FAO, 1990). This is occurring in the areas under coffee cultivation.

5.5.3 Soil erosion

The main types of erosion occurring in the area are splash erosion, rills, gullies, sediment deposition and land slides. A steep slope, low vegetation cover, erosive soil, high intensity rainfall and improper soil, crop and water management are factors leading to, or increasing, erosion. Erosion occurrence is more common in areas where Regosols are the dominant soil type (indicated by black circle - Figure 20) more evident as rills or gullies.

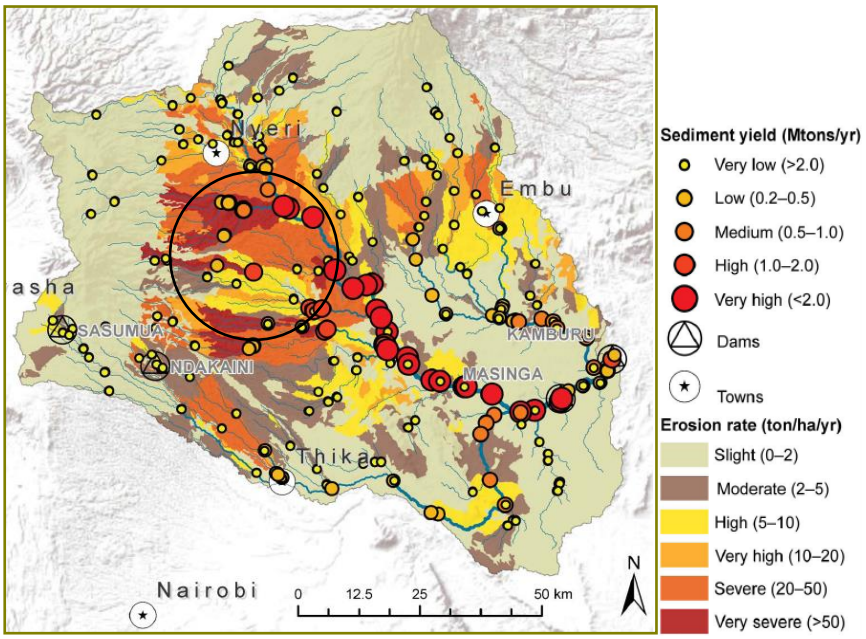


Figure 20: Mean erosion rates and annual sediment yield in central Kenya region
Source: Hunink *et al*, 2013

Plate 3: Erosion to the south of Murang'a

(a) (b)

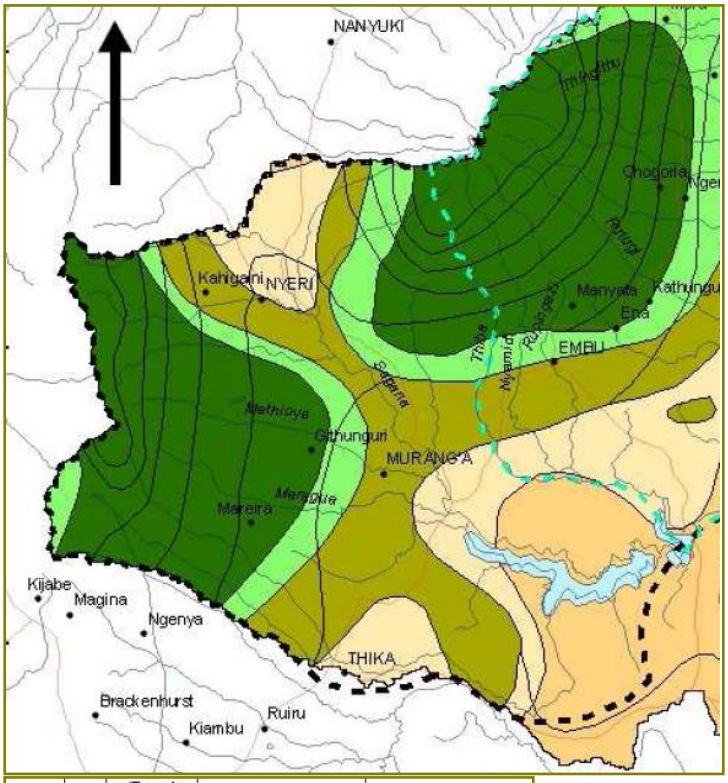
Plate 4: Erosion prone areas at (a) 13 km+250 of the alignment and b. at 22km +600 near Kambiti trading centre

5.6 Agro-ecological Zonation

The combination of topography, soils and climate in the central Kenya region yields a complex series of ecological zones (Figure 21). There are six main agro-ecological zones which cross the proposed project

area in central Kenya, ranging from LH1 (tea and dairy) in higher areas north to LM (lowland midland zones) in the lower areas as follows:

- LH1: Lower Highland Zone: Tea-Dairy zone with permanent cropping possibilities, with good yield potential for peas, cabbage, lettuce, carrots, leek, and kales. The zone is also good for passion fruits, maize, pyrethrum and plums. Spraying against diseases is important. Too much wet conditions can cause crops to rot.
- UM1: Upper Midland Zone: The UM1 is a Coffee - Tea zone with permanent cropping possibilities; very good yield potential for lima beans, cabbages and kales; also supports the growing of bananas, mountain pawpaw, avocadoes, arrow roots and zero grazing.
- UM2: Main Coffee Zone: Very good yield potential, can also support the growing of fruits, potatoes, and also zero grazing.
- UM3: Marginal Coffee Zone: This can also be called Coffee - Maize Zone. The zone supports the growing of early maturing crops like Katumani maize, beans and sunflower. There is a small transitional area before reaching UM4.



	Zone	r/Eo ratio in %	Climatic designation	Key crop or land use
	I	>80	Humid	Tea and forestry
	II	65 - 80	Sub-humid	Coffee, maize
	III	50 - 65	Semi-humid	Coffee, maize, cotton
	IV	40 - 50	Semi-humid to semi-arid	Maize, cotton
	V	25 - 40	Semi-arid	Rangeland
	VI	15 - 25	Arid	Rangeland
	VII	<15	Very arid	Rangeland

Figure 21: Agro-ecological classification of Central Kenya region

- UM4: Sunflower – Maize Zone or Upper sisal zone: This zone has a short to medium and a short cropping season. Full potential could be attained through contour ridging. The zone can support dry land crops such as composite maize, sorghum, tobacco, sisal (Makuyu/Yatta area).

- LM Lower Midland Zones: These are zones categorized as cotton zones. They are characterized by short to medium and short cropping seasons. LM3 has two short cropping seasons while LM4 is categorized as marginal cotton zone. These are the areas found mainly in Makuyu/Kambiti, Masinga, and some parts of Mwea. The area is very good with irrigation. In the absence of irrigation systems, dry crops such as millets, cassava, sweet potatoes, *mwezi moja* beans, sisal, jastropha, aloe vera and castor are the option crops. The area also supports local livestock breeds, bees and the local chicken.

Table 1: Central Kenya region - Agro-Ecological zone characteristics

Agro-Ecological Zone	Alt (m asl)	Mean annual temp °C	Mean annual rainfall (mm)	Land use potential
Tropical Alpine(TA)				National Park
Upper Highlands (UH)				Forest reserve
UH0				Sheep and dairy
UH1				
UH2	2440 - 2740	13.7 -11.7	950 - 1600	Pyrethrum-wheat
UH3	2230 - 2900	14.9 - 10.5	700 - 1000	Upper wheat-barley
UH4				Upper Highland ranching
Lower Highlands (LH)				
LH1	1830 - 2200	17.4 - 14.9	1700 - 2600	Tea-dairy
LH2	1890 - 2130	17.0 - 15.4	1200 - 1800	Wheat, maize, pyrethrum
LH3	2070 - 2220	15.8 - 15.0	700 - 1400	Wheat-maize, barley
LH4	2070 - 2210	15.8 - 15.1	600 - 850	Cattle-sheep-barley
LH5				Lower Highland ranching
Upper Midlands (UM)				
UM1	1520 - 1800	19.2 - 17.6	1500 - 2400	Coffee-tea
UM2	1280 - 1680	20.6 - 18.2	1500 - 2400	Coffee
UM3	1280 - 1520	20.6 - 19.2	1400 - 2200	Marginal coffee
UM4	1520 - 1770	19.3 - 18.0	750 - 1600	Sunflower-maize
UM5	1520 - 1770	19.3 - 18.0	500 - 1100	Livestock-sorghum
UM6				Upper Midland ranching
Lower Midlands (LM)				
LM3	910 - 1280	22.9 - 20.6	1000 - 1600	Cotton
LM4	760 - 1220	23.7 - 21.0	800 - 1200	Marginal cotton
LM5	700 - 910	24.0 - 22.9	600 - 900	Livestock-millet
LM6				Lower Midland ranching
Inland Lowlands (IL)				
IL5	610 - 700	24.7 - 24.1	500 - 850	Lowland livestock-millet
IL6				Lowland ranching

5.6.1 Vegetation Cover

The Central Kenya region contains some of Kenya's largest tracts of indigenous forest on Mount Kenya and the Aberdare ranges. Almost all of these forests are on government land - either as forest reserves or a national parks set up to safeguard biodiversity or hydrological services. The areas surrounding these forests are densely populated with intensive agricultural production in the foothills of the two mountain ranges.

Over the past 100 years, much of the land in the foothills that once was forest or a mosaic of forest and other habitats has now been cleared and converted to agriculture, resulting in significant losses of biological diversity. However, the remaining highland forests continue to provide habitat for a disproportionate share of Kenya's total biological diversity, including 50 percent of plant species, 40 percent of mammals, 35 percent of butterflies, and 30 percent of birds (KFWG, 2001). In addition to

providing food and other crops, the farmlands in the foothills are an important source of wood, mostly because the remaining indigenous forests are legally protected from large-scale wood removal. Currently, at the household level, farms and woodlots in Kenya provide about two thirds of firewood for domestic use (MoE 2002). Agricultural landscapes in the foothills also have a role to play in conserving the rich diversity of life-forms of the Kenyan highlands.

The vegetation cover in the region is as shown in Figure 22 can be divided into the Aberdares and Mt. Kenya sub-catchments. Vegetation in the Aberdares sub- catchment can be divided into three categories:

1. The Aberdare conservation area including the National Park;
2. The middle zones consisting of farming areas; and
3. The lower drier ASAL zones

In the conservation areas, vegetation is determined by rainfall distribution and temperature. The vegetation has been divided into four categories as one ascends, namely: - wetter evergreen forests; drier evergreen forests; Juniperus/Podocarpus/Ocotea forests; and low altitude shrubs. The conservation area vegetation can be divided depending on altitude as follows:

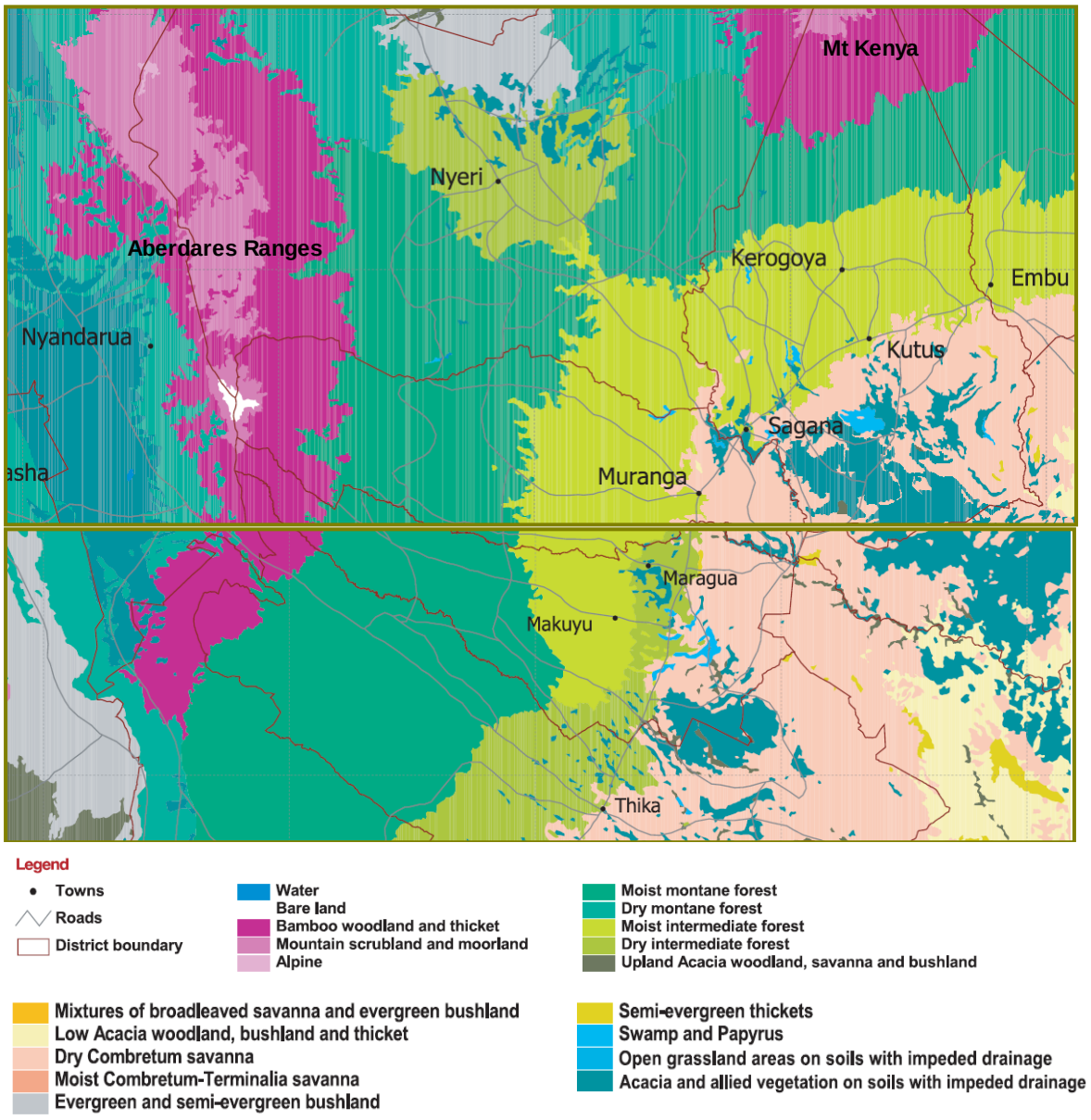


Figure 22: Vegetation types of project area in Central Kenya and surrounding areas

Table 2: Vegetation zones of Aberdares ecosystem

Vegetation Belt	Zone	Elevation (meters)	Elevation (feet)
Montane Forest	Montane Rain-forest	1,600-2,400	5,200-7,800
	Bamboo (east slopes)	2,300-3,150	7,500-10,300
	Bamboo (west slopes)	2,600-3,300	8,500-10,700
	Hagenia-Hypericum	2,800-3,400	9,200-11,000
Ericaceous	Moorland	2,850-3,560	9,200-11,600
	Ericaceous-shrub	2,850-3,660	9,200-11,900
Alpine	Alpine	>3,650	>11,900

Table 3: Vegetation types in the Aberdares

Vegetation Type	Coverage (km^2)	Coverage (%)
Closed Natural Forest	459	33
Montane Forest/Bamboo mix	282	19
Bamboo	196	13
Exotic tree plantations	166	11
Forest/Scrub mix	110	8
Moorland	49	3
Grassland	33	2
Scrub/Grassland mix	27	2
Cultivated land	65	4
Other (camps, infrastructure, stations, roads etc)	15	1
TOTAL	1,460	100

The most extensive vegetation type in the Aberdares Conservation Area (ca. 2,185 km^2) is bamboo (ca. 556 km^2, 25% coverage), followed by " wetter evergreen forest" (ca. 398 km2, 18% coverage). Of the tree-dominated habitats, "drier evergreen forest" (ca. 12 km^2, <1% coverage) and Hagenia woodland (ca. 76 km^2, 3% coverage) are most poorly presented. In contrast, most of the Hagenia woodlands lie well within the National Park and are well protected.

The Aberdares National Park has been fenced but some areas still lie outside the fence. Those within the fence are better protected. The areas inside the fence have been designated for indigenous forests, while those outside for plantations. The 10 most common species of trees in the three forest reserves of the Aberdares Conservation Area was determined by KIFCON (1994). The five most abundant species of trees are N*uxia congesta, Juniperus procera, Olea europaea, Podocarpus latifolius*, and *Neboutonia macrocalyx*.

There are at least 774 species, subspecies and varieties of vascular plants within the Aberdares National Park. These belong to 4213 genera and 128 families (Schmitt, 1991). The vegetation of the alpine and ericaceous belts of the National Park consists almost exclusively of species, which are endemic, or near –endemic to the Afromontane and Afroalpine Regions (i.e. to the high mountains of East Africa), (Hedberg, 1986). The level of endemism drops rapidly as the elevation declines. Plants of endemism drops rapidly as the elevation declines. Plants endemic to the Aberdares include *Anemone thomsonii* var.friesiorum, *Helichrysum Gloria-die* ssp. Sattimae and *Senecio keniensis* ssp. Brassiciformis (Hedberg, 1957).

The middle zones consist of agro forestry areas mainly planted with Grevillea, Eucalyptus, and fruit trees especially mangoes, pawpaw and avocado. The lower drier zones consist of fruit trees, mainly mangoes, and some of the indigenous trees like Ficus sycomorra (mikuyu), and Cordial africana which have been left intact or which have regenerated. Other trees include Commiphora spp., Combretum molle, Acacia spp., and Cassia spp.

Vegetation cover in the Mt. Kenya Sub-catchment can be divided into four zones:

1. The Forest Zone;
2. The Tea Zones;
3. The Coffee Zone; and
4. The Lower Zones

The Forest zone consists of the Mt. Kenya National Park and Reserve, which is a protected area. The Mount Kenya ecosystem constitutes an important reservoir for biodiversity. Beenjte (1991) and Bussman (1994) identified 880 plant species, subspecies and varieties belonging to 479 genera in 146 families below the 3200m altitude. There are at least 11 strictly endemic species of higher plants and more than 150 species that are near endemic.

Vegetation zones and species distribution are distinguished according to the different climatic zones and altitudes, most obviously through variation in vegetation structure, cover and composition. The vegetation of Mt. Kenya ecosystem tends to vary with altitude. The following vegetation zones are apparent from the high altitudes to lower altitudes (Njue, 2000):

- **Nival Zone:** This is the central rocky peak area which lies above 4500 m. Mosses and Lichens are the predominant species. Larger plants such as Alchemilla argrohylla, Helichrysum citrispinum and Helischrysum are common.
- **Afro-Alpine Zone:** This belt, between 3,500m and 4,500m, is characterized by specialized afro-alpine species that have developed adaptations to withstand extreme conditions. The dominant vegetation is moorland with tussock grasses. Common plants include the giant groundsels (*Senecio keniodendron and S. Aberdarica*), Cabbage groundsel (*S. brassica*), the Giant Lobelias (Lobelia *telekii and L. aberdarica)* by tussock grass, lobelia and giant groundsel (Beck et al., 1988).
- **High Altitude Heath:** This lies between 3000m and 3500m. It is also referred to as Ericaceous belt and is mainly covered with giant heath, African sage (*Artemisia afra)* and several Gentians (*Swertia spp*).
- **Upper Forest:** Lies above the Bamboo zone and characterized by smaller trees in glades, such as the East African Rosewood (*Hagenia abyssinica)* and St. John's Wort *(Hypericum spp*). Trees are covered with Mosses and Lichens (*Usnea spp*).
- **Bamboo-Podo Forest Zone:** This zone is dominated by *Arundinaria alpina,* and extends from 2500m to 3200m ASL. *Podocarpus latifolias* are spread throughout the Bamboo. *Sambucus Africana* grows on openings during transition phase of collapsed Bamboo stems. The bamboo zone is absent in the Northern side due to drier conditions. This is a favoured habitat for mammals.
- **Montane (Mixed) Forest:** This zone starts at 2400m down to 2000m and is dominated by *Podocarpus latifolio*us mixed with Muxia congesta at the upper altitudes. Forest types that occur at lower altitudes include:
    - **Moist *Ocotea* forests;** (*Ocotea usambarensis*) occur on 27,000 ha between 1500m and 2400m on the southern and south-eastern slopes and are the largest surviving blocks of this type though selective logging and clearing at its lower margins have disturbed and removed large tracts of the forest.
    - ***Newtonia* forest;** in the lower Imenti forest east of Meru and on the eastern slopes at lower altitudes is rare in Kenya and occurs on about 3500 ha as impoverished remnants in the ecosystem.
    - ***Croton sylvaticus-Premna* forest;** occurs on about 1600 ha in the upper Imenti forest near Meru at altitudes 1500-1800m.

- ***Croton-Brachylaena-Calodendrum* forest;** also occurs near Meru at altitudes 1450-1850m. This forest type is rare and 3000 ha of its total area of 6200ha is found in Mt. Kenya ecosystem.

- **Plantation Forest Zone:** At 2200m and 2400m ASL before community interface zone, fast growing exotic commercial forest trees were introduced way back in the early 60s with the main purpose of supplying commercial forest products to the forest industries located within the adjacent communities. Main commercial tree species planted include Cypress, Pines, and Eucalyptus among others.

In the tea and marginal coffee zones, there are remnants of natural vegetation along the riverine corridors and some indigenous trees are found in the farmlands. The tree mix consists of both indigenous and fast growing exotic species. The resultant tree vegetation arising due to human activities is woodland of mixed indigenous and exotic trees. Trees are planted around homesteads and along farm boundaries. Farm forestry has been an important livelihood activity due to the ban on logging in Mount Kenya region since the year 2000.

The woodland community is composed of several indigenous trees including *Croton macrostachus, Croton megalocarpus, Bridelia micrantha, Erythrina abyssinica, Cussonia holstii, Markhamia lutea* and *Ekebergia capensis*. In this zone there is also a large percentage of introduced species of which the most dominant is the *Grevillea robusta.* Other exotic species include *Cuppressus lusitanica, Eucalyptus saligna, Eucalyptus camaldulensis, Cassia siamea* and *Leucaena leucocephala*. Further down, where the rainfall ranges between 900 and 1200mm, with a prolonged dry season, the characteristic vegetation is Combretum woodland, *Terminalia brownie* interspersed with cultivated areas. The dominant grass is *Themeda triandra*.

5.6.2 Fauna

Wildlife animals are found in the protected areas, forests, rivers and farmland. Velvet monkeys for example are very common in farm land and cause a lot of damage to crops. Occasionally, elephants from the forests neighbouring the community breaking into the farmlands especially in the unprotected areas without game fence. Other animals found in the neighbouring forests include the Bongo, buffaloes, Antelopes and Leopards. Outside the forests, there are few wild animals that are found in the rivers, such as Hippopotamus and crocodiles. These are found in the two major rivers – Mathioya and Sagana. These are a lot of birds in the county.

Different animal species are found in a variety of places such as on trees, rocks, rivers, swamps, caves, and other microhabitats situated in the region. They are comprised of mammals, birds, reptiles, insects, amphibians and mollusks.

The central region has several wildlife parks including the Aberdares and Mt Kenya national parks but these are outside the alignment of the proposed route.

5.7 Drainage and Water resources

5.7.1 Rivers and drainage

The main river in the Central Kenya region is the Tana, which supplies water to 17 million people, about 50% of the country's population (IFAD/UNEP/GEF 2004). The Upper Tana River receives its water from the higher elevation regions, in particular from the Aberdares range and Mount Kenya. Rivers originating from Mount Kenya are: the Thingithu, Rutugi, Ena, Rupingazi, Nyandi and Thiba. Mathioya, Maragua and Sagana drain from the Aberdares. The Nairobi Water Company (NWC), that delivers water to the municipality of Nairobi, extracts about 75% of its demand from the Thika River through the Ndakaini reservoir. The project area is located within the Upper Tana catchment.

The Tana River basin is the largest and most important basin in Kenya. Its catchment covers some 95,950 km^2 (approximately 17% of Kenya's land mass), and the flow of the Tana River basin constitutes 27% of the total mean discharge measured along rivers in the

Plate 5: Tana River at 27 km +950 of the alignment

In terms of hydro-power production, the Tana River basin has both the largest existing generated hydro-power and the greatest remaining hydro-power potential. The Tana basin has a total installed capacity of 496 MW and 2,070 GWh of average annual energy, with a potential remaining un-installed capacity of up to 583 MW. In relative terms, the Tana basin presently accounts for approximately 61% of the total power supply in the country; in terms of hydro-power production only, the Tana basin contributes about 82% of the installed capacity, while the basin holds 43% of the remaining uninstalled hydro-power capacity. Within the country's river basins, the hydro-potential is presently best exploited in the Tana basin.

The upper Tana Catchment has all its perennial rivers emanating from the Aberdares and Mt. Kenya. The Mt. Kenya sub-catchment drains the Mt. Kenya side of the upper Tana catchment. The main rivers in this sub catchment include the Rupingazi, Nyamindi, Thiba, Rwamuthambi, Ragati, Sagana, Thego and Nairobi which have tributaries within their systems. These rivers flow through the forests, tea and coffee zones, joining the other rivers downstream. The Mt. Kenya sub catchment comprises Kirinyaga county, and parts of Nyeri, Mbeere and Embu counties.

The Aberdares sub-catchment drains the Aberdare side of the Upper Tana Catchment. The rivers in this sub catchment include the Chania, Thika, Sabasaba, Maragua, Mathioya, Gura and Amboni. These rivers have a network of tributaries which join them as they flow downstream. The rivers flow through deep valleys as they cut through the forests, tea and coffee zones. The Aberdares sub catchment comprise the whole of Murang'a county; a small part of Kiambu, Nyandarua and Thika counties, and almost the whole of Nyeri district, although there is small portion of Nyeri county around Kiganjo that falls within the Mt Kenya region. The rivers get bigger as they flow because other small rivers and streams join the main ones.

Recharging of the rivers by groundwater where the aquifers cut to the surface is very common. The drainage of the main rivers and their tributaries is determined by three factors: The slopes and shape of the tertiary volcanic; the directions of the slopes of the Aberdare range and Mt. Kenya; and the structure of the Basement System. The section of Mt. Kenya covered by the upper Tana Catchment, like the rest of the mountain, has largely radial drainage pattern predominating the upper and middle until the streams open out in the flatter sections of the Basement System floor. The Aberdare ranges supply the largest part of the Upper Tana catchment area. Several perennial rivers in the upper zone of the mountain range flow in moderate valleys to the southern end to very deep valleys in the North-west. These led to deeply incised V-shaped valleys to flatter areas towards the basement system. Among the streams and rivers originating from Mt. Kenya and draining into the Tana River (i.e. within the sub-section of drainage area 4), four main sub-basins can be distinguished (from north to south) as follows:-

- *Sub-basin 4A* Amboni, Muringato, Chania, Gura and Gikira all which rise from the Aberdares join Nairobi, Thegu, and Rongai rivers all which rise from Mt. Kenya *within this Sub-basin.* Hence, this sub-basin is also partly fed by Mt. Kenya and partly by the Aberdares similar to sub-basin 4B
- *Sub-basin 4B:* Rwamuthambi which originates in Mt. Kenya while Sabasaba, Maragua, South and North Mathioya drain into the Sagana *at this sub-basin*. Hence, this sub-basin is partly fed by Mt. Kenya and partly by the Aberdares.
- *Sub-basin 4C:* Chania *(Thika side)* and Karimenu both rising from the southern slopes of the aberdares are tributaries to the main Thika *(rising also from the aberdares)* to later flow into the lower limb of Masinga Dam *as Thika River*.
- *Sub-basin 4D*: Thiba River with its tributaries Murubara, Nyamindi and Rupingazi

The main rivers like Sagana, Thiba and Rupingazi (Mt. Kenya), Maragua, Mathioya (south/north) and Thika (Aberdares) and the main tributaries to these rivers such as Rongai, Nairobi and Thegu (Sagana tributaries); Kiringa, (Thiba and Mukengeria Tributaries); Karimenu and Chania (Thika Tributaries) originate from the forest zone. Most of these tributaries join the main rivers outside the forest zone, even below the coffee zone. However, both rivers and tributaries receive additional water inflow from smaller streams originating from the tea and the coffee zones.

The water from all the rivers sources is reported to be diminishing over the years. Although river flow data is limited, available evidence seems to suggest that quantities of surface water flowing out of the forest into the tea zones is rather constant. Therefore, reduced surface water availability observed downstream the mountain, seems to be mainly the result of reduced inflow from sources outside the forest area; and increased abstraction.

Plate 6: Sabasaba River and bridge at 26 km+350

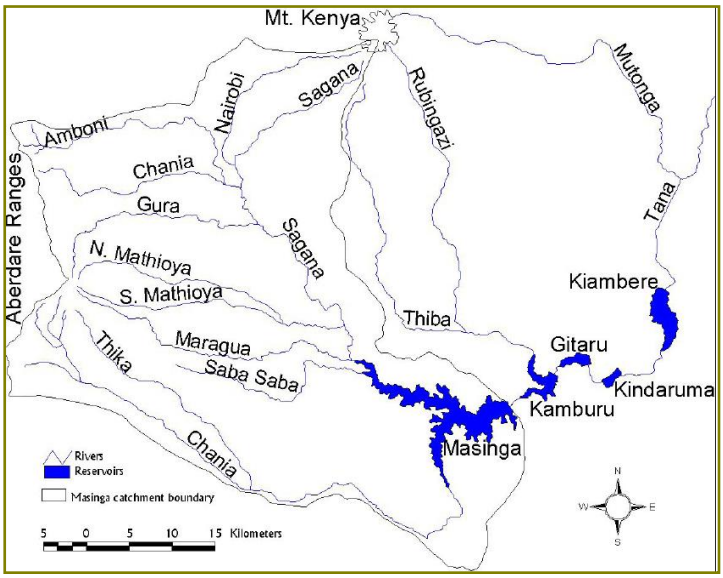


Figure 23: Drainage system within the proposed project region

Table 4: Characteristics of subcatchments and rivers, and main land use

Sub-catchment	Rivers/Sub-basins	Length (km)	Area (km2)	County	Zone
Aberdares	Chania	73	537	Kiambu	Forest, Tea, Coffee, Cotton
	Thika	60	313	Kiambu	Forest, Tea, Coffee, Cotton, ASAL
	Sabasaba	58	374	Murang'a	Forest, Tea, Coffee, Cotton, ASAL
	Maragua	69		Murang'a	Forest, Tea, Coffee, Cotton, ASAL
	Mathioya	70	547	Murang'a	Forest, Tea, Coffee, Cotton, ASAL
	Gura	58		Nyeri	Forest, Tea, Coffee
	Chania (Nyeri)	53	429	Nyeri	Forest, Tea, Coffee
	Amboni	59	684	Nyeri	Forest, Tea, Coffee, Cotton
Mt Kenya	Rupingazi	78	354	Embu	Forest, Tea, Coffee, Cotton
	Nyamindi	78	453	Kirinyaga	Forest, Tea, Coffee, Cotton
	Thiba	78	715	Kirinyaga	Forest, Tea, Coffee, Cotton, ASAL
	Rwamuthambi	36		Kirinyaga	Forest, Tea, Coffee
	Ragati	55		Nyeri	Forest, Tea, Coffee
	Sagana	46		Nyeri	Forest, Tea, Coffee
	Nairobi	53		Nyeri	Forest, Tea, Coffee
	Mathauta			Machakos	Cotton., ASAL

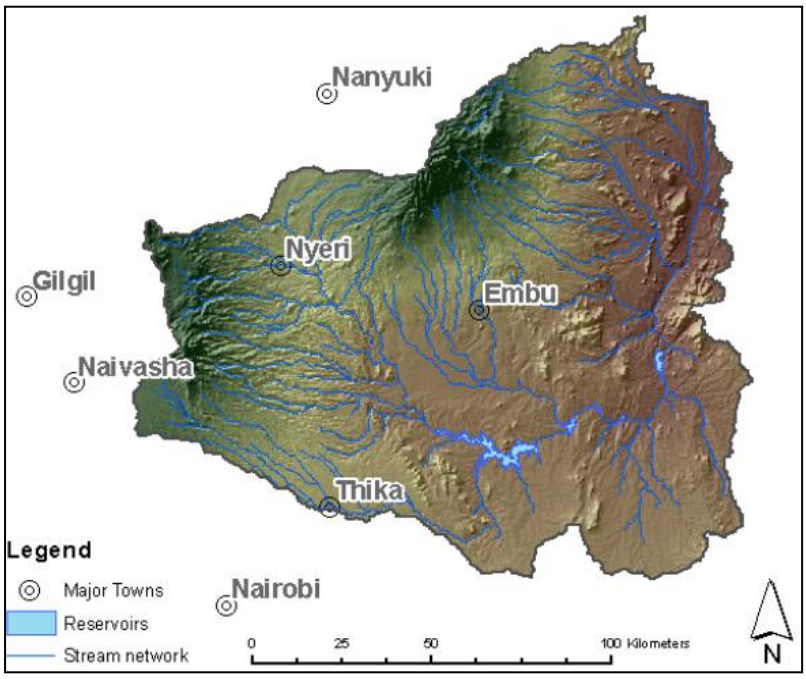


Figure 24: River and stream in the project area

5.7.2 Wetlands

There are several known wetlands in the project area, though none of them falls under the Ramsar Convention as they are mainly small in size, with only a few which are 10 km^2 or above Table 8). Wetlands are important for ground water recharge, regulating water flow, for temporary storage and later release of water to water courses, and as sinks for wastes and pollutants, thus serving a cleansing role. Wetlands in the area are however under heavy threat, mainly through conversion to agricultural use. The main wetlands identified in the project region include:-

Table 5: Wetlands and their location within the project region

County	Name of Wetland	Location/Area
Kirinyaga	Gikumbo Karia-ga Gacormo Rukenya swamp Karia swamp Karia swamp Karia swamp	Kangaita Kangaita forest Gatugura Castle forest Kiandari
Nyeri	Thuti Swamps Kandune Swamps Rongai Swamps Njengu swamps Kianjogu swamps Mumwe Karia-ka-Ngware Kianjuri & Kinungu, Itoga, Ragati Area	Othaya Kabaru Kambura-ini location Kimathi Mathira Mahiga, Othaya Wanjerere Kararumo forest Ichaga location, Mathira East Mathira East near Karatina

County	Name of Wetland	Location/Area
	Chele	Chele Forest
	Chinga dam	Othaya
	Mahuhi River	Upper Iraini location, Ragati
	Makurata	Ndathi
	Ngutui Swamp	Kimahuri in Kabaru Forest
	Kahuhi swamps	Kahuhi river
	Thingini swamps	
	Gakanga (Itandara)	Tetu
	Miagayuini (Tetu)	Tetu, shopping centre
	Kanjora	Kangora Sub Location, Tetu
	Kiunyu Dam	Giakanja, Tetu
	Kagioini	Chegenge, Tetu
	Hombe dam	Hombe Forest
	Nguniu dam	Hombe Forest
	Kangati Kainit dam	Kiamariga, Nyeri
Murang'a	Rubiru spring	
	Kiyau wetland	
	Mutoho	
	Kwa Ndumia	
	Githambo	Muiruri
	Githimu	Near Kari on Githumu Road
	Itomboya	Near Socfinaf on Gatanga road
	Kandara	Ngararia/Kahaini
	Motoho	Kandara
	Kianduru	Muranga South
	Athaara	Muranga South

6 SOCIO-ECONOMIC BASELINE

6.1 Population

The project area in central Kenya covers 3 counties namely Murang'a, Nyeri, Kirinyaga, but also affects Embu Tharaka, and Meru and the surrounding region. The total population in the 3 counties according to the 2009 Kenya Population Census was 2,173,213 people (KNBS, 2010). The project area has an average 311 people per km^2. This however ranges from 208 people per square kilometre in Nyeri County to 368 people per square kilometre in Murang'a County (Figure 25). The national average population density is estimated at 66 people per square kilometre. Population characteristics of the three counties are shown in the Table 9.

Table 6: Population in three central Kenya counties

County	Male Pop	Female Pop	Total Pop	Density sq km
Murang'a	457,864	484,717	942,581	368
Kirinyaga	260,630	276,424	537,054	357
Nyeri	339,725	353,833	693,558	208

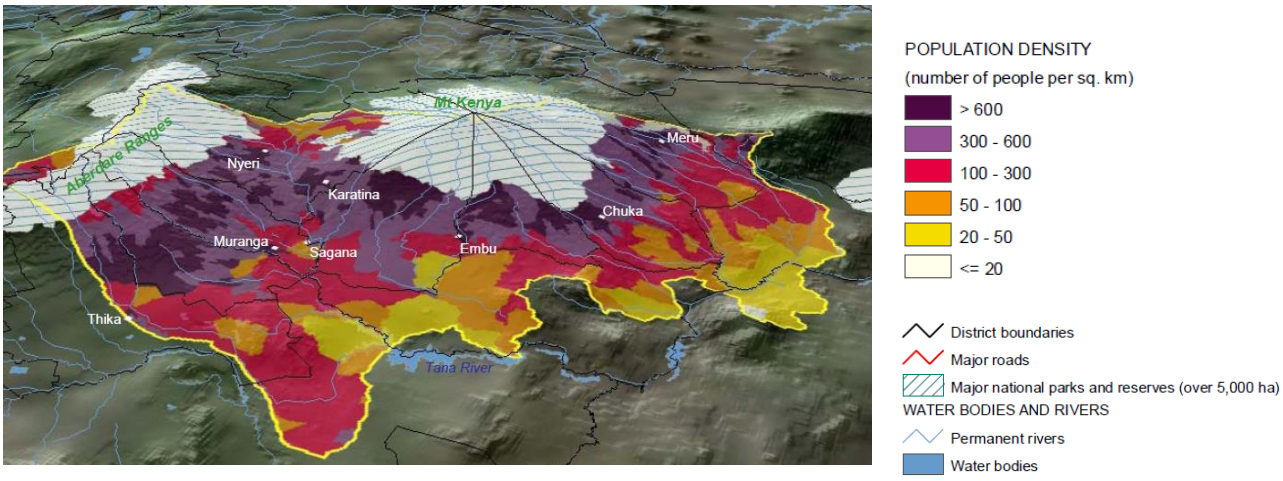


Figure 25: Distribution of population density

Table 7: County population attributes

COUNTY	Male	Female	Total	Households	Area (Km^2)	Density
NYERI	339,724	353,834	693,558	201,703	3,337.09	207.83
KIRINYAGA	260,628	267,426	528,054	154,220	1,479.09	357.01
MURANG'A	457,860	484,721	942,581	255,696	2,558.82	368.37
Total	**2,152,967**	**2,230,776**	**4,383,743**	**1,224,742**	**13,163.67**	**1,755.18**

Table 8: Constituency population distribution

Murang'a County			Nyeri County			Kirinyaga County		
Const	Area Km^2	Pop	Const	Area Km^2	Pop	Const	Area Km^2	Pop
Kangema	173.7	76,988	Tetu	149.8	78,320	Kerugoya	542.8	190,512
Mathioya	351.3	88,219	Kieni	1,378.1	175,812	Mwea	229.6	124,672
Kiharu	268.8	181,076	Mathira	296.6	148,847	Gichugu	210.8	99,515
Kigumo	242.1	123,766	Othaya	174.7	87,374	Ndia	222.2	113,355
Maragwa	466.7	152,272	Mukurweni	178.7	83,932	Central		

Kandara	236.0	156,663	NyeriTwn	183.1	119,273			
Gatanga	587.2	163,597						
County Total	**2,325.8**	**942,581**		**2,361.0**	**693,558**		**1,205.4**	**528,054**

6.2 Human Settlement

Settlement patterns in the area are determined by climatic conditions, infrastructure, food availability and proximity to urban centres. The majority of the people in central Kenya region settle in the upper zones where agricultural potential is high. Furthermore, it also corresponds to natural resource endowment. This pattern is mainly due to ecological factors which influence settlement in the upper zones near mountains where the land is fertile and receives sufficient rainfall. The type of farming also influences settlement patterns with the upper zone attracting a higher percentage of population, where they grow cash crops. Other areas where the concentration of people is high includes along the major roads and in areas where soils are productive with reliable rainfall. Some areas in the highlands, such as Makuyu division in Murang'a and Kieni West in Nyeri, however, have densities that are lower than the county averages. Makuyu division for instance has a density of 319 persons per km^2 while Kieni West has 116 persons per km^2. The district averages are 408 and 162 respectively. This relatively comparatively lower population density is as a result of harsh climatic conditions in the areas.

Another reason for clustered settlement is the growth of towns. Higher population densities are common in urban areas compared to the rural areas (Table 12). Due to socio-economic influences, the population of town dwellers continues to increase with areas close to the towns opening up new settlements. More people tend to migrating into the urban areas in search of economic opportunities. Urban areas are also relatively well served with infrastructure and basic services.

Table 9: Population in largest urban centres in the 3 counties

Murang'a County		Nyeri County		Kirinyaga County	
Makuyu	44,007	Nyeri	119,353	Wanguru	23,983
Murang'a	28,775	Karatina	8,499	Kerugoya/Kutus	19,422
Maragua	26,374	Naro Moru	5,805	Sagana	10,551
Kabati	3,128	Othaya	5,137	Kagumo	3,449
Kangari	2,810	Mweiga	3,583	Kagio	3,357
Kiria-ini	2,457	Endarasha	3,049		

Notably, this region also contains large protected areas where settlements are not permitted. These include the forested areas and the national parks. Other areas with minimum settlement are the large-scale farms notably Kakuzi, Delmonte and other individual large scale farms in Nyeri and Murang'a South districts. In Kirinyaga, there is Ngariama ranch, and Solio ranch in Nyeri which are also fast growing areas owing to the Government program of re-settling the landless. Similarly, in Kirinyaga Mwea rice fields, settlement is clustered with much of the land being used for irrigation purposes.

The largest towns in the region are Thika and Nyeri (45 km and 165 km from Nairobi, respectively), followed by Embu (135 km from Nairobi). These towns host some agriculture-based industries (e.g., coffee and tea factories, flower farms, milk and cotton processing) and some small-scale timber based industries (e.g., saw mills and furniture manufacturing). The secondary road network is denser and better developed in Thika, Maragua, Murang'a, Nyeri, and Kirinyaga areas. It is less dense in the remaining foothills of Mount Kenya farther east, and

is least developed in the plains (World Resources Institute, 2007). Agriculture is the main economic activity in the region (IFAD/UNEP/GEF, 2004).

6.3 Land Use and Land Tenure

Main land use classes in the Central Kenya region are: natural vegetation (forest, grassland and wetlands), rain-fed and irrigated agriculture (tea, coffee, maize and cereals) and rangeland (Figure 26). The region can be divided into agro-ecological zones corresponding to different land-uses types. The upper zone, 4000-5200 m is the afro-alpine zone. Between 3300 and 4000 m there is moorland with the typical vegetation being *Arundinaria alpina* with *Acacia abyssinica*. The forest zone is located between 2200 and 3000 m and comprises highly diverse indigenous forest. Below 2200 m the natural vegetation has been largely removed and the land is converted to agriculture.

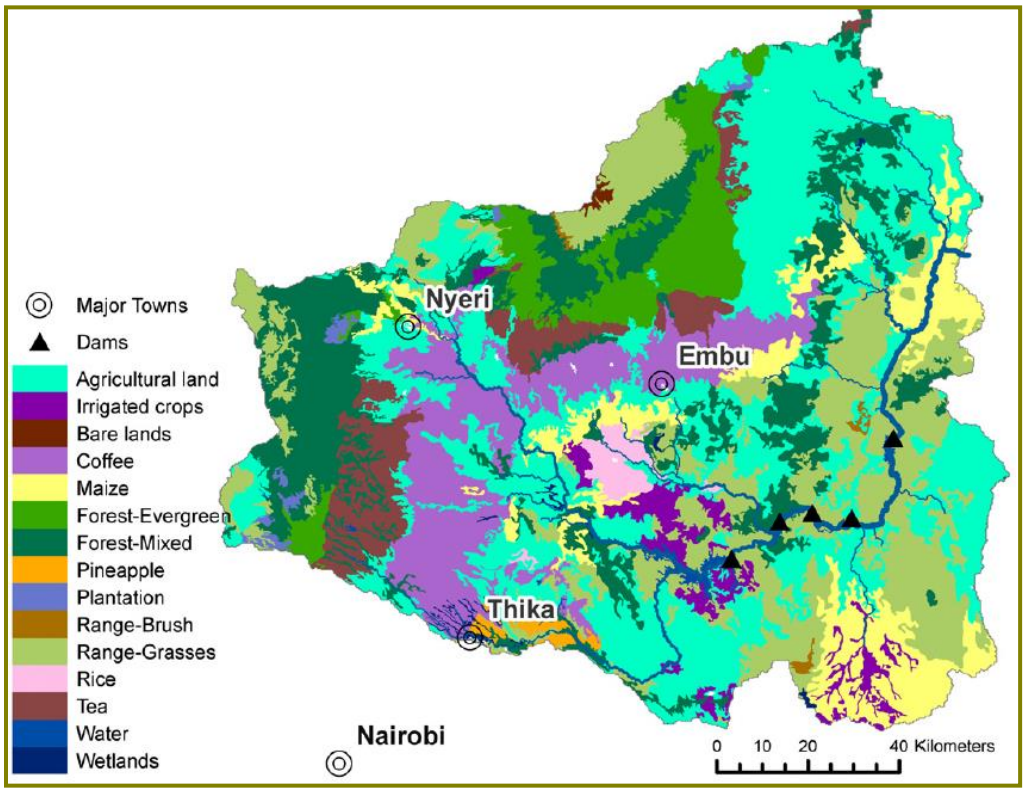


Figure 26: land use in the project region

The tea zone is located between 1800 and 2200 m. Areas between 1400 and 1800 m fall largely within the cultivated Mount Kenya and Aberdare slopes. This is the zone within the basin where human population most effectively starts to exert its influence on the land in terms of land use practices. This area is used for cultivation of maize, coffee, bananas, vegetables and other subsistence crops including limited grazing. The population density in the higher portions of the area is of the order of 300 persons per km^2 but higher concentrations of population are experienced on the cultivated slopes located in the Murang'a and Nyeri counties on the slopes of the Aberdares. Areas lying below 1400 m, which comprise about half of the entire central Kenya, are suitable for marginal cultivation and grazing and support limited wildlife. These areas, however, support irrigated rice growing within the Mwea Plains making use of the Thiba and Nyamindi waters. Towards the moisture deficient areas, population densities decrease to less than 40 persons per km^2 in response to the environmental factors which do not favour extensive human occupation. Between 1100 and 1300 m subsistence cropping (maize, sunflower) is taking place. Below about 1100 m are the Arid and Semi-Arid Lands (ASAL).

Plate 7: Tea Plantations in Murang'a **Rice in Mwea**

6.4 Economic activities

Nyeri has private ranches that supply dairy and beef products. Some of the ranches serve as private wildlife sanctuaries that host local and foreign tourists and augment the vibrant tourism sector another contributor to the county's economy. The nearby Mount Kenya and Aberdare National Park attract a good number of tourists. Facilities and hotels such as The White Rhino, Outspan and Aberdare Country Club serve this market. Due to its large population, commerce thrives in major urban centres in the county. Main economic Activities/industries include Tea, Coffee, Dairy Farming, Milk Processing Firms and Maize Millers. Major resources include Forest, Wildlife, Minerals (Stone, Sand, and Kaolin), Livestock, Pasture, Water, and Medicinal Plants. Main tourist attractions are Mt. Kenya, Mt. Kenya National Park, and Aberdare National Park

Murang'a County is a predominantly an agricultural County. (Tea, coffee, maize, beef and dairy products) with 80% of population relying on agriculture, informal sector, tourism and manufacturing. The county also hosts tourist attractions such as the expansive Aberdare's forest one of Kenya's water towers and home to varied fauna and flora. The county is a hub of trade and commerce in the region partly due to its proximity to Nairobi and its high population.

In Kirinyaga County, main resources include Mt, Kenya, Forests, hills, rivers and arable Land. There are 4 tourist hotels. The major economic activities/Industries include **h**orticulture, tea and coffee farming, fishing and commercial businesses. The county leads in rice production in the country.

There are basically three forms of land tenure in the Central Kenya region i.e. Freehold or absolute tenure, Government land (e.g. land owned by Prisons and Kenya Forest Service, KWS etc) and Trust land. Freehold land tenure forms an estimated 40% of the total land area in the 3 counties with an average land holding size of 1.635 ha, and a range of 0.1 to 5 ha.

6.5 Livelihood activities

6.5.1 Agriculture and Livestock production

Population density is highest in the southern and eastern sides due to favourable climate and relatively fertile soils. The agricultural lands are privately owned where small-scale cash crop and subsistence farming dominate. The cropping intensity increases with elevation, because of the better soils and higher water availability. Farm size varies from 0.2 ha to 1.6 ha. Small plots near the homestead are used for subsistence crops such as maize and beans, and farm forest trees are planted along the boundaries of the plots. A variety of crops are produced, including

maize, beans, arrowroot, yams, bananas, macadamia nuts, passion fruit, coffee and tea, and there is some livestock (IFAD/UNEP/GEF, 2004).

Agroforestry and farm forestry are common in the central Kenya region. Trees are planted around the homestead and along farm boundaries. In agroforestry and farm forestry systems, the tree mix consists of both indigenous and exotic tree species, but faster growing exotics dominate. Such species include Grevillea, Eucalypts and cypress. Farm forestry and agroforestry are an increasingly important livelihood activity subsequent to the ban on logging in the Mount Kenya Reserve since 2000 (IFAD/UNEP/GEF, 2004).

Kenya's economy relies heavily on the agricultural industry, which accounts for 60% of total employment and contributes 25% to Gross Domestic Product. Most important export products are tea and coffee. The type of agriculture practiced in the region and potential productivity depends mainly on altitude which in turn determines temperature and rainfall. On the eastern and southern slopes of Mount Kenya intensive arable farming is practiced. In the upper reaches of the region, potatoes, pyrethrum and tea are grown. In the mid-altitude zones, coffee, maize, beans, rice and bananas and mixed livestock are grown, while in the lower zone, tobacco, cotton, sorghum, millet, and pigeon peas and cowpeas are most common. Income varies between agricultural zones: farmers in the tea zone have the highest gross income and those in the cotton/tobacco zone the lowest (IFAD/UNEP/GEF, 2004). The main crops grown are as follows:

Tea: In the highland tea zone, three quarters of the land is under tea, managed by the Kenya Tea Development Agency which also operates tea factories. Tea is perennial; under good management, it covers the ground entirely, except during establishment and after pruning, and so provides good soil protection. Other crops in the tea zone include a variety of horticultural crops, maize, beans, bananas, and fruit trees.

Coffee: In the coffee zone, low prices in recent years have driven a shift to alternative cash crops such as French beans, tomatoes, and Asian vegetables. Farmers also maintain the subsistence part of the mix - maize, beans, potatoes and sweet potatoes intercropped with coffee. Other plots are abandoned with poor coffee bushes which cannot legally be grubbed up because coffee is a *scheduled crop.* This provision of the Agricultural Act is not strictly adhered to but farmers may persevere with an established crop, hoping for better times.

Cotton/tobacco: The major land use systems in the lower zone are irrigated cropping, rain-fed cropping, and livestock production under rangeland conditions. There is rice growing in Mwea, in Kirinyaga and Mbeere; as well as irrigated flower production in the lower Rupingazi/Kapingazi Rivers. Most of the land within Nguuru Gakirwe irrigation schemes is under high-value horticultural crops. Bananas, maize and beans are grown both under irrigation and rain-fed conditions.

Rice: Mwea Irrigation Scheme is a major rice producer. Small-scale irrigation includes group horticultural schemes, group food schemes, and individual smallholder enterprises (Onduru and others 2002). In other regions, the proportion of farmers practicing irrigation is lower: 12 and 6 per cent, respectively, in Thika, and Nyeri. Irrigators mainly use bucket application; flooding is mainly practised in rice fields of Kirinyaga, overhead sprinklers only in Murang'a and Nyeri.

Forage: Livestock are an important asset. It is common to see Napier grass and Rhodes grass grown all over the region. Forage crops are also used in water management as grass strips, fodder trees and banana on such strips, and cover crops.

In summary, the main Cash Crops grown are Coffee, Tea, Wheat, Cotton, Macadamia, Tobacco, Irish Potatoes and pyrethrum. The food crops are Maize, Beans, Sorghum, Bulrush Millet, Finger Millets, Cow peas, Pigeon peas, Snow peas, Soya beans, Dolichos lablab and Green grams. The root crops include Arrow roots, Sweet potatoes, Yams, Cassava and Irish potatoes. Fruits include Mangoes, Oranges, Lemons, Bananas, Pawpaw, Water melons, Passion fruits and Avocadoes. Horticulture is a major enterprise in the region producing Vegetables like Snow peas and French beans, Fruits, Nuts and Floriculture for both local and export market. Mid zone produces Bananas, Coffee, and Maize and Beans. Field crops (Maize, Beans, Cow peas, Pigeon peas, Green grams) are grown in the lower zones which are the food basket for the area. The area covered by food crops as a percentage of total crop land is shown in Figure 27.

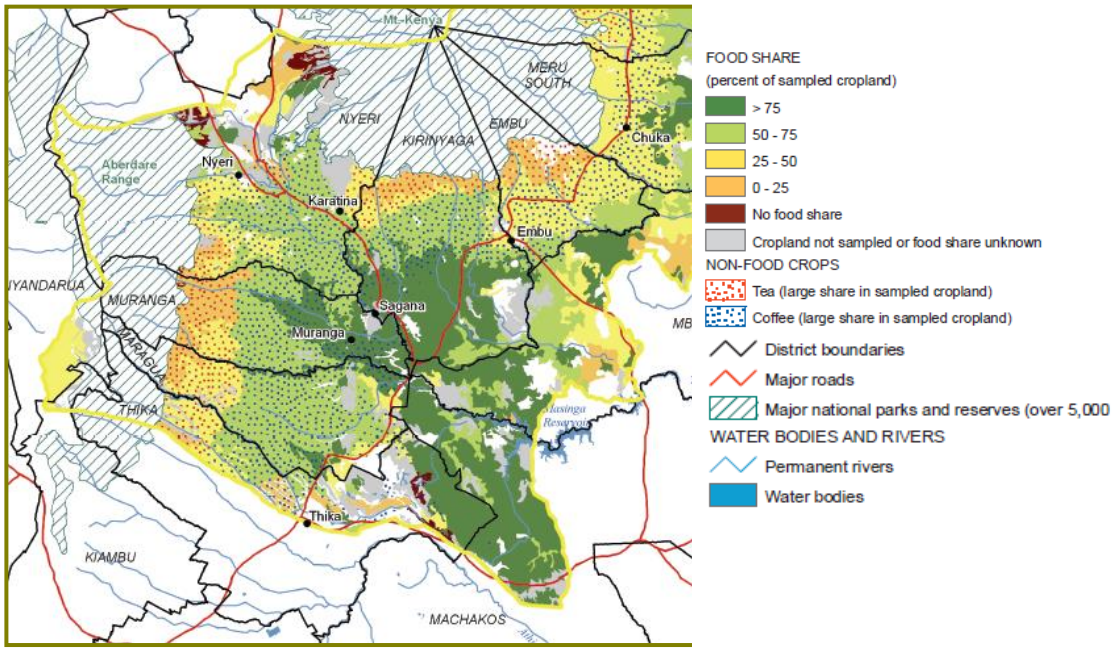


Figure 27 crops as percentage of all cropland in the project region

Cattle and sheep are the main livestock kept in the region. The number of different types of livestock is shown in Table 13 for the three counties.

Table 10: Types of livestock and the number in three counties

Livestock Type	Nyeri	Murang'a	Kirinyaga
Cattle	222,246	243,248	144,112
Sheep	168,809	54,319	27,642
Goats	102,926	187,147	101,596
Camels	88	4	7
Donkeys	3,283	3,298	3,990
Pigs	13,584	22,284	10,606
Indigenous Chicken	513,637	682,752	465,455
Chicken Commercial	152,380	415,090	82,458
Bee Hives	15,999	33,494	10,227

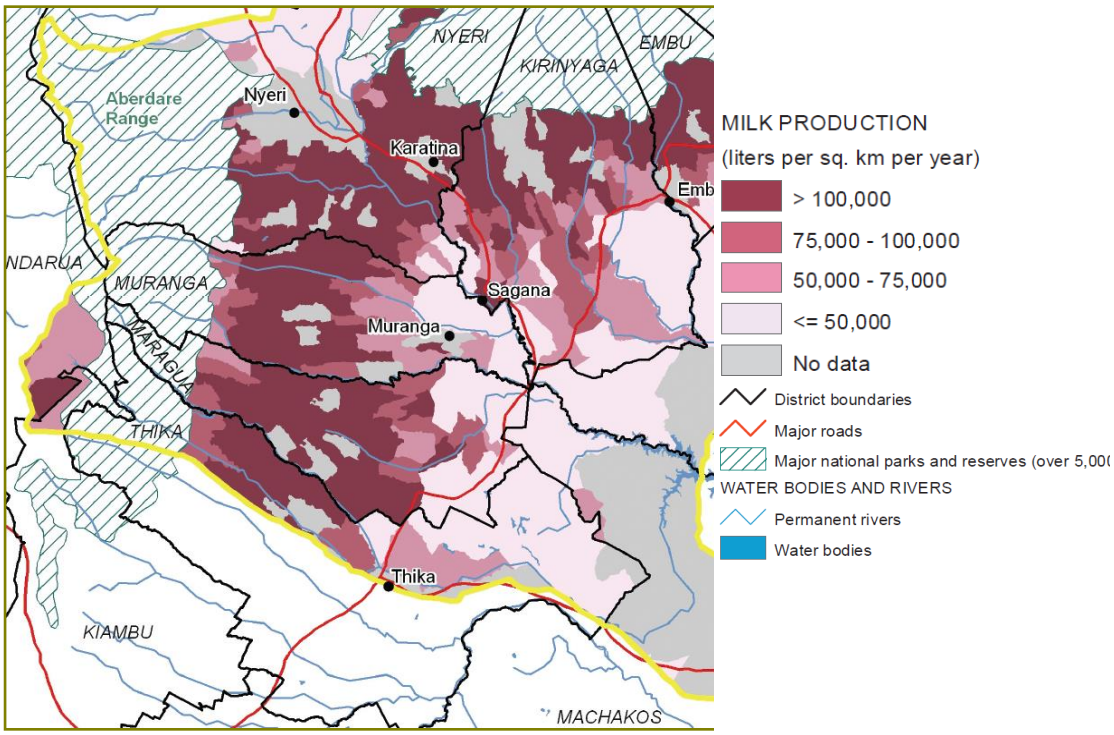


Figure 28: Milk production in the project area

(a) (b)

Plate 8 (a&b): Agricultural and settlement landscapes in Central Kenya

6.5.2 Tourism

The main tourist attraction sites in the project counties are the *Aberdares* National Park and cultural heritage sites that have a rich history on the origins of the *Agikuyu* people. Such sites are at *Mukurwe wa Nyagathanga* and *Karia Ka Mbari ya Ngware*. Other tourist attractions include Mt Kenya forest and Mt. Kenya National park, Sagana white water are *Daraja ya Mungu* ("God's Bridge") and numerous waterfalls located in the upper parts of the county. Moreover, there are also ideal natural sites for hiking and camping at Rapid Camp, *Aberdare* cottages and sport and leisure fishing sites at *Kimakia* fishing grounds and *Ndakaini* Dam.

There are also wildlife including elephants in the Aberdare forest as well as Columbus monkeys and a variety of birds, buffaloes, hippos, bushbucks, crocodiles and snakes.

Plate 9: Sample tourist attractions in the project counties

Mt.Kenya, Water falls at Sagana and Thiba rivers and The Ark Hotel in Kieni Constituency

1.1.1 Trade, Commerce and industry

Trade and commerce along the project road includes industrial processing, wholesaling, retailing, hotel and lodging/bars (Troters Hotel, Kwasamaki Hotel, Jungle mans curio shop), petrol stations as well as transport and communications. The trading centres found along the project road include Kenol, Kambiti, Makutano, Sagana, Kibirigwi and Karatina.

Karatina open air market *Kibirigwi "fruit" market*

Plate 10: Sample markets along the project road

The main processing establishment along the road is Sunny Fruit Processors while others include tea and coffee factories. There are also small-scale industries in urban centres along the project road including welding, motor vehicle repairs, carpentry, maize mills and bakeries

Plate 11: Industries: Sunny Mango Processors and Kakuzi log treatment plant

There are many banking and financial institutions in towns traversed by the project road including Kenol, Sagana and Karatina. These banks include Kenya Commercial Bank, Barclays, Standard bank, Equity bank, Co-operative bank, Barclays bank, Family bank and K-rep bank. There are also financial institutions including Micro-finance (SMEP DTM, Faulu Kenya, Kenya Women Finance Trust and Ecumenical Loan Fund (ECLOF), Building societies and insurance companies (Britam, Invesco, APA, Kenya Orient and other small agencies) as well as numerous banking agents in all markets along the project road. These institutions foster economic development through provision of credit facilities, advisory services to businesses and as channels of government funds to the vulnerable members of the population, the Youth and women (Youth Enterprise Development Fund and Women Development Fund respectively).

6.6 Water supply

The Central Kenya region has several types of water facilities ranging from boreholes, furrow, rivers, wells and springs as well as piped water. The water services are not evenly distributed with some areas only depending on surface run off or underground water.

The majority of the population of the central Kenya region obtains drinking water from untreated surface water, groundwater, or a combination of surface and groundwater. In areas where more than 75 percent of households depend exclusively on surface waters (shown in red), people obtain their water directly from lakes and streams or from reservoirs and ponds. Such areas are mostly located in the foothills of the Aberdare Range or Mount Kenya as well as at lower elevations in the plains closer to the Tana River and its reservoirs. The quantity of surface water available at any given time depends directly on natural flows of water and the patterns of rainfall that generate these flows.

Dependence on surface waters also implies direct reliance on ecosystems for their natural waste removal capacity, such as filtering by wetlands and the dilution capacity of freshwater systems. Areas in which more than 75 percent of households depend solely on groundwater for their drinking water are shown in Figure 29 in orange. Here people use springs, wells, and boreholes to obtain water. Such areas are located mostly in the lower plains and drier areas of the Tana headwaters and tributaries. These communities are likely to be somewhat less vulnerable to water quality problems due to greater natural filtering of groundwater supplies. Areas where more than 75 percent of households receive piped drinking water are shown in dark blue.

These populations are more indirectly linked to their ecosystem and in theory could rely on modern methods of municipal water treatment to insulate them from vulnerability to drinking water contamination. They are clustered in more densely populated areas, including the towns of Nyeri, Thika, Murang'a and surrounding locations.

Kirinyaga and Nyeri have higher proportions of population obtaining drinking water through pipe 43.8% and 33.4% compared to Murang'a with 16.8%. Majority in Murang'a (48.8%) use streams as sources of water.

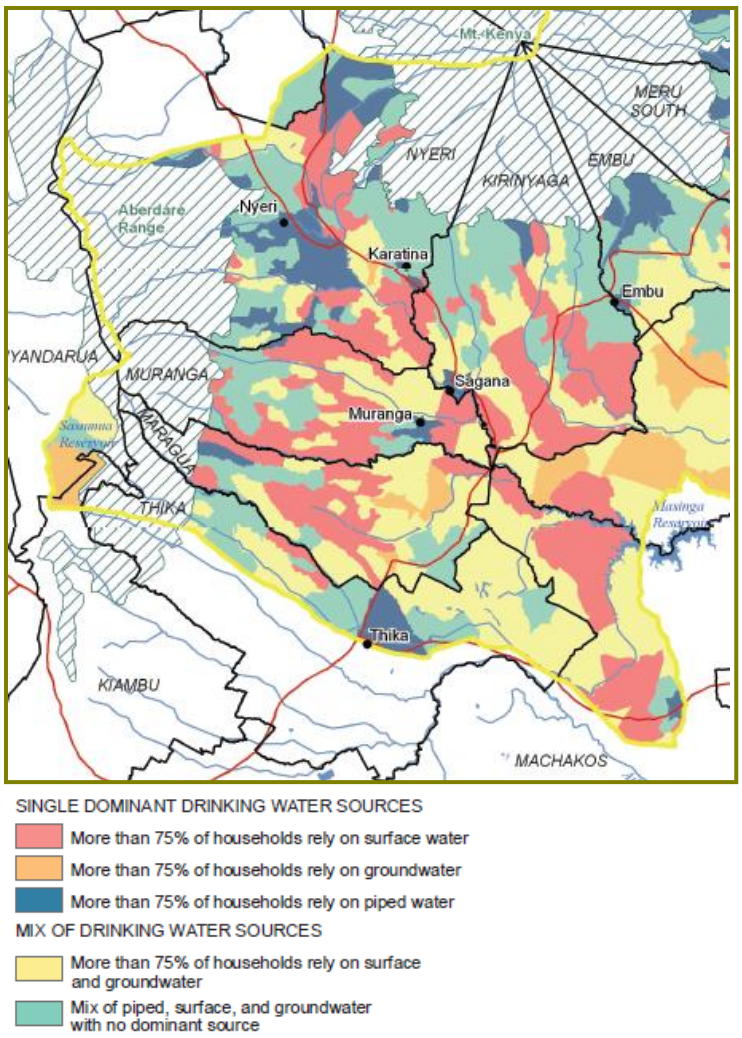
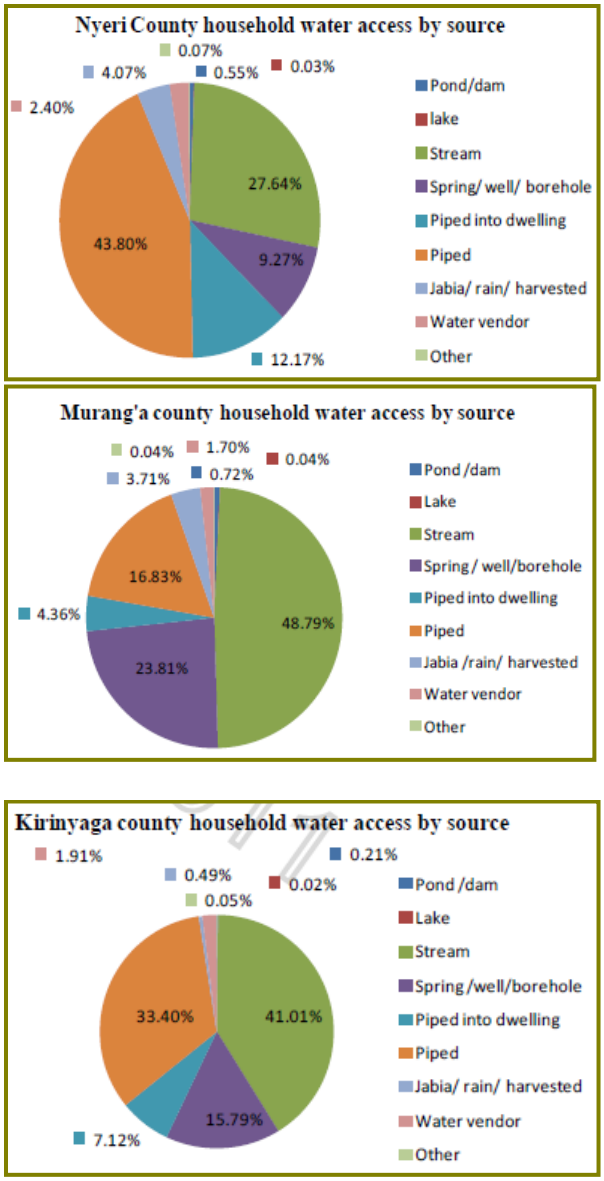


Figure 29: Dominant source of drinking water

Plate 7.10: Giakia-Gogoyo water tank along the proposed by-pass Nyeri

Plate 7.11: Hohwe Dam Nyeri East at 77+900 of the alignment



(c)

Figure 30: Sources of water (%) for human and livestock in 3 Central Kenya

6.7 Energy supply and Use

Energy supplies include electricity, wood fuel, solar, wind and petroleum based fuels. Electricity supply is connected in major and minor urban centres along the proposed road alignment

Wood fuel is the most commonly used form of energy mainly in the rural households. Petroleum products are mainly used in the transport sector although products like kerosene are also consumed in great quantities by the households. These products are readily available in the markets. Energy sources like wind and solar are not fully utilized although there is a high potential mainly because of lack of appropriate technology especially in the rural interior.

6.7.1 Electricity

Even though important to spur economic growth, the county is inadequately covered by the electricity network. Only 13.9%, 16.4% and 26.3% of households in Murang'a, Kirinyaga and Nyeri Counties are connected to electricity with an average of 18.9%. In total, there are 598, 413 households with access to electricity in the 3 counties. Electricity is mainly used for lighting purposes while fuel wood provides energy for other purposes, like cooking and heating.

6.7.2 Solar

This is the least utilized yet most abundant energy resource. The use of solar energy is limited to a few households especially within the urban and trading centres, while between quarter to half a percent of households use solar power. This is mainly due to inaccessibility of the necessary technology to the majority of the population and lack of promotion of solar energy as alternative energy source especially to electricity.

Table 11: Percentage of households' source of lighting in 3 counties

Source of Energy	Nyeri	Murang'a	Kirinyaga
Electricity	26.30	13.96	16.44
Pressure Lamp	0.81	0.54	0.67
Lantern	34.47	39.50	33.45
Tin Lamp	32.87	42.77	44.82
Gas Lamp	0.51	0.53	0.65
Fuel wood	4.28	2.31	3.47
Solar	0.50	0.23	0.27
Other Lighting	0.24	0.16	0.24
HH with electricity	53,086	33,847	25,353
Total Households (HH)	**201,703**	**242,490**	**154,220**

6.8 Education

In Nyeri, there 584 Primary and 194 Secondary schools. Primary school enrolment stands at 145,906 with at teacher to pupil ratio of 1:35 while the enrolment for secondary schools is 47,524 with a teacher to pupil ratio of 1:25. There are 2 Universities, 3 Satellite Campuses, 2 Medical Training Colleges, 2 Teacher Training Colleges, Several Youth Polytechnics and more than 18 Commercial Colleges. Adult Literacy Classes in Central region is over 6,500.

For Murang'a County, there are 500 primary schools with a pupil enrolment of 196,650 (Boys 85%; Girls 80%) and 106 Secondary schools with enrolment of 47,691 (Boys 38%, Girls 38%). There are 12 tertiary Institutions including Murang'a Institute of Technology, Murang'a Teachers College. For Kirinyaga, there are 388 Primary schools with 103,006 pupils and teacher: pupil ratio of 1:37and 123 Secondary schools, enrolment of 23,151 and teacher to pupil ratio of 1:23. There are over 1,020 Adult class enrolments.

(a) St. Michael Girls high school at 2+100

(b) Makuyu Boys Secondary at 9+850

(c.) Murang'a Teachers College at 11+300

(d) Upper Sagana Primary School at 47+200

(e) Kibingoti youth polytechnic at 59+100

(f) Kangocho Secondary School at 66+200

Plate 12: Schools and other educational institutions along the proposed road alignment

6.9 Poverty

In the Central Kenya areas, poverty is common. The poorest communities are found in the drier plains downstream of the Aberdare Range and Mt. Kenya (World Resources Institute, 2007). The main causes of poverty in the region are (IFAD, 2003b, 2003c) degradation and overexploitation of natural resources; small farm holding and low productivity and population pressure.

The most recent statistics show that the average percentage of population below poverty line in the 3 counties is 29.1%, with Nyeri having 32.7%, Murang'a 29% and Kirinyaga with a lower value of 25.6%. This is below bellow the national average of 47.2%. Even then there are pockets of very severe poverty in the counties, confirming that the available poverty measures mask a lot of inequality in the distribution of assets and income within the region (Figure 31).

The vulnerable groups hardest hit by poverty in the area include the women, the unemployed youth, widows and orphans, neglected retired old people, the street children and those living in the more marginal areas. Gender inequality is a common phenomenon in the county and is deeply rooted in the cultural and traditional values. Women are disadvantaged in terms of access and ownership to resources and decision-making. Women do not own household resources and they have limited decision-making power on the use of resources. Further, women lack exposure as they do not attend development meetings and extension services hardly reach them despite the fact they perform most of the duties at the farm level.

Poverty situation in the central Kenya region is manifested in various forms such as inaccessibility to health services, food security, inadequate potable water, inadequate shelter, poor sanitation, inaccessibility to education and landlessness.

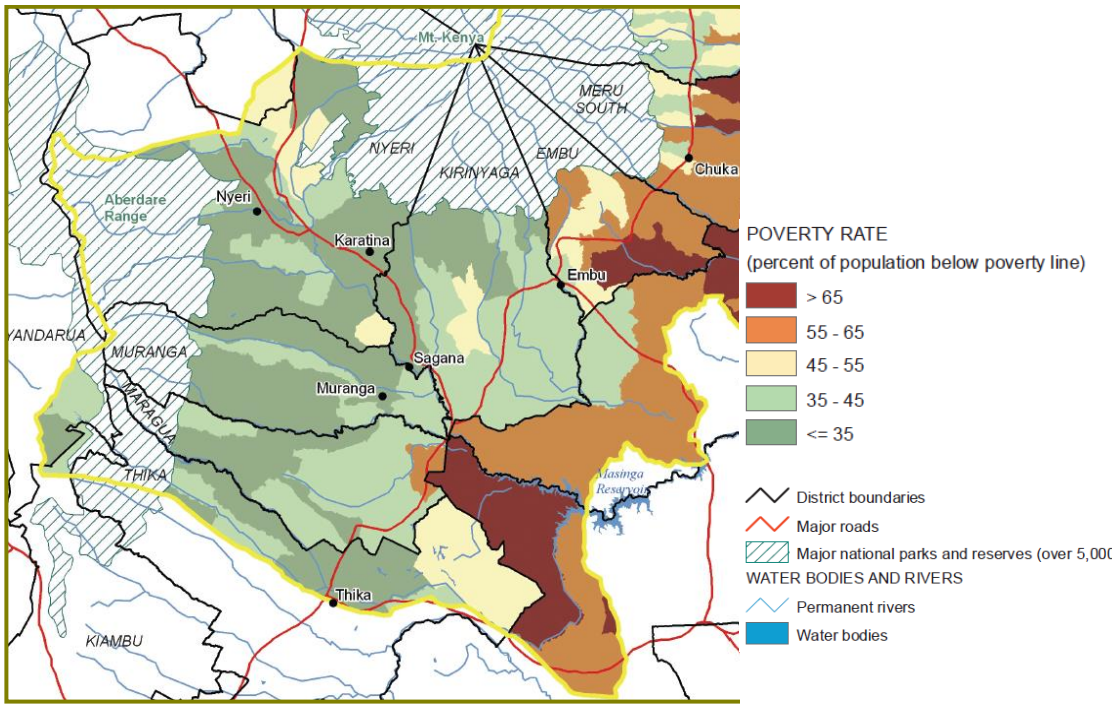


Figure 31 Poverty rate with central Kenya region

6.10 Health

In the year 2009, Murang'a County had has 3 District Hospitals and 2 Sub District Hospitals and many health centres and dispensaries that are run by the government, in addition to private clinics. The health facilities are fairly distributed with the average distance to a health facility standing at 5-7 Km. The number of doctors in 2009 was 34, with a doctor to population ratio of 1:17,000 showing an over-utilization of doctors whereas the ration for nurses was 1:1,609 . The most prevalent diseases are Malaria, Respiratory Tract Infections and Water Borne Diseases.

In Nyeri, there are 340 health facilities available as follows: Provincial General Hospital (1), District Hospital (1), Sub-District Hospitals (3), Dispensaries (109), Health Centres (13), Medical Clinics (182), Nursing Homes (3), Maternity Homes (2), Radiology Units (3), Dental Clinics (7), Eye Centre (1) and Others (15). The Doctor to Population Ratio is 1:29.000. Prevalent diseases are include Malaria, Urinary Tract Infections, Skin Diseases

For Kirinyaga there are 168 health facilities including 1 District Hospital, 2 Sub-District Hospitals, 63 Dispensaries, 12 Health Centres, 78 Medical Clinics & Centre, 6 Nursing Homes, 1 Dental Clinic, 2 Eye Centres, and 3 Others. The Doctor to Population Ratio is 1:79,690. Prevalent Diseases include Malaria, Respiratory Systems Diseases and Skin Diseases. Notable Hospitals are Kerugoya District Hospital, Kianyaga and Kimbimbi Sub-District Hospitals.

One of the major health concerns related to the project is its potential to significantly increase the spread of HIV/AIDS and other sexually transmitted infections (STIs) in the local population and among the workers. The mobilization of a large workforce over a long period is likely to increase sexual activities in the area and the presence of the workforce may even bring in a number of commercial sex workers. From the data provided, a large number of the population

is under the age of 50 (see section on demography) and being an active age group, the impacts of new relationships are highly to affect them. HIV/AIDS poses a big threat to development of the area because of increasing dependency ratio with an increasing number of orphans and street children. These could reverse progressive gains made in poverty reduction. The youth (15-49 years) are the hardest hit and this is a threat to the labour force of the region. This group is also important because of the labour force they are likely to provide during the construction phase of the project. The HIV prevalence in the 3 counties that the road passes as at 2010 are shown in Table 15.

Table 12: HIV prevalence in the 3 project counties

County	HIV Prevalence (15-49 yrs)	HIV positive (15-49 yrs)
Kirinyaga	2.74%	13,503
Murang'a	2.09%	14513
Nyeri	3.00%	20779

6.11 Physical Infrastructure

Vision 2030 development agenda by the Ministry of Planning and National Devolution mainly comprise roads and housing and are described as the basic foundations for national transformation. The poor road network is of a major concern to the area residents since it is the only link to markets for farm produce. Most accessible roads (bituminized road and all weather roads) are mainly directed to Murang'á town and lack links to nearby markets. This limits the farmers' accessibility to markets and at the same time, perishable farm produce do not always reach the markets on time.

6.11.1 Roads Network

The road network is highly utilized for delivery of farm produce to markets and factories (REPUBLIC OF KENYA, 2009). However, some areas such as the coffee and tea zone are affected by inadequate tarmacking, resealing, gravelling and maintenance due to the steep terrain, rivers and heavy rainfall which makes roads impassable. The road network in Murang'a in 2010 consisted of: 159 Km of tarmac; 210 Km of gravel/murram and 509 Km of earth surface; In Kirinyaga 150 Km of tarmac, 650 Km of Gravel Surface and 296.5 Km of Earth Surface. The proposed Kenol-Sagana-Marua dual road will follow the existing Kenol-Sagana-Marua-Nyeri road as shown in Figures below.

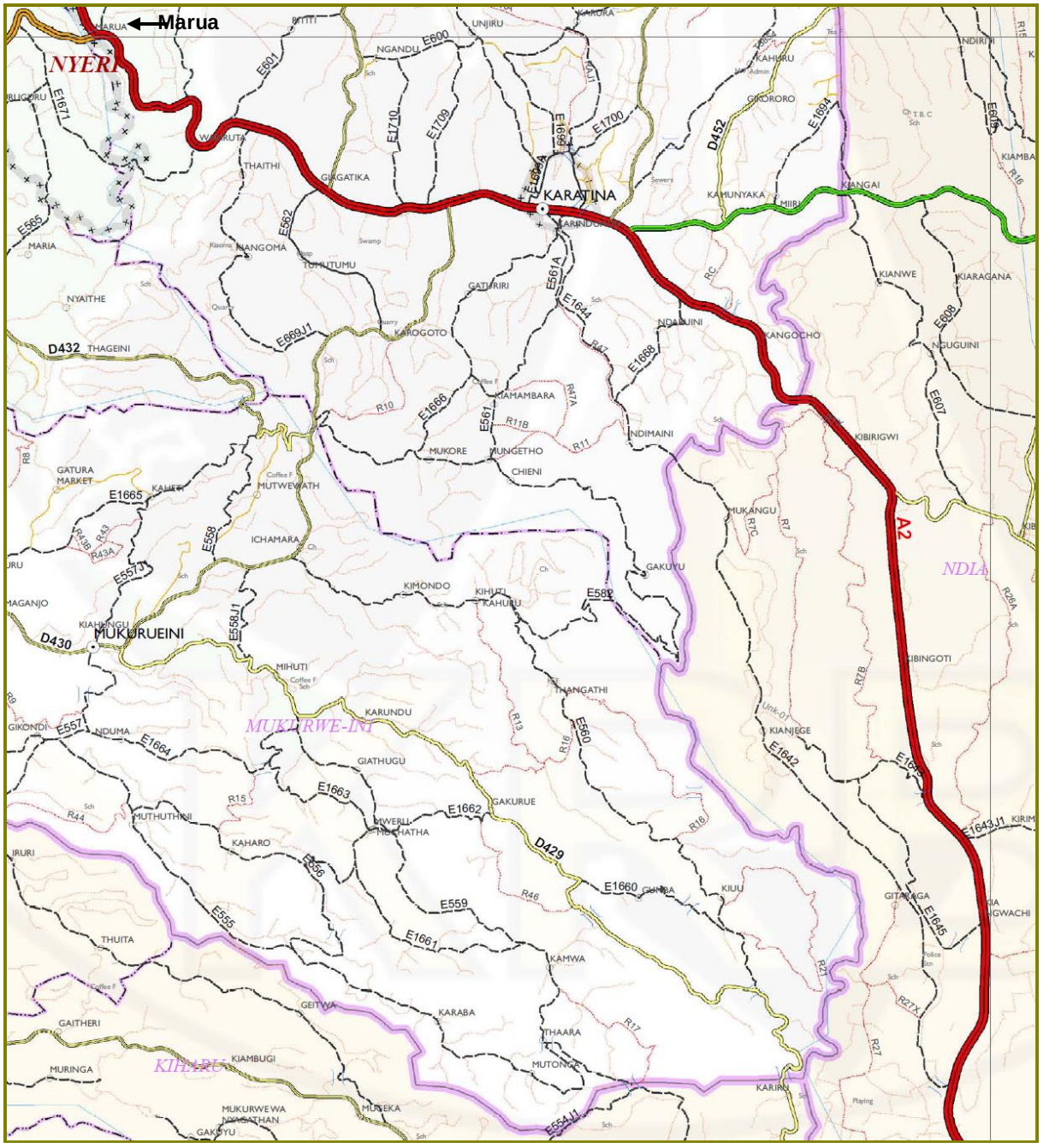


Figure 32: Nyeri County Section of the proposed road alignment

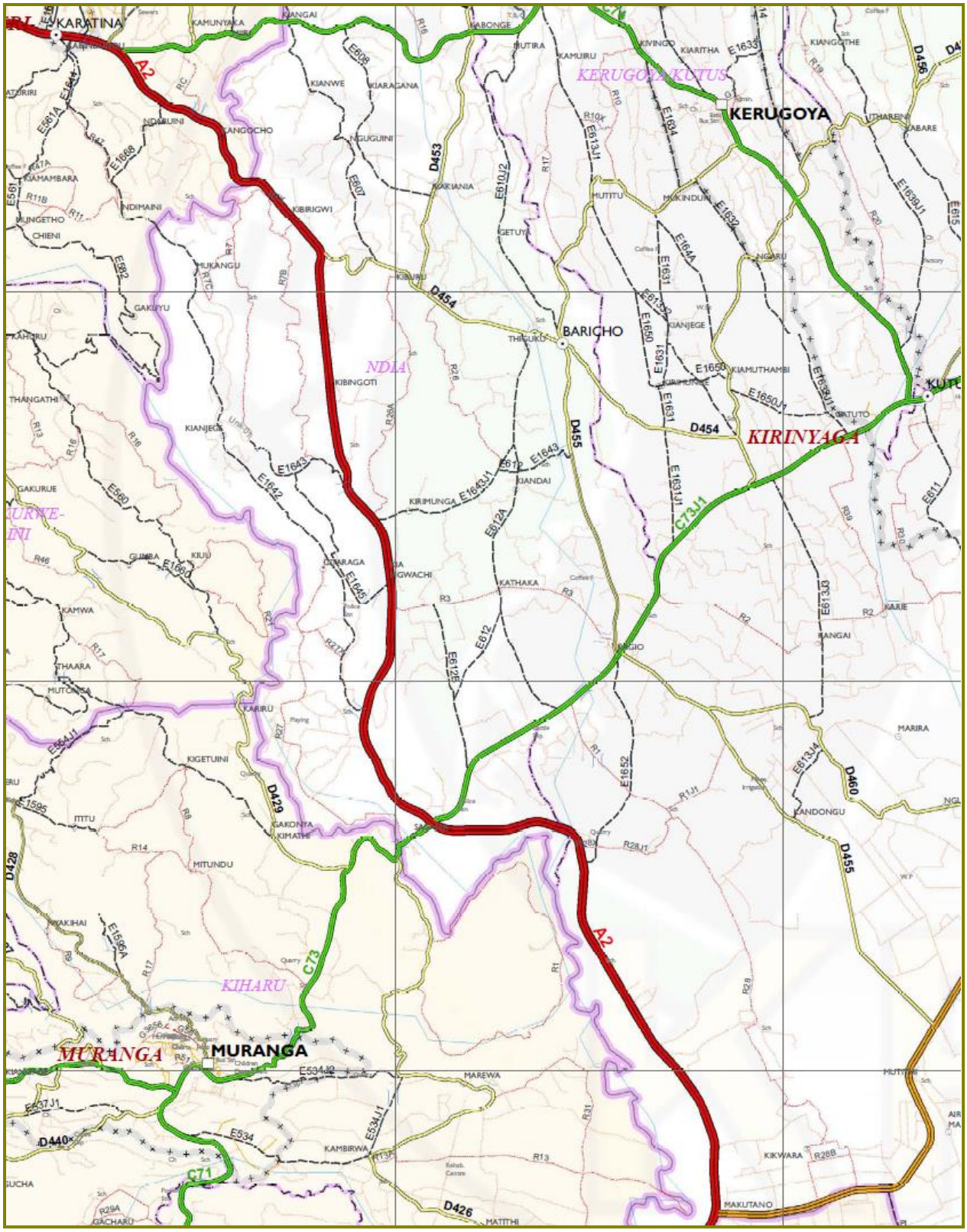


Figure 33: Kirinyaga County Section of the proposed road alignment

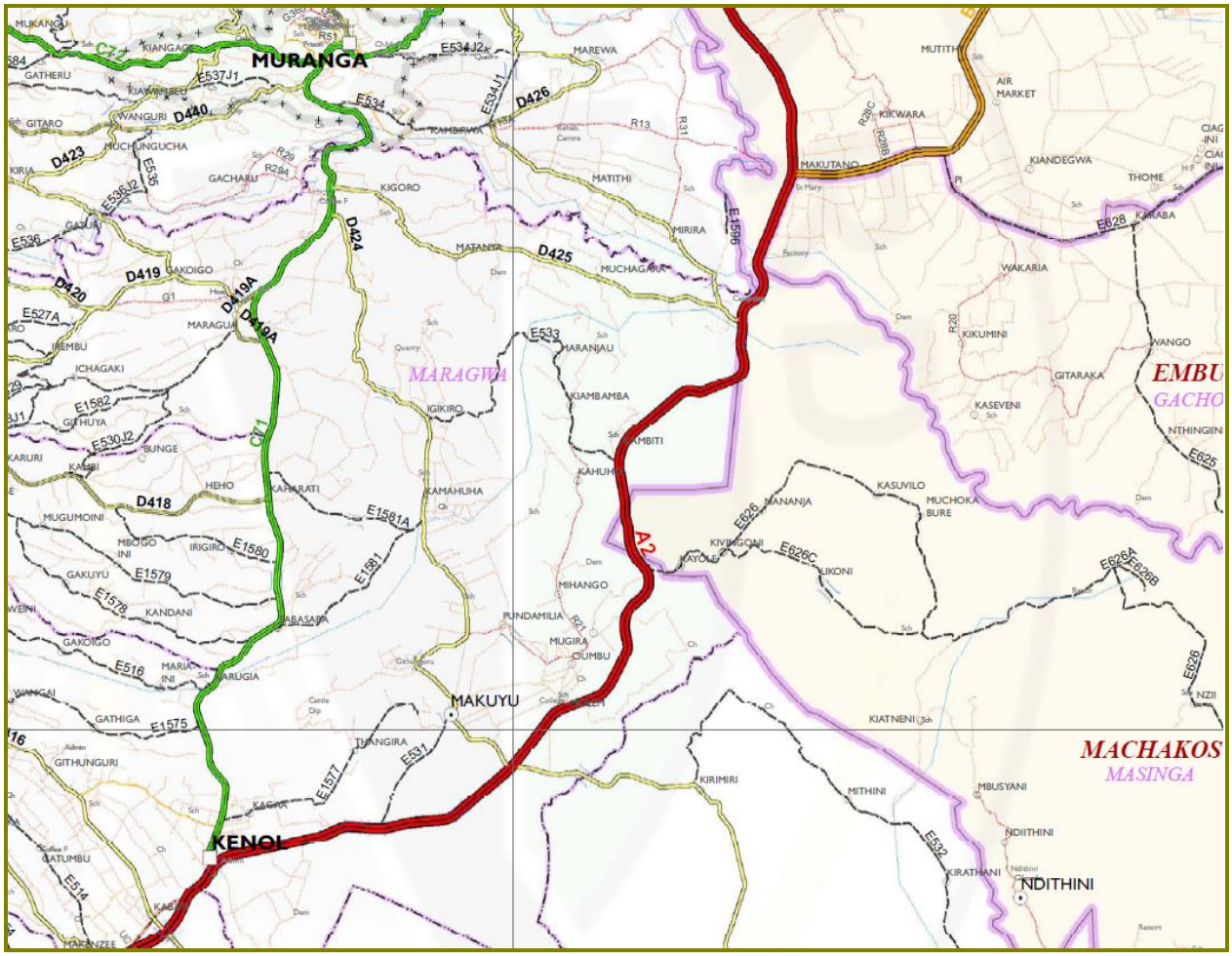


Figure 34: Murang'a County Section of the proposed road alignment

6.12 Social and Cultural Aspects

The dominant ethnic group in the project area is the Kikuyu who consists of several clans. However, there are other ethnic groups mainly concentrated in urban areas including Asians. Thus the project area generally has monolithic cultural based on Kikuyu customs and traditions. However, modern influence has eroded the traditional way of life for this community. According to Kikuyu mythology, all of creation began at the summit of Mount Kenya. Although Gĩkũyũs historically adhered to indigenous faiths, most have today converted to Christianity. The project corridor is dotted with many religious institutions including churches and mosques. Both Christianity and Islamic religions exists in addition to traditional practices.

The proposed road construction will affect the social and cultural aspects of the population in the following ways:

(i) Enhanced social interaction and networking that will further erode the Kikuyu traditional ways of life as many adopt to hybrid cultures. In addition, there will be cultural diffusion and to some extent, extinction of some values and practices

(ii) Relocation of graves will be a major concern especially the road sections from Sagana to Marua and the Karatina bypass. The key players to be involved in relocating graves from road sites will include among others the affected household and some relatives, religious leaders, the County governments and the public

administration. Relocation of one grave was estimated to cost over KShs. 150,000 depending on several factors including the structure and relocation site.

Majority of the counties' population is organized into community self-help groups, and both producer and marketing cooperative societies. There are a number of other non-state actors operating in the county including local and international Non-Governmental Organizations whose objective is to improve the socio-economic well-being of the local people.

The county has 1,832 registered self-help groups of which 676 are youth groups and 1,156 are women groups. These groups operate with a view to pooling their resources to uplift the economic and social welfare of the members.

6.12.1 HIV/Aids

HIV/AIDS is a serious health and development problem in the project area. The HIV/AIDS prevalence rate stands at 3.0%. Nyeri has the lowest prevalence rate of 2.1% while Murang'a has the highest at 3.7% as presented in the following figure:

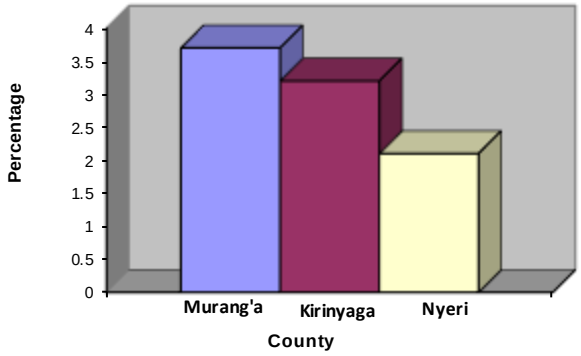


Figure 35: HIV prevalence in the project area

The major drivers of HIV/AIDS in the counties include engaging in unprotected sex, ignorance on safe sex practices, unwillingness to use condoms, ignorance on HIV status, commercial sex workers unsafe sexual behaviour, drug abuse (drinking of illicit brews), high levels of peer pressure and family breakdowns. The age group between 15 and 45 years is mainly affected by the HIV/AIDS as it constitutes the sexually active and women being the majority. There are many Voluntary and Counseling Centres (VCTs) along the project road with almost all health facilities having one.

Construction into a dual of the Kenol – Sagana - Marua road may lead to an increase in HIV/AIDS mainly resulting from "imported" prostitution. The road should therefore incorporate a major component in HIV/AIDS prevention activities.

6.12.2 Gender

The main gender issues are contained under the customary practices where the male vests ownership and control of productive assets. Women constitute about 51% of the population and contribute to 60 -80% of the total agricultural labour. Women in the counties are faced with a number of challenges including inadequate access to credit, lack of technical skills, multiplicity of roles for women and inadequate access to education and training. The tradition delineation of labour persists with women assuming the entire responsibility for childcare, provision of food, water and firewood collection and the general maintenance of the homestead among others.

81% of all households in the project area are male headed with Murang'a having the highest (89%) of tha male headed households. 19% are female headed households with Kirinyaga having the highest (25%) number of female headed households. The Table below summarizes the conditions of household headship by sex.

Table 13: Percentage Household Headship by Sex

County	Number and percentage of female headed households	
	Total number of households	**Percentage of the county households**
Murang'a	28,126	11%
Kirinyaga	38,555	25%
Nyeri	40,340	20%
Average	**107,021**	**19%**

Sources: Analytical report on gender dimensions Vol. XI

The most notable fact in the project area is that women play the primary role in farming while most men spent their time in leisure in market centers.

Culture, literacy levels and religion dictates gender issues in the project area. These in turn will dictate the levels of participation in decision making and roles played as well as contribution of resources during and after construction of the road. During construction, men indicated to participate in key decision making, authorize use of land and where to relocate/reconstruct, break ballast and undertake heavy manual works. Men would also provide security as watchmen on campsites and machines. Women indicated to participate in preparing meals for the workers and could provide water where needed in small quantities as well as undertake light manual jobs such as pouring water on constructed culverts and secretarial duties.

7 CONSULTATIVE PUBLIC PARTICIPATION

7.1 Overview

It is a Government policy that beneficiaries and members of the public living near new or improvement project sites (both public and private) are consulted to seek their views and opinions regarding the projects before they are implemented. Consultative Public Participation is therefore an important process in ESIA studies. Through this process, stakeholders have an opportunity to contribute to the overall project design by making recommendations and raising concerns. In addition, the process creates a sense of responsibility, commitment and local ownership for smooth implementation of the project.

7.2 Consultation and public participation

Consultations for the proposed Kenol – Sagana – Marua was carried out in two phases namely general indepth interviews (see annexed list of consulted persons) followed by consultative stakeholder and public participation meetings.

Phase one involved in-depth consultations with key informants including the County Governments (Murang'a, Kirinyaga and Nyeri Counties) and National Government Coordinators (the Chiefs and Assistant Chiefs), as well as GoK heads of departments (NEMA, DDO, Fisheries and agriculture among others), CBOs, farmers, land owners and traders. Under these in-depth consultations, the following observations and recommendations were made:

(i) Roads leading to institutions should be tarmacked and bumps put at the market places including Sagana and Kibirigwi.

(ii) The road will have heavy impacts on peoples livelihoods especially on travel time and saving as it will enhance trade and movement of people;

(iii) Trees along the project road should be conserved or replanted;

(iv) There is likelihood of increase in (imported) insecurity where they recommended that police posts should be constructed and police patrols conducted;

(v) The locals should be considered for employment and the contractor should pay labor offered according to the Kenyan pay standards.

(vi) Sagana needs an interchange or an overpass since the area is very deadly and the bridge and the railway is far away from the black spot.

(vii) At Kiangwaci there is need for a foot bridge.

(viii) The fruit vendor's livelihoods should be considered during compensation.

7.2.1 Consultative stakeholder participation

The three stakeholder consultative meetings, one for each County, were conducted from 18th to 20th August 2014 at various venues. The meetings were preceded by mobilization through the National Government. These sessions were used for sensitization, information sharing and soliciting comments from the participants as well as enhancing project ownership among the stakeholders who mainly consisted of policy makers and leaders. The meetings involved participation of a cross section of stakeholders including National government (County Commissioner, assistant County Commissioners and Chiefs), County government (executive and MCAs), security organs, Roads Authorities (KURA, KeNHA and KeRRA), NEMA, Institutional managers (Health, education and religion), key entrepreneurs, market chairmen, cooperative chairmen, managers of public utilities (Kenya Power and Lightning, Water

Service Boards, Water and Sewerage companies, etc), and other leaders. The venues for these meetings including dates and number of participants is presented in Table 17 while detailed minutes of the proceedings are annexed to this report:

Table 14: Schedule and participation in stakeholder consultative meetings

County	Date	Venue	Total number of Participants
Murang`a	18/8/2014	Murang`a Teachers Training College	92
Kirinyaga	19/8/2014	Ndia CDF Hall	52
Nyeri	20/8/2014	Karatina Municipal Hall	37

The general and specific issues arising from these meetings were as follows;

General Recommendations

1. KeNHA, as a precautionary measure, before implementing the project must first put up road signs to indicate the major challenges which may be on the road. Once put in place, it should be ensured that the road signs are maintained;
2. The road shoulders should be filled with soil to ensure accidents are averted;
3. Erect road signs to indicate where bridges and corners are;
4. Provide U-turns near institutions and markets;
5. Put in place street lights at the urban centers, Kenol-Kakuzi, at Murang`a TTC, Kambiti, Sagana, Kibirigwi and, Karatina;
6. Provide motorbike and bicycle operators with special facilities such as sheds for parking and specific lanes especially in Kenol and Karatina;
7. Give the local entrepreneurs priority in any subcontracts or jobs which will be available;
8. The engineers put up a special market for the fruit vendors to keep them from operating on the road reserves in Makuyu and Kibigoti;
9. Construction of the road should ensure that public utilities (water, electricity, etc) are not in any way disrupted;
10. In resettlement:
    a. The compensation rates should be fair and paid promptly before relocation
    b. Give the elderly special consideration
    c. The PAP beneficiaries should be educated on how to use the compensation money.

Specific recommendations

Construct a reserve for damaged vehicles at Kambiti hill

Erect flyovers/interchanges/under passes	County and Area Murang'a County (Kenol market, Murang'a TTC and Kambiti market) Kirinyaga County (Sagana, Kibirigwi and Kibigoti) Karatina market

Widen the road to contain accidents.	Around Mung'etho hill Between Kibirigwi and junction to Kerugoya and Karatina to Marua
Provide service roads	Kenol, Sagana
Provide bumps	Murang'a County (Kenol market, Mung'etho, Makuyu and Kambiti which are already black spots) Kirinyaga County (Kwavii)
Under pass for the cattle's	RwaMuthambi river bridge
Provide for lorries parking	Kenol market Kibigoti market
Bypass at Karatina	Participants reached a consensus that further consultation involving a wider forum of stakeholders will have to be called before the implementation of the project and especially decision to finalize the bypass.

7.2.2 Consultative Public Participation (CPP)

A total of eight public participation meetings were held along the project road between 19th and 22nd August 2014. The sites of these meetings including dates and number of participants is presented in Table 18 and detailed minutes of the proceedings are annexed to this report:

Table 15: CPP Venues and Levels Of Participation

County	Date	Venue	Locations/sub-locations Represented	No.Of Participants
Kirinyaga West	19th/8/2014	Kibirigwi Market	Kiine, Ruiru, Nyangio, Njugulni and Kareti.	215
Nyeri	20th/8/2014	Karatina Stadium	Karindundu, Mathaithi, Gatundu, Magutu, Kangima and Kiangararu.	44
Nyeri	21st/8/2014	Gatiko Chiefs Camp	Kirimukuyu, Ngaini and Tumutumu.	150
Kirinyaga	21st/8/2014	Kimincha Primary.	Rukanga,Kiandegwa,Mutithi and Wachoro.	27
Kirinyaga	22nd/8/2014	Kamuthanga Market	Kariti, Kamuthanga, Sagana, Gitumbu and Mukagara.	111
Murang`A	25th/8/2014	Chiefs Camp Kambiti	Kambiti, Kihaini and Mathegeta.	59
Murang`A	25th/8/2014	Kimorori Primary Grounds	Kenol.	83

7.3 Public Views, Opinions, Comments and Suggestions

During public consultations, participants raised various comments and suggestions. Among the key highlights from the consultative public participation meetings are presented in the following paragraphs:

7.3.1 Compensation, ROW Encroachment and Property/Asset Valuation

There is need to avoid compulsory land acquisition of property or land. The compensation efforts are likely to face challenges due to pending court cases. In such cases, for those having cases and disagreements, they should first agree among themselves on who is to be paid. There were fears that the government will compensate at low values and may take long to pay. However, compensations should be timely provided at market values and an additional 15% disturbance fee provided. The aim is to ensure that the PAPs livelihood is restored or improved further. Clarification was sought as to how government land will be compensated. Public land and facilities are restored. For example the fences and institutions are re-built.

It is important that the project affected persons be educated on how to use the compensation money. The PAPs should be advice in advance to open bank accounts as compensation will be made through personal bank accounts and not cash. Issues of compensation will however be further be addressed during subsequent PAPs meetings.

7.3.2 Road Safety

Accidents, emanating from speeding vehicles and construction machines (among the operators during construction), may increase. Accidents are likely to occur in sharp corners at Mahiga-ini, Mung'etho, Sagana, Kambiti, Kibirigwi and, Kaseve site. In order to minimize the accidents, these sites should be provided with road marks, regulatory and cautionary signs and speed limits to reduce the accidents.

During construction the roads are very dusty and the contractor should provide for tarmac at the diversion route. In addition, the contractor should provide diversions on convenient sites which will reduce conflict when the contractor is on the ground.

7.3.3 Public Utilities

Water and electricity lines are normally disrupted during construction and there were concerns that measures be put in place to handle such issues. Therefore, service providers of water and power are involved from the beginning and are advised to do the necessary relocation of the facilities before construction commences.

7.3.4 Provision of Complementary Road Facilities

There were requests to extend the road so as to include market service roads in Kenol, Sagana and Karatina as well as feeder roads. However, the earmarked project is designed to provide dual road only.. Other roads could be constructed under KeRRA or KURA and residents were directed to consider this in the requests.

7.1.1 Employment

The stakeholders and general public feared that the available job opportunities for the people along the project road will be snatched by "outsiders" who commonly come with the contractor. The communities along the road therefore need to organize in order to forge a common employment agenda. It is important that employment opportunities priority be given also to the physically challenged and the elderly.

7.3.5 Design of the Road

The design should take into account the following:

(i) Location of stages for the public vehicles and safety measures to reduce accidents especially in regard to school going children.

(ii) Consideration when constructing U-turns to ensure that motorists do not travel far before turning to join traffic on the direction they want to head to.

(iii) Space for lorry parking was also cited as a major constraint. It was therefore agreed that there is need to look for possible alternatives through consultations with the relevant County Government authorities to provide space in Kenol and Kibirigwi.

7.3.6 The Marginalized and Vulnerable Members of the Public

People with disabilities were identified to face challenges if the road design does not provide specific facilities for this category of persons. Thus facilities to serve them should be provided adequately including rumps on footbridges as well as signboards.

7.3.7 Drainage

A number of road sections were noted to face drainage (storm water – soil erosion and waterlogged soils) challenges including Sagana. The public recommended that drainage should be considered so that it won't cause erosion.

The design should therefore provide adequate culverts and in addition, KeNHA should purchase land wehere drainage terraces and gabions are to be constructed. The road construction should also not block public water (mainly springs) sources along the road. However, the locals should be vigilant and ensure that water is not directed to their farms and institutions.

7.4 Gender Analysis

7.4.1 Rationale for Gender Analysis

The Feasibility Study, Environmental and Social Impact Assessment and Detailed Engineering Design of the Kenol - Sagana - Marua Road are financed by AfDB. One of the main principles of the Africa Development Bank (AfDB) is to promote gender mainstreaming in the Bank operations including its funded projects. The complete gender report is in a separate volume.

7.4.2 Methodology

1. Gender analysis was aimed at understanding the gender dimensions of road infrastructure development among communities living along the road corridor through identification of barriers to women's full participation in economic development. It was carried out using the rapid assessment procedures methodology. The RAP methodology adopted qualitative and quantitative data collection tools including semi-structured questionnaires, observations and focused group discussions – tools which are attached as annexes to this report
2. In total of 268 individuals operating and living along the full road length corridor were randomly selected and interviewed and eight focus group discussions were conducted with men, women and mixed youth and the physically challenged persons.

7.4.3 Socio- economic data

A gender analysis exercise was carried out from 23rd to 29th September 2015. A total of 268 individuals spread (operating/living) in the 31 sub-locations along the full road length corridor and its proposed bypass were randomly selected and interviewed using a semi-structured

questionnaire. 194 resided in the rural while 66 resided in the urban areas. Among the interviewed, 4% were child headed, 29% were female headed and 67% were male headed. On gender basis, 48% were female headed households and 52% were male headed households.

The average membership in male headed households was 3.8 members and in female headed households was 4.4 members. 80% of the respondents were married, 15% were single, 1% were divorced and 4% were widowed. The average age for male household heads was 45.1 years while the average age for female household heads was 47.4 years. 37% of the household heads were aged 36-50 years while only 2% were below 21 years and 10% above 65 years. 24% and 27% aged 21-25 and 51-45 years respectively.
11% of the populations were illiterates while 38% had attained primary level of education. 31% were secondary school leavers, 9% had attained college/technical level of education and 11% were University graduates.

6% of males compared to 17% of females had not attended any school education. 38 of men compared to 39% of women had attained primary education level. More females (34%) than males (27%) had attained secondary school education level. The main ethnic group along the project corridor is the Kikuyus followed by the Kamba. Other ethnic groups along the project corridor include Mbeere, Embu, Meru, Luhyia and Kamba among others. Over 98% of the people along the project road are christians, the rest being Muslims and Hindus. Twenty two percent of the respondents indicated they earn less than KSh. 5000 while 11.5% earned above kshs. 30,000. The Highest income earned by men is KSh 3,200,000 while that earned by females is lower at KShs. 1,000,000. The lowest income earned by men is KSh 2,000 while that earned by females is KSh. 500.

7.4.4 Land ownership and access

85% of the respondents indicated to have title deeds while 14% had allotment letters to the land they occupied where male headed households outnumbered the female headed households under this category.

7.4.5 Gender roles

Traditionally, male roles included heavy manual duties such as quarrying, defending their families/societies, house construction and advice/decision making among others while women roles were viewed to include child bearing, singing as well as domestic household chores and guidance and counselling of the youth and other women. The youth roles included schooling, tending their young siblings as well as keeping livestock. In the project area, women are involved in charcoal sells, agrovet, fruit selling, hotel, petrol station/restaurant, selling seedlings along the road, shop keeping. Men are involved in businesses such as shop keeping, liquor bars, transport business and sometimes casual labour.

7.4.6 Transport, control and ownership

Both gender have equal access to all types of transport options available but women control mainly donkeys while men in addition also own and control Boda boda taxis and Vehicles. Both gender use all available means of transport (Bicycles. Motorcycles, Car/vehicles, Donkey and Hand carts) mainly for business and accessing social services.

7.4.7 Project Impacts on Gender

Both gender indicated that construction of the road will lead to various benefits including getting employment and income generation, experience and socializing, easing congestion, reduced accidents, reducing maintenance of vehicles, Job opportunity will emerge, enhanced

safety to pedestrians, psychological satisfaction due to availability of job and may further education with money generated from employment.

Negative impacts anticipated from the project will include business disruption, health hazards (pollution from machines), relocation of business premises, increase in accidents due to speeding of vehicles on the newly constructed road, cultural choke, immoral activities and insecurity.

7.4.8 Conclusions and recommendations

Both gender felt the need for the road to be built was high. In general the community feel that the potential negative impacts should be mitigated and the positive benefits enhanced to realize full potential of the project. It is recommended that employment for the locals be prioritized and especially for female headed households. It is recommended that various gender issues be monitored during construction especially changes in livelihoods, local employed especially women, number of accidents by gender, prevalence of road related diseases, levels of gender awareness and road related social issues. Further women should be involved during and after compensation and awareness about the risks of diseases brought about by engaging in sexual activities with construction workers needs to be created.

8 RESETTLEMENT AND COMPENSATION ISSUES

8.1 Introduction

A separate full resettlement action plan has been undertaken for the dualling of Kenol – Sagana – Marua road and a separate report has been prepared.

8.2 Areas Most Affected

Land acquisition and property compensation will mainly occur in areas under the following categories:

(i) Market centres of Kenol, Makuyu, Makutano, Sagana, Kibirigwi and Karatina mainly due to encroachment especially by informal enterprises where structures will have to be cleared thereby affecting livelihoods of the PAPs. Those to be affected will include hawkers, tree nursery operators, fruit hawkers, partial daylight business persons selling vegetables and fruits;

(ii) The road section from Sagana to Marua where an extra 20 feet will have to be acquired. Those affected will mainly include farmers and affected items will include crops, structures and land;

(iii) Karatina bypass running slightly over three kilometers as the road will mainly be constructed on fresh alignments. Majority of those to be affected will include business men and farmers while affected items will include crops, structures and land. The impacts will be heavy owing to high population and housing densities, and impacts on institutions along the route;

(iv) Makutano and Marua interchange sites. At these sites, the impacts are minimal as the areas have not been much developed.

8.3 The Project Most Affected Persons

Project Affected Persons can be categorized into four broad groups namely, those:

(i) Whose whole structures and/or plots will be fully acquired – mostly plots in market centres;

(ii) Whose land and farms will partially be acquired;

(iii) Whose land and farms will partially be acquired including housing structures;

(iv) Who will be affected by the changed environment as they co-exist with the transmission line and;

(v) Whose businesses and livelihoods will be transformed

8.4 Activities that would lead to resettlement and compensation

A 60 meter road corridor would be required as per the typical designs for road implementation. Construction of the road will include activities that give rise to resettlement including:

i. Expansion of the existing road to accommodate dual carriage way with proper two lane facility and shoulders

ii. Improvement of the horizontal alignment at selected locations to reduce sharp curves and thereby provide safe driving conditions,

iii. Widening, repair or reconstruction of damaged bridges and culverts including construction of new drainage structures,

iv. Provision of service roads and cycle lanes, especially in the town centres

v. New interchanges and expanded junctions

The above activities will lead to land acquisition, physical displacement of people, loss of shelter, loss of assets, loss of income sources and livelihoods, and restriction of access to economic resources.

8.5 Impact Areas

Impact areas for the road will be concentrated along the road corridor and specifically from Sagana to Marua where an extra 20 meters will be acquired and in within the Karatina Bypass. The road's affected administrative areas lies within the 22 sub-locations in Embu, Kirinyaga, Murang'a and Nyeri Counties. The various administrative units traversed by the project road and where the above impacts will occur are tabulated in the Table below:

Table 16: Impact administrative areas

County	Sub-county	Location	Sub location
Embu	Mbeere	Karaba	Kaminji
			Rukanga
			Kachoro
Kirinyaga	Kirinyaga west	Kariti	Gacharu
			Sagana
		Kiine	Kibingoti
			Nguguine
			Kirimara
Muranga	Maragua	Kambiti	Mihango
Nyeri	Nyeri south	Kirimara	Gatundu
		Mathira east	Iriani
		Mathira east	Karatina
		Kirimuuyu	Baricho
		Kirimuuyu	Gathima
		Gatundu	Gatundu
			Gaturiri
		Ruringu	Marua
			Mathaithi
			Mathira east
			Mbogoini

8.6 Impacts on Socio-cultural network and support systems

The perceived impacts on social groups included breakdown in communication, cessation in reception of benefits, disconnection/loss of the member/dismissal, failure of organization and activities, increased distance to organization meetings, interference with savings, loss of premises, and reduced group activity/coordination.

A cultural amenity however that raised issues was on graves as whenever these were affected, the PAPs did not wish to think twice about. Relocation of graves is an emotional issue that needs to be addressed under this RAP as they cannot be valued; hence the

owners need to get a token for its relocation according to the traditional or modern/religious procedures. In as far as emotional relocation of graves, there is need for an intensive social engineering prior to the project implementation.

8.7 Impacts on institutions and public utilities

A total of 54 public institutions ranging from education, health, religious, security and water institutions will be affected. The affected institutions and utilities are tabulated below:

Table 17: Affected Institutions

Churches	Schools	Factories & Society Farms	Offices	Water Projects	Health Facilities & Cemeteries
1. Sagana Mosque 2. ACK Gitumbi 3. PCEA Mathaithi Church 4. EAPC Church 5. Redeemed Church Kiangwaci 6. St Stephens Church Kiangwaci 7. PEFA Church 8. PCEA Kibirigwi 9. Deliverance Church Kibirigwi 10. Kagocho Aipcea 11. Kagosho Catholic 12. Pcea Mathaithi Church 13. SDA Kienjeini 14. PCEA Kienjeini 15. Glory Outreach 16. PCEA Kianjogu 17. St James Catholic Church	1. Upper Sagana Primary 2. Kiine Mixed Day School 3. Kibirigwi Girls 4. Kibirigwi Primary 5. Brookfield Academy 6. Deb Primary School 7. Karatina Girls 8. Mathaithi Girls 9. Mugi Academy 10. Kirimara High School 11. Pcea Mathaithi Primary School 12. Kianjogu Secondary School	1. Karatina Factory 2. Gatomboya Factory 3. Kpcu Sagana 4. Tegu Coffee Factory 5. Marua Coffee Factory 6. Kibirigwi Dairy Farmers 7. Kibirigwi Farmers Cooperative 8. Kianyakura Farm 9. Muri Farm.	1. Kifco Dos Office Kibingoti 2. 2nk Sacco 3. Kiangwaci Police Patrol Base 4. Karatina Ap Camp 5. Administration Plot Makutano	1. Rukanga Water Project 2. Kifco Intake Plant 3. Kiwasco 4. Mathira Water And Sanitation Company 5. Mahiga-Ini Springs 6. Tarda 7. Hohwe Dam	1. Gatithi Dispensary 2. Kibirigwi Health Centre 3. Githima Dispensary 4. Karatina Cemetry
Total: 17	**12**	**9**	**5**	**7**	**4**

		
A petrol station	A residential house	A cattle pen
		
A treatment plant & water tank	Karatina Girls' Highschool	A police station & a Church

Plate 13: Sample of affected properties

8.8 Minimizing resettlement and losses

The proposed measures to avoid or minimize land acquisition and disturbances include reducing the road reserve, redesigning the project route at certain points, facilitating consultations and participation with the PAPs, and putting appropriate impact limitation and mitigation measures in the construction and design stages. Minimizing impacts during construction stage will entail implementing various measures including:

i. Preference for hire of existing rental houses, rather than building workers' camps, which also will boost the economy of the area. This would go hand in hand with hiring of local residents who would reside in their homes;

ii. Roads for earth moving equipments should be strictly confined to existing tracks to limit social disturbances and destruction of the environment;

iii. Project will be carried out after the harvest of crops so as to minimize damage to crops;

iv. It is proposed that all those that shall be affected by the project should be compensated before project commencement to ensure that their livelihoods have improved or restored to the pre-impact status.

Overall, the results of efforts to minimize resettlement will be to:

- Significantly reduce disturbances and resettlements and therefore lower the costs of resettlement for the proposed project;
- Ensure majority of the residents positively support and participate during the project implementation and operation;
- Enhance and sustainably maintain social integration;
- Residents' livelihoods will be left undisturbed.

8.9 Cost of Compensation and Resettlement

The compensation cost caters for loss of land, trees, crops and structures by the PAPs, and disturbance allowance. The compensation cost depends on the preferred route as noted on the summary Table below. If the preferred route is through the bypass, the compensation is approximately Kshs. 3.7 billion (Read Kenya shillings three billion, seven hundred million). However, if the preferred route is through Karatina Town, the compensation cost is approximately Kshs. 4.5 (Read Kenya shillings four billion, five hundred million) as summarized on the Tables below and presented in detail in the full report.

Table 18: Estimated value according to various routes (KShs)

Route	Structures	15% Statutory/disturbance fee	Land	Trees	Crops	Total
Bypass	99,347,399	14,902,110	863,364,249	30,657,750	4,192,040	**1,012,463,548**
Karatina	825,807,870	123,871,181	822,036,048	7,287,350	1,873,411	**1,780,875,860**
Kenol-Marua	885,064,891	132,759,734	1,593,660,743	69,696,650	4,896,500	**2,686,078,518**

Table 19: Estimated value on alternatives routes (Kshs)

Kenol-Marua thro Bypass	Kenol-Marua through Karatina Town
3,698,542,066	**4,466,954,377**

8.10 RAP Monitoring Framework

During the RAP implementation, monitoring will be conducted on a continuous basis by the PIU through the PAPC/CRC who will collect and record the information of resettlement activities and submit the monitoring reports, on timely basis, to the PIU and attend its meetings. In the overall internal monitoring framework, there will be continuous information circulation from the village level through the PAPC/CRC to the PIU Office accompanied by periodic supervision and verification by the CRC Office. The monitoring and evaluation involves both the internal and external monitoring.

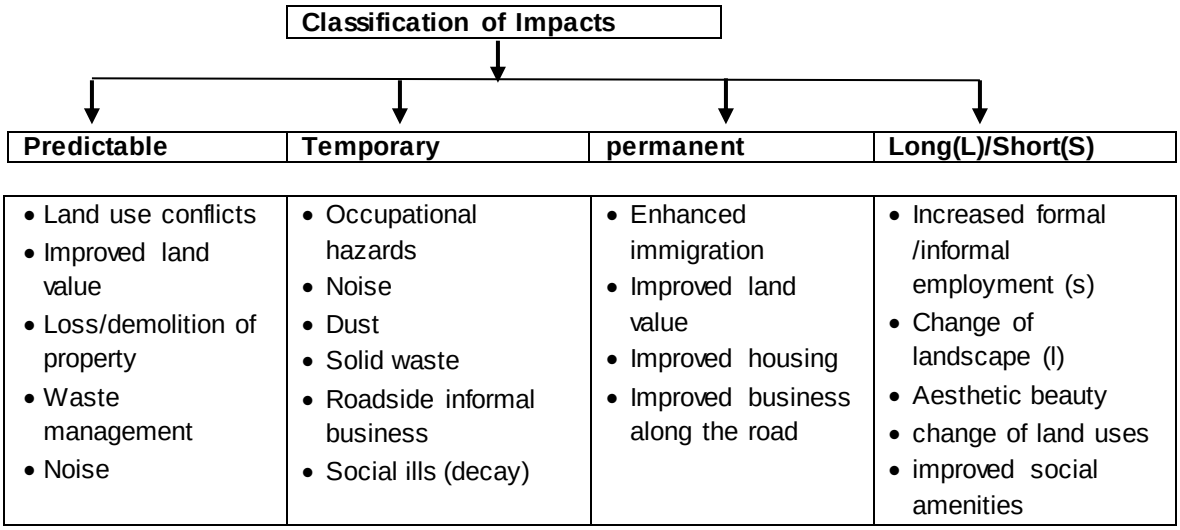
9 ENVIRONMENTAL AND SOCIAL IMPACT ANALYSIS

The purpose of the ESIA of the road project is to improve decision making and to ensure that the project progresses in a sustainable approach. The ESIA identifies ways of improving the project environmentally and socially by preventing, minimizing, mitigating, or compensating for adverse impacts.

These measures will help to avoid potentially costly remedial measures. The proposed road project activities are likely to have potential impacts on natural and human environment. These impacts can be categorized in various ways. They can be grouped according to their nature, into positive or negative impacts, random or predictable impacts, cumulative, local or widespread impacts, temporary or permanent impacts, short- or long-term impacts or even their level of magnitude.

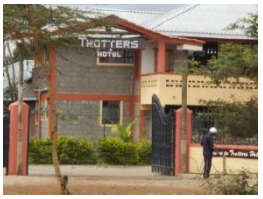
Table 20: Type of impacts and examples

Type of impact	Example
Predictable	Road accidents due to speeding.
Temporary	Noise and dust during haulage of raw materials from borrow pits or quarries.
Permanent	Change of landscape within areas where new roads are constructed or if a new road alignment will be followed.
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 surfacing a 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 an area stemming from easier (more profitable) transportation of logs to market or the influx of settlers.
Cumulative	Impairing the water regulating and filtering capacity of a wetland system by constructing a road across it.



9.1 Sensitive Environmental and Social Features along the Road

The Table below lists the environmental and social features along the road which will require special care during construction.

S/N	Chainage	Features	Comments	Picture
1	0+000	End of Existing Thika - Kenol Dual Carriage and start of the proposed Kenol - Marua Dual Carriage. Kenol filling station, kiosks, residential and commercial buildings.	Some buildings encroaches the road reserve with a few roadside nurseries	
2	1+600	Kaaga Catholic	Noise receptor during worship hours	
3	2+100	St. Michael Girls high school to the right of the alignment. Marshy area/ swamp on the left. A few Acacias and gravellia on the school compound	Dominant trees along the stretch are; Gravellia, Blue gum, Acacia. Presence of Noise and air pollution receptor	
4	2+700	Bishop John Mahiani Junior School on the right and Josaly Boys and Girls Boarding on the left	Noise and dust receptor during the construction phase	
5	2+900	Trotter Hotel on the right of the alignment	Positive during construction phase of the project. Good business opportunity. Possibility of air and noise pollution	
6	3+700	Thangira shopping center	There is possibility of air and noise pollution during the construction phase of the project especially to the existing shops. Safety concerns.	

S/N	Chainage	Features	Comments	Picture
7	4+100	Oilibya petrol station on the left of the alignment	Care should be taken to avoid damage that could lead to ground water sippage	
8	4+200	Railway crossing through an under-pass	Road expansion will lead to loss of acacia trees along this section.	
9	4+350 to 5+000	Start and end of Eucalyptus plantation on the left of the alignment	Biodiversity loss	
10	4+300 to 5+100	Start and end of Eucalyptus planation on the right of the alignment	Biodiversity loss	
11	5+100	Makuyu KPLC Sub-station. Few acacia spp with an average DBH of 40 cm	Loss of trees on the road reserve	
12	5+600 to 9+600	Eucalyptus plantation with few acacia spp along the right side of the alignment	Biodiversity loss	
13	9+400	Huhi town center with few business premises and eucalyptus and acacia spp on the right side of the alignment.	Noise and air receptor during the construction phase. Loss of Biodiversity	
14	9+600	Proposed Under-pass within an area with few huge eucalyptus and acacia spp	Potential loss of flora	
15	9+850	Makuyu boys secondary school on the right of the alignment	Noise and air quality receptor during the construction phase of the project when school sessions are on.	
16	10+300	Eucalyptus plantation on the right of the	Few trees on the road reserve	

S/N	Chainage	Features	Comments	Picture
		alignment and ending at 11+100		
17	10+600	Rural Electrification Authority poles treatment plant, Makuyu		
18	11+300	Murang'a Teachers Training College	Noise and air quality receptor	
19	11+800	Eucalyptus plantation on the right of the alignment and ending at 12+650	Possible loss of trees	
20	12+150	Eucalyptus Plantation on the left of the alignment. There is a water pan further down	Possible pollution of the dam that help the locals with domestic water supply	
21	12+700	Pine plantation on the right of the alignment that ends at 12+950	Possible loss of trees	
22	13+250	Gulley erosion prone area with likelihood of further soil degradation	Enhanced land degradation	
23	14+200	A stream running across the road	Potential water pollution	
24	14+500	Sloppy area on the right of alignment	Soil erosion may occur	
25	14+600	Mungetho center with river Mungetho crossing the road. There are acacia trees.	Care should be taken to avoid ground water contamination	
26	15+900	Sloppy area on the right of alignment. Some tree nurseries within the road reserve.	Soil erosion may occur.	

S/N	Chainage	Features	Comments	Picture
27	16+800	Gitini nurseries on both sides of the alignment	Possible loss of livelihood	
28	17+200	Fruit trees both side of the alignment e.g. Mango, grevillea	Possible loss of livelihoods	
29	17+400	Water pond	Possible loss of fishing ground for the locals.	
30	19+200	Rocky slope on the right of the alignment	May require rock blasting hence causing noise pollution to neighbouring households	
31	20+500	Kambiti town center	Possible noise and air quality receptor	
32	21+200	Apple park resort	Possible noise and air quality receptor	
33	22+600	Gulley prone area with likelihood of soil degradation	Caution required during construction	
34	22+900	Kambiti Secondary school on the right of the alignment. Sunny processor ltd on the left of the alignment.	The area is rocky and may require rock blasting thus causing noise pollution to the two institutions	
35	23+900	Water pan on the left of the alignment	Water pollution	
36	24+400	Seasonal stream cuts across the road	Possible water pollution	
37	25+200	Kwamuthike town		
38	26+350	Saba Saba River also known as Mathengeta. Few fruit trees, eucalyptus and acacia, fishing activities.	Sand harvesting carried out in the area.	

S/N	Chainage	Features	Comments	Picture
				
39	27+100	Bushy area around an upcoming market	Loss of vegetation cover	
40	27+300	Rocky slope on the right of the alignment with short bushes	Land cover exposure and rock blasting could occur	
41	27+600	Tana power station run by KENGEN	Impacts avoided in design	
42	27+950	Tana River crossing	Water quality and erosion issues.	
43	29+050	Tebere concrete co ltd	Sloping terrain, possible soil erosion	
44	30+900	Joseph Allamano Wachoro sec school.	Potential noise receptor	
45	31+700	Makutano junction to Mwea. Grevillea and acacia spp on-farms proposed for the under-pass	Enhanced air pollution due to soil types hence fine dust	
46	32+500	Muragu stream with marshy grasses	Impact on wetland	
47	33+100	CMI - Christ is the King primary school	Possible noise and air quality receptor	
48	35+900	Seasonal stream cuts across the road with piped water under the curvet	Water pollution issues	
49	38+300	Marshy area with piped water running in the culvert	Water pollution	

S/N	Chainage	Features	Comments	Picture
51	41+400	Marshy are with sugarcane and few trees on the right of the alignment	Water pollution	
52	41+700	Open quarry and a water pan on the left of the alignment. Used by locals for irrigation	Possible pollution	
53	42+800	Muthambi River	Water pollution	
54	44+300	Seasonal stream	Water pollution	
55	45+600	Marshy area on the left of the alignment with banana trees on the right	Possible loss of livelihood	 
56	46+000	Kenol petrol station on the right	Safety and soil pollution risk	
57	46+200	Skyline petrol station and restaurant on the left of the alignment	Safety and soil pollution risk	
58	46+300	Sagana fish farm. Petrol station on the right of the alignment	Possible pollution of pond, risk of pollution.	
59	47+200	Upper sagana primary school	Possible noise and air quality receptor	
60	48+500	ACK Diocese of Kirinyanga. St Annes Gitumbi church	Possible noise and air quality receptor	

S/N	Chainage	Features	Comments	Picture
61	52+000	Grevillea along the alignment along the boundary planting and a few croton macrostachus		
62	52+600	Grevillea boundary planting on the left of the alignment. Junction to Kagio shopping center		
63	53+300	Kiangwaci shopping center	Shops and few residential buildings on both sides of the alignment	
64	55+000	Kirinyanga water and sanitation company. Sagana water treatment works on the left of the alignment	Water pollution	
65	56+900	Irrigated farmlands on both sides of the alignment. All season small river cuts across the alignment	Soil and water pollution	
66	57+900	Kibingoti mugi Academy Boys and Girls Day and Boarding on the right. Full gospel church of Kenya and Seventh Day Adventist Kibingoti on the left	Possible noise and air quality receptor	
67	58+800	Kibingoti town center market	Possible noise and air quality receptor. Compensation issues.	
68	59+100	Kibingoti youth polytechnic on the right of the alignment	Possible noise and air quality receptor	
69	60+000	Fred's Grammer School kibingoti on the right of the alignment	Possible noise and air quality receptor	
70	62+150	Junction to Kimburu		

S/N	Chainage	Features	Comments	Picture
71	62+7500	Ragati River crossing. Several indigenous trees with rock outcrops	Water pollution	
72	63+400	Kibirigwi town center.	No much anticipated here since the road alignment is on the right of the center	
73	64+000	Kibirigwi water point (pump)		
74	66+200	Kangocho Secondary School	Possible noise and air quality receptor	
75	66+500	Kangocho Primary School	Possible noise and air quality receptor	
76	68+300	Mwenda town center with few shops fairly good with no vegetation	Noise and air receptor	
77	68+450	P.C.E.A Kienja-ini church on the left of the alignment the gate is on the road reserve. Boundary fence of *Croton macrostachyus*	Noise and air receptor	
78	68+900	Commercial houses on the road reserve and some temporary kiosks	Compensation issues	
79	69+000	Grevillea trees on-farm and residential gate on the road reserve. Beginning of By-Pass 1 to the left of the alignment.	Vegetation loss, loss of macadamia nuts hence livelihood.	
80	69+300	Hot-pot motel on the right of the alignment	Possible noise and air quality receptor	
81	69+600	Commercial houses on the road reserve. Presence of Eucalypts, banana, mango and macadamia trees along the road reserve	Compensation issues	

S/N	Chainage	Features	Comments	Picture
82	69+900	Junction to Kerugoya with some commercial building and Bakri petrol station to the right of the alignment	Loss of property	
83	70+100	Jumbo center with kiosks and Shell petrol station	Loss of property	
84	70+200	Coffee, grevillea, banana trees on the left side of the alignment	Vegetation loss	
85	70+300 to 70+550	The area has a mixed plantation of coffee and banana tree which are on the road reserve	vegetation loss is anticipated	
86	70+700	Brookfield Academy on the right side of the alignment	Possible noise and air quality receptor	
87	70+900	Junction to Karatina District hospital on the right of the alignment and Oilibya petrol station to the left of the alignment	Enhanced soil erosion	
88	71+100	Karatina girls high school to the left of the alignment	Possible noise and air quality receptor	
89	71+350	Railway line crossing the alignment. The area has an open air market of local traders and Motor bike bonding area	Livelihoods issues	
90	71+400 to 71+700	Karatina town with Uchumi, total petrol station on the left of the alignment and Equity, Family banks and IBIS Hotels on the right of the alignment	Possible noise and air quality receptor, compensation issues	
91	71+700	Proposed round-about. Poorly drained with Kenol petrol station on the right of the alignment	Soil excavation may lead to soil erosion	

S/N	Chainage	Features	Comments	Picture
92	72+200	Mathira water and sanitation company to the right of the alignment. The area is swampy on both sides with arrow roots and sugarcanes on the farm. There is a eucalypts plantation on the road reserve with an average DBH of 25cm	Care should be taken during the construction phase to avoid water contamination and vegetation loss	
93	72+300	Deliverance church Karatina	Possible noise and air quality receptor	
94	73+100	By-Pass 1 on the left of the alignment joins the dual carriage.	vegetation loss is anticipated on adjoining area of the dual	
95	73+400	Mathaithi primary school on the right of the alignment	Possible noise and air quality receptor	
96	73+550	Junction to Othaya town center		
97	74+900	Wetland with a small bridge. Arrow roots and a few coffee bushes on both sides of the alignment	Water pollution likely	
98	75+300	Boundary fence of eucalyptus trees on both sides of the alignment	Vegetation loss likely during construction phase	
99	77+400	Huge eucalyptus trees on the road reserve on both sides of the alignment	Vegetation loss likely during construction phase	
100	77+900	Hohwe Dam Nyeri East. Large water body on the right of the alignment	Possible pollution	
101	78+900	Steep slopes with eucalypts and black wattle woodlots on the left side of the alignment	Enhanced soil erosion likely to occur during the construction phase	

S/N	Chainage	Features	Comments	Picture
102	79+900 to 80+800	Croton macrostachus woodlot with very steep valley cutting across the section on the left of the alignment	soil erosion likely to occur during the construction phase	
103	81+700	Very steep slope that needs excavation on the right side of the alignment	Enhanced soil erosion during construction	
104	82+500 to 83+000	Rock outcrops	Rock blasting may be necessary. Noise and air quality receptor	
105	83+500	Coffee bushes on-farm. Presence of Marua river on the left of the alignment	Water pollution likely	
106	88+400	End of project road, Marua River and Marua coffee factory		

9.2 POTENTIAL POSITIVE IMPACTS

- The additional benefits from the expected increase in economic activities will translate into higher income levels of the households and therefore reduced poverty levels.
- Improved transport system and accessibility will reduce travel time, enhance comfort and safety and lower costs associated with an increase in public service vehicles. It will also enhance accessibility to the various institutions namely health centers, places of worship and educational facilities.
- A majority of unskilled labour will be sourced from the local residents during the construction of the road thereby creating new jobs. Indirect employment will include sub-contracted works and support businesses including food kiosks
- Through labour recruitment locally the workers will have an opportunity to learn an array of skills that relate to road construction.
- The anticipated efficient, reliable and cheap transport, will enhance rapid transportation of perishable farm produces (vegetables and fruits) to markets, increase acreages under crop production and improve marketing of agricultural products. Improved production of crops and enhanced transport may call for establishment of agro-processing plants to process the huge supply of fruits and vegetables. Improved transport means will induce for efficiency and multiplicity of transport alternatives to be availed as currently, farmers rely on trucks and drought animals to transport farm produce

- The dualling of the project road can be expected to increase women's access to and utilization of education and healthcare, thereby improving their general well-being.
- Reduced routine maintenance and vehicle operating costs as the road is currently an earth road and the government and the local authorities spent quite some amount of scarce funds in its maintenance each year,
- Increase in land values along the project corridor by over 40%;
- Improved response to emergency services.

SUGGESTIONS ON ENHANCING THE POSITIVE IMPACTS

Most of the aforementioned positive impacts are socio-economic in nature. To enhance their impacts will require a programmatic approach. This will include, but not be limited to the following:

- The Contractor(s) who carry out the construction works should consider sourcing non-skilled labour from the project area.
- Long-term regional economic planning taking into account the improved infrastructure as the key economic driver.
- The Government could provide incentives to investors in the area, and promote development of sectors such as agriculture, industries, tourism and livestock.
- Regular maintenance of the road
- Pro-active planning in anticipation of enhanced immigration to the area.

The above measures are of course beyond the scope of the Ministry of Roads and KeNHA since they are cross-sectoral in nature.

9.3 POTENTIAL ADVERSE IMPACTS DURING CONSTRUCTION AND OPERATION

9.3.1 Soil Resources

Background

The main types of erosion occurring in the area are splash erosion, rills, gullies, sediment deposition and landslides. A steep slope, low vegetation cover, erosive soil, high intensity rainfall and improper soil, crop and water management are factors leading to, or increasing, erosion. Erosion occurrence is more common in areas where Regosols are the dominant soil type more evident as rills or gullies.

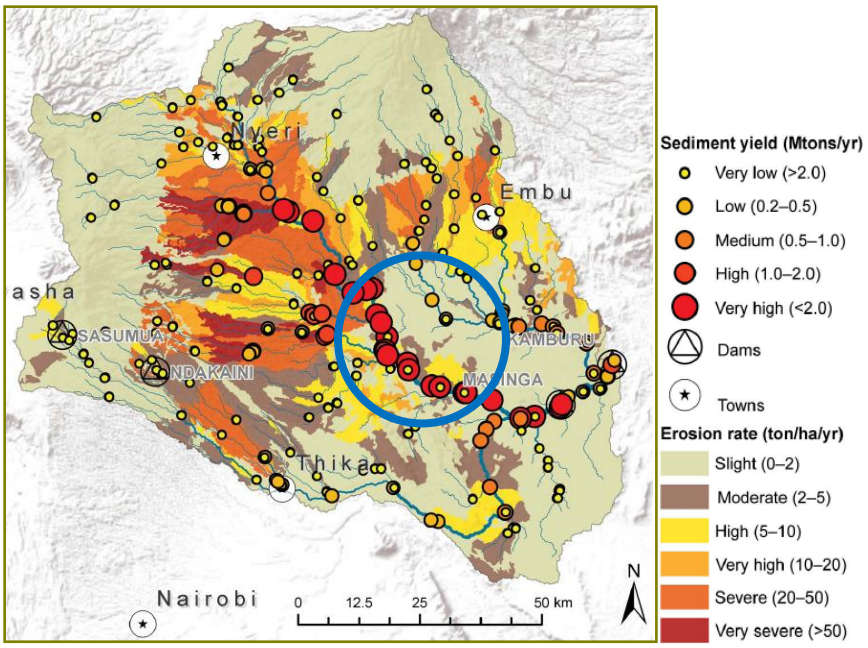


Figure 36: Mean erosion rates and annual sediment yield in central Kenya region
Source: Hunink *et al*, 2013

Plate 7.2: Erosion to the south of Murang'a

The project area receives moderate rainfall and which when combined with the terrain generates substantial soil erosion. The dominant soil type is prone to soil erosion, especially road sections crossing undulating landscape to the north of Sagana.

Construction phase

Typically during construction, soil disturbance occasioned by site preparation mostly excavation, vegetation clearance and stockpiles could generate new soil erosion. Soil erosion will manifest itself during both construction and operational phases of the project. However the impacts are expected to be higher during the construction phase when the road acts as a barrier to run-off occasioning concentrated water flow and enhancing scouring of the road embankment and side drains.

As mentioned earlier, the dominant soil type is derived from soils which are highly erodible. However, since the road is already in existence, impacts, which are associated with the road acting as a barrier that concentrates flow, have already been seen and noted.

In the event of torrential rains, construction activities may cause soil erosion in the following ways:

- Heavy vehicles used during construction activities compact soils, resulting in the reduction of their infiltration capacities, thus initiating soil erosion and possible gully formation.

- The concentration of flows at both inlets and outlets of culverts may cause scouring. Increases in flow volume within a narrow channel and enhanced speed may enable the flow to scour and cause soil erosion. Side drains in areas with steep slopes have a similar effect.

- Clearing of vegetation along the roadside during construction will cause a reduction of the vegetation cover within the RoW. The soil is then exposed to soil erosion.

Soil erosion arising from road construction related activity could be both a short and long-term impact depending on whether measures are put in place to arrest it. The rate of soil erosion tends to increase with time. Therefore initially soil erosion will have a small magnitude effect, but once gully erosion has been initiated then the impact will have a progressively larger magnitude effect, following repeated episodes of torrential rains.

Operation phase

Optimized new drainage structures over the current drifts and realigning approaches to the current drifts and improved capacities of the new drainage structures should generally improve on drainage and in combination with specific erosion protection works will reduce soil erosion from that currently experienced. In fact soil erosion occasioned by overland flow could impact on the road more than the road would cause soil erosion as has been noted with the current road

Mitigation measures

The success of mitigation measures for soil erosion depends upon three factors:

  - *The design of the road's drainage*
  - *Stabilisation of the soil along the roadside and in the road reserve*
  - *The cooperation and participation of the local community*

- *Specific engineering solutions should be implemented to mitigate soil erosion. Soil may erode along the road alignment, particularly during the wet season (March through May) in the initial years after decommissioning.*

Some of the engineering measures include:

- *All earth cuttings need to be at a gentle angle, wherever possible and economic, in order to allow vegetation to grow. Steep side-slopes tend to result in seeds washing away rather than having a chance to become established.*

- *Soil holding structures should be constructed in very loose soils especially along steep slopes immediately on the upper catchment of the road, such points are common immediate north of Sagana and between Karatina and Marua*

- *Culvert outfall should be lined for an appropriate distance, especially north of Karatina towards Marua*

Scour checks should be constructed alongside drains on steep slopes

9.3.2 Hydrology

Baseline

The project road traverses the Sagana (Upper Tana) River drainage systems, that rises from the Aberdare and Mount Kenya.

The existing alignment passes over Large and Medium size river crossings like Muri / Kakuzi River, Saba Saba River, Sagana/Tana River, Murangu/Kiruara River, Ruamuthambi River, Ragati River, Galchamuki River and Hohwe River, which are currently being crossed using concrete bridges or culverts.

There are several small and other medium drainage channels currently crossed using Single and multiple cells Pipe and Box culverts.

Construction phase impacts

Impact on hydrology will mainly be manifested in water quality as opposed to quantity. The major rivers that intersect the road could be contaminated in two ways:

1. Through enhanced sedimentation through soil disturbance accompanying excavations, cut and fill and activities associated with bridge construction
2. Through contamination by accidental oil spills from construction machinery and traffic, cement and bitumen.

Operational Phase

Dualling of the road will more than double the new paved surface that will substantially increase the run-off from the road corridor. As a guide we have computed the possible cumulative runoff from the current single carriageway and compared this with potential run-off after dualling of the road.

For the current situation the length of road The following formula and assumptions were used:

Length of the current single carriageway road is 84 km with an average carriageway width of 7 m and 1 m shoulders giving a total width of 9m leading to cumulative paved surface area of 756,000 m^2 or 756 km^2. Applying the standard run-off coefficient of 0.85 for paved roads, then we have a current run-off level of 642,600 m^3.

On the other hand the new additional carriageway will have the same dimensions therefore the total runoff from the road corridor will increase significantly. Taking the run-off coefficient of general surface (grass, parkland) which is 0.35 and applying this to the corridor to be taken up by the second carriageway we get the current run-off of 265,600 m^3. Since this carriageway will have the same dimension as the current road we expect additional run-off of 378,000 m^3. This is substantial and will need careful drainage design to manage impacts on the lower catchment of the road.

The conventional structures used to drain water are culverts, side drains, miter drains and bridges. Most culverts concentrate flows at their inlets and outlets resulting in localized increased rates of flow, and consequently potential for scouring, especially at the outlets. Such soil erosion could endanger the road itself, and be a hazard to traffic. In addition, the water disposed from such concentrated flows could enhance erosion and gully formation downstream and most possibly onto farms. This could lead to gully erosion on farms leading to reduced harvests.

As this is an existing road, it has been possible to see some of the effects of changes in hydrology as a result of the road's presence. Whereas there are many adequate drainage structures along the road, some drainage structures may be inadequate, or in poor condition, and may require re-designing and repositioning. The design of the upgraded road is largely expected to mitigate, rather than enhance impacts on drainage. On balance, this is a positive impact of the project.

No new negative impacts on drainage are foreseen.

Mitigation measures

Aggressive grassing of the entire road reserve especially the road embankment and the median is recommended to encourage infiltration of rainfall

This impact is largely positive since the new design will mitigate the current impacts associated with drainage.

9.3.3 Air quality

Baseline

Air quality is defined by ambient air concentrations of specific pollutants determined to be of concern with respect to the health and welfare of the general public. The project road crosses some of the most densely populated areas in Kenya with multiple air quality receptors.

Construction phase
Construction activities associated with the project are expected to have only short-term adverse impacts on local air quality and are reversible. Such impacts would be primarily caused by increased emissions of carbon monoxide, hydrocarbons, and nitrous oxides from construction traffic.

The following receptors were identified:

	1+600	Kaaga Catholic
	2+100	St. Michael Girls high school
	2+700	Bishop John Mahiani Junior School and Josaly Boys and Girls Boarding on the left
	2+900	Trotter Hotel
	4+100	Oil Libya petrol station on the left of the alignment
	9+400	Huhi town center
	9+850	Makuyu boys secondary school on the right of the alignment
	11+300	Murang'a Teachers Training College
	14+600	Mungetho center with a river crossing the alignment also referred to as Mungetho river. There are acacia species
	20+500	Kambiti town center
	21+200	Apple park resort
	22+900	Kambiti Secondary school on the right of the alignment. Sunny processor ltd on the left of the alignment.
	25+200	Kwamuthike town
	30+900	Joseph Allamano wachoro sec school.
	31+700	Makutano junction
	33+100	CMI - Christ is the King primary school
	38+800	Riandira center
	46+200	Skyline petrol station and restaurant on the left of the alignment
	47+200	Upper sagana primary school
	48+500	ACK Diocese of Kirinyanga. St Annes Gitumbi church
	53+300	Kiangwaci shopping center
	57+900	Kibingoti Mugi Academy Boys and Girls Day and Boarding on the right. Full gospel church of Kenya and Seventh Day Adventist Kibingoti on the left
	58+800	Kibingoti town center market
	59+100	Kibingoti youth polytechnic on the right of the alignment
	60+000	Fred's Grammer School kibingoti on the right of the alignment
	62+150	Junction to Kimburu
	63+400	Kibirigwi town center.

	66+200	Kangocho Secondary School
	66+500	Kangocho Primary School
	68+300	Mwenda shopping center
	68+450	P.C.E.A Kienja-ini church
	68+900	Commercial houses on the road reserve and some temporary kiosks
	69+300	Hot-pot Motel
	69+600	Commercial houses on the road reserve.
	69+900	Junction to Kerugoya with some commercial building and Bakri petrol station to the right of the alignment
	70+100	Jumbo center with kiosks and Shell petrol station
	70+700	Brookfield Academy on the right side of the alignment
	70+900	Oilibya petrol station to the left of the alignment
	71+100	Karatina girls high school to the left of the alignment
	71+350	Railway line crossing the alignment. The area has an open air market of local traders and Motor bike bonding area
	71+400 to 71+700	Karatina town with Uchumi, total petrol station on the left of the alignment and Equity, Family banks and IBIS Hotels on the right of the alignment
	71+700	Proposed round-about. Poorly drained with Kenol petrol station on the right of the alignment
	72+200	Mathira water and sanitation company to the right of the alignment.
	72+300	Deliverance church Karatina
	73+400	Mathaithi primary school on the right of the alignment
	73+550	Junction to Othaya town center
	88+400	Marua coffee factory

Vehicle travel along unpaved road surfaces, especially along diversions and excavation of bare ground surfaces would create fugitive dust emissions. In addition to fugitive dust, project construction activities would generate tailpipe emissions from mobile heavy equipment and increased vehicular traffic. In a regional context, the daily equipment emissions associated with project construction, even during maximum-intensity work periods, would be relatively minor. Longer term effects on air quality would occur as a result of significantly increased traffic in the area. Increase in road traffic would result in increased daily emissions of carbon monoxide, hydrocarbons, and nitrous oxide. The adverse effect on regional air quality could thus be substantial when the projected increase if traffic materializes.

Considering the prevailing conditions in the project area, dust pollution is potentially the most important source of pollution. Concentrated construction activities across the towns on the project road could lead to sustained generation of dust, as opposed to sporadic generation of dust by vehicular transport.

This sustained high level of dust could impact negatively on the people who spend considerable time within the area adjacent to the road, such as shopkeepers.

Whereas the public can withstand dust as a trade-off for better infrastructure, the workers may not have the luxury of such a trade-off. Construction workers at the road construction sites, quarries and borrow pits will be exposed to high dust levels under hot and dry environmental conditions for many hours each day. This impact, if not well mitigated could have very serious health implications on the workers.

Mitigation measures

- *Use dust suppressants as far as possible, especially within the towns and within the environs of sensitive institutions*
- *All workers should wear dust masks at all times when at the sites of high dust generation*
- *Warn the neighbourhood of possible generation of dust beyond normal levels*
- *Construction machinery should be well maintained and low sulphur diesel should be used*

9.3.4 Vegetation resources

Baseline

The project crosses an area where natural vegetation have been largely degraded and replaced by exotic tree species, thus biodiversity is already compromised. Furthermore the project will mostly be restricted to the current road reserve which have good vegetation cover but poor species diversity. The few sections that will be realigned and the new bypass at Karatina are mainly laid to agricultural crops and exotic trees. In some cases the local farmers have planted crops and fodder within the road reserve.

Construction phase

The project will result into transformation of land use from vegetated ground cover to permanent paved surface, leading to permanent and irreversible loss of vegetation cover. Loss of vegetation will also lead to loss of income through loss of fodder planted within the road reserve, loss of grazing area and farmlands.

Impact on flora related to clearance and earthworks

The vegetation cover in the project area is substantial, though the dominant species are exotic species that are not of conservation concern. Construction of the road will be accompanied by clearance of vegetation along the roadside, clearance for construction of access roads and other civil works. Impact of the project on vegetation is thus very specific to the site of the activities and therefore localized to the road corridor and to limited off-site areas.

Additional vegetation clearance at quarries and borrow pits, and camping sites will also contribute to overall vegetation loss. However, the diversity of natural vegetation in the project area is low, suggesting that vegetation clearance will not cause loss of rare species, species of medicinal and of major commercial values. No endangered trees or other plant species that are endemic to the area would be affected. The impact of vegetation clearance for construction is therefore likely to be minor.

Operation phase

As has been seen with the hinterland of the Nairobi – Thika Superhighway, the project is likely to attract major influx of developers and new home owners to the hinterland of the project. This will be heightened by the ever rising property prices within the precincts of Nairobi. In almost all likelihood, the now rural landscape will be rapidly transformed into an urban landscape. This urbanization and immigration is expected to increase the population in the area. This increase in population, alongside envisaged improved economic wellbeing will place increased demand on currently vegetated areas to be converted to built environment thereby reducing vegetated land cover. It is not easy to estimate the loss of vegetated areas during operation but the loss is certainly expected to increase.

Mitigation measures

- *Vegetation should only be cleared where it will interfere with road construction and/or present a hazard to traffic. In such instances, the local community should be given a chance to harvest*

the vegetation if they so wish. Construction workers could also be allowed to use cleared materials for firewood.

- *As far as practicable, materials should not be stockpiled on vegetated areas. In areas where soils are compacted during road construction (such as along temporary access roads) the soil should be loosened through ripping, after completion of the works, to enable infiltration of water and growth of plants.*

- *Pro-active physical planning to ensure some green spaces are preserved as urbanization creep into the project area.*

9.3.5 Faunal resources

Baseline
Although none of conservation value, different animal species are found in a variety of places such as on trees, rocks, rivers, swamps, caves, and other microhabitats situated in the region. They are comprised of mammals, birds, reptiles, insects, amphibians and molluscs.

Construction phase
Due to heavy human settlement and economic activities that include agriculture, mammalian wildlife diversity and population in the project area is very low. As everywhere else in the wider Central Kenya region the population of other faunal life-forms such as reptilia, arthropods and other life forms are abundant. The small population and diversity of wildlife can be affected as follows:

Mitigation measures

- *Empty containers and other waste should be managed carefully to avoid exposing wildlife to possible poisoning.*

9.3.6 Noise and Ground Vibrations

Noise and ground vibrations can be defined as unwanted sound. However, sound and vibration are measurable, whereas noise is subjective. The relationship between measurable sound and vibration and human irritation is the key to evaluating noise impact.

The challenge to evaluating noise impact lies in determining what amount and what kind of sound constitutes noise. The majority of people exposed to noise are not in danger of direct physical harm. There are several generally accepted conclusions about noise as an environmental impact:

- The effects of sound are cumulative; therefore, the duration of exposure should be included in any evaluation of noise.

- Noise can interfere with outdoor activities and other communication.

- Noise can disturb sleep, TV/radio listening, and relaxation.

- When community noise levels have reached sufficient intensity, community-wide objection to the noise would likely occur.

Individual responses to noise are difficult to predict. Some people are annoyed by perceptible noise events, while others show little concern over the most disruptive events. However, it is possible to predict the responses of large groups of people — i.e. communities. Consequently, community response has emerged as the prime index of noise measurement.

While noise emanates from many different sources, transportation noise is perhaps the most pervasive and difficult source to avoid in society today. Highway traffic noise is a major contributor to overall transportation noise and is generally of most concern within the project area.

Construction phase

Activities associated with road construction will cause a temporary increase in noise levels in the vicinity of the construction sites. This should be of short duration, however, and should not produce any long-term adverse effects within the region.

This impact can be of concern only at construction sites within the larger urban environments of Kenol, Makutano, Sagana and Karatina. In addition there are over 30 noise-sensitive institutions that are within 300m of the road that include schools, health facilities, colleges and places of worship.

Where explosives will be used, especially at quarries, there will be serious noise and vibrations in the vicinity of the site. Certain degrees of explosion can be destructive to structures particularly houses. Fortunately most of the potential material sites are located in land far removed from human settlements and activities. In any case impacts associated with explosions are sporadic and short term.
The most critical noise receptors are listed below:

1+600	Kaaga Catholic Church
2+100	St. Michael Girls high school
2+700	Bishop John Mahiani Junior School and Josaly Boys and Girls Boarding on the left
2+900	Trotter Hotel
9+850	Makuyu boys secondary school on the right of the alignment
11+300	Murang'a Teachers Training College
21+200	Apple park resort
22+900	Kambiti Secondary school
30+900	Joseph Allamano wachoro sec school.
33+100	CMI - Christ is the King primary school
47+200	Upper sagana primary school
48+500	ACK Diocese of Kirinyanga. St Annes Gitumbi church
57+900	Kibingoti Mugi Academy Boys and Girls Day and Boarding, Full Gospel Church of Kenya and Seventh Day Adventist Kibingoti
59+100	Kibingoti youth polytechnic on the right of the alignment
60+000	Fred's Grammer School kibingoti on the right of the alignment
66+200	Kangocho Secondary School
66+500	Kangocho Primary School
68+300	Mwenda shopping center
68+450	P.C.E.A Kienja-ini church
69+300	Hot-pot Motel
69+600	Commercial houses on the road reserve.
70+700	Brookfield Academy on the right side of the alignment
71+100	Karatina girls high school
72+300	Deliverance church Karatina
73+400	Mathaithi primary school on the right of the alignment

Operation phase
The operation and maintenance phases of the project will be accompanied by significant increases in traffic, much of which will be composed of heavy and medium goods vehicles, which will in turn increase noise levels significantly along the road. Furthermore, noise associated with vehicular traffic would be largely unavoidable.

Mitigation measures

- *At commencement of construction works, map all noise sensitive receptors and prepare a construction plan that avoids excessive noise within proximity of the receptors as appropriate*
- *Avoid loud noise during school hours*
- *Warn residents within 300m of quarries of intention to blast and the exact blasting time. To the extent possible, heavy vehicles should not be used at night across populated areas especially Karatina and Sagana.*
- *Ensure that construction equipment is operating optimally and with operational noise mufflers where possible.*

9.3.7 Visual Intrusion (landscape disfigurement)

Baseline

Quarries and borrow pits, limited cut slopes that are anticipated and material stockpiles when exposed to the public, often leads to visual intrusion. The landscape within the project area is dominated by vegetated agricultural fields, pockets of woodlots and tree plantations over undulating terrain. The project area is not a major tourist attraction neither is it extraordinarily scenic.

Construction phase

On the whole, there are few scenic sites along the road other than the general landscape. If the construction contracts specify that material sites/borrow areas and quarries are to be landscaped after use to blend with the landscape as far as is reasonably possible, visual intrusion associated with these activities would be swamped by the expansive landscape, hence impact would be minor.

Operation phase
Quite often, broken down machinery, structures and other facilities are left on the camp site at decommissioning. This could create visual intrusion. The impact will depend wholly on the decommissioning standards set out in the contract details.

Mitigation measures

- *Spoil materials including solid waste produced at camping sites for road construction crews should be properly disposed.*
- *Rehabilitate quarries and borrow areas as suggested in the section. 8.3.9*

9.3.8 Waste management

Baseline
Other than at the major trading centres and towns, the road traverses agricultural landscape where dominant waste is organic and, therefore, biodegradable. At the more populated commercial centres and market places, solid waste management is a perennial problem. This is mainly plastic paper bags that are discarded without much care. This often clogs drainage channels and an eyesore.

Construction phase
There is a wide variety of waste generated during construction. This includes debris, domestic and human waste, timber, stones, rock, metals, paper, plastics, etc. The quantity of waste can be substantial and can be both a health hazard and be of visual intrusion. Furthermore, there is potential for contamination of soils and watercourses as a result of improper disposal of liquid and solid waste from construction activities and construction camps.

The large number of used containers invariably have residual chemicals that could be poisonous to humans and other life forms if used to ferry cooking (humans) and drinking water for both domestic and wild animals. Disposal of containers of used oil, lubricants, paint, and other toxic substances, etc. should therefore be carried out with extreme care, so that individuals do not use them as water containers. Spoil material and earth waste from excavations are also produced and require careful disposal.

Mitigation Measures

- *Construction and domestic waste should be stored only in the specially designated places and removed and disposed of regularly. Disposal and burial of waste should be agreed upon in the established manner before commencement of the works. Discharge of any non-treated drain waters and waste to the rivers or on the surrounding land should be forbidden.*
- *Ensure that waste materials are properly disposed to suitable locations. Partly inert waste materials (for example concrete from bridge reconstruction) can possibly be used as fill materials.*
- *Periodic inspection of waste storage areas and facilities at the construction works sites/camps helps to ensure proper handling of waste materials.*
- *Contractors should encourage reuse and recycling wherever possible to minimize residual waste.*
- *A handling protocol, e.g., waste storage away from public view, and provision of retention areas to contain accidental spills of toxic, hazardous, and harmful construction materials, such as caustic and acidic substances, oil, waste oil, diesel, and bitumen, should be prepared and implemented by the contractors.*

9.3.9 Hardstone Quarries

Quarrying is one of the areas that can lead to substantial impacts on the environment. Provisional hardstone material sites have been identified (see Annex), but it is noted that other new sites may be identified by the contractor(s). Below are some negative impacts that are associated with the quarries and broad guidelines for managing them.

Potential negative impacts

- Vegetation clearance and loss at the site, and along created access roads.
- Blasting could have substantial impacts as follows:
- The workers are exposed to risks of scattering rocks, dust and deafening noise during blasting.
- As some quarries may be close to the main road, motorists, although few, could be affected by sudden nearby blasts, which could lead to accidents.
- Large quantities of dust and noise can be generated during blasting, which could affect the workers.
- Blasting can adversely affect wildlife by scaring them, which in turn can affect their behaviour, breeding patterns, and in some cases can even cause death.

Mitigation measures

- The contractor will be expected to formalize licensing.
- Topsoil material resulting from stripping or associated operations should be stockpiled in raised areas so as to avoid being washed away by any sudden storm.

- The environmental rehabilitation measures needed (after completion of certain works) should be enforceable through provisions in the contract agreement(s) for the construction works.

- Blasting should take place at pre-arranged designated times and the affected public, within approximately 1 km radius, duly informed. Appropriate warning signs on the road will also need to be erected.

- Keep workers a minimum 350 m away from the blast spot to avoid scattering stones. If possible, machinery and other facilities should also be kept at least 200 m from the blast site. These distances will, however, depend upon the charge power. The workers should return to the working zone 10-15 minutes after the explosion.

- The storehouses of explosives should not be kept on the sites, instead they should be delivered to the site as necessary from special storehouses managed by the contractor.

- Only qualified personnel should be allowed to handle explosives.

- Fence off the entire quarry to prevent wildlife and even the public, especially curious herds' boys from accidentally falling over the cliff.

- Development should be oriented so that grading and other site preparation is kept to an absolute minimum. Natural features, landforms, and native vegetation, such as shrubs and occasional trees, should be preserved to the maximum extent feasible.

- Any adjacent water facilities, or structures such as water pans, should be protected.

- Due to scarcity of water and hot windy conditions in the project area, sprinkling of water as a way of reducing dust may not be a sustainable measure to mitigate the potential dust pollution, which will particularly affect the workers. Whereas it is highly recommend that dust suppressants be used, it may not be very effective, hence it is advisable that the workers be provided with dust masks while in the quarry area.

- An attendant should be stationed at the entrance gate of the access road at all times, when the quarry is open, to control entry to the site. The entrance gate should be locked when the quarry is not in operation.

- Quarrying operations should be conducted in a neat and orderly manner, free from junk, trash, or unnecessary debris. Where in public view, salvageable equipment stored in a non-operating condition should be suitably screened or stored in an enclosed structure.

Post-closure recommendations

- Piles or dumps of quarry waste should be stockpiled in such a manner as to facilitate phased reclamation over the quarrying period. Such waste should be segregated from topsoil, etc.

- Topsoil should be spread on hard rock surfaces to allow natural colonization by vegetation over time. It is not realistic, under the prevailing conditions, to broadcast seeds or plant trees.

- At closure, all dumps of quarry waste and overburden should be used to landscape the area to conform to the surrounding topography as much as possible.

- Reclamation surfaces, however, should be provided with available native soils and vegetative debris recovered in quarrying and these materials should be placed in crack systems where plants could potentially propagate. To increase the potential for successful reclamation and to augment topsoil from the site, additional topsoil may be required to be imported to the site.

9.3.10 Borrow pits

Most of the mitigation measures for the hardstone quarries are also applicable to borrow areas. In summary, on completion of operations in a borrow area, the contractor should reinstate the entire area so as to blend with the surrounding area as much as is reasonably possible, and to permit the re-establishment of vegetation.

9.3.11 Enhanced urbanization

Impacts on urbanization by the recently completed Nairobi – Thika Superhighway is now evident. During construction, there were several complaints by the public on inconveniences caused. Basically, the project has led to rapid urbanization rate within the area of influence as typified by land use change, increasing property values with subsequent change in the local demography.

Construction phase
Construction phase may lead to a slight dip in urbanization rate due to the disruptions that will accompany construction. This is temporary in nature.

Operation phase
In tandem with the increased importance of the trading centres and towns will be an increase in population within these centres. The increase in urban population will in turn exert increased demand on land and other utilities.

Mitigation measures

- *Proactive planning by the County Physical Planners*

9.3.12 Public Health

Due to majority of motorists unfamiliarity with an expressway, several accidents may occur immediately after completion.

Potential public health and safety issues will be both directly and indirectly associated with the activities of the project. The direct impacts include effects of dust, noise and fumes from machinery and construction traffic, as well as noise and fumes from the expected increase in traffic along the road.

Construction workers will be most pre-disposed to these direct impacts, during the construction phase. As discussed in other sections, pollution, noise and vibration during both construction and operation could have comparatively higher impacts on health in urban centres and sensitive institutions than in the rural country. The indirect impacts of the project on health and safety are associated primarily with human behaviour, and this includes the potential for transmission of STIs including HIV-AIDS.

Mitigation measures

- *Road construction workers should be informed about diseases that are prevalent in the project area, and how they can minimize their exposure to, and the transmission of, such diseases*

- *Conduct a yearly audit of occupational health and safety within all premises of the contractors and at sites of works as required by law*

- *The contractor should establish a clinic within the main camp with a full time nurse since health facilities in the area far between. The clinic should be linked to the Minsitry of Health in order that the clinic can support the local community who may want medical attention.*

9.3.13 Sexually Transmitted Diseases (STIs) and HIV-AIDS

9.3.13.1 HIV/Aids

HIV/AIDS is a serious health and development problem in the project area. The HIV/AIDS prevalence rate stands at 3.0%. Nyeri has the lowest prevalence rate of 2.1% while Murang'a has the highest at 3.7% as presented in the following Table:

Table 21: HIV prevalence in the 3 project counties (year 2010)

County	HIV Prevalence (15-49 yrs)	HIV positive (15-49 yrs)
Kirinyaga	2.74%	13,503
Murang'a	2.09%	14513
Nyeri	3.00%	20779

The major drivers of HIV/AIDS in the counties include engaging in unprotected sex, ignorance on safe sex practices, unwillingness to use condoms, ignorance on HIV status, commercial sex workers unsafe sexual behaviour, drug abuse (drinking of illicit brews), high levels of peer pressure and family breakdowns.

Accompanying HIV/AIDS is prevalence of other sexually transmitted diseases whose infection rate mirrors that of HIV/AIDS.

Construction phase

One of the major health concerns related to the project is its potential to significantly increase the spread of HIV/AIDS and other sexually transmitted infections (STIs) in the local population and among the workers. The mobilization of a large workforce over a long period is likely to increase sexual activities in the area and the presence of the workforce may even bring in a number of commercial sex workers. From the data provided, a large number of the population is under the age of 50 (see section on demography) and being an active age group, the impacts of new relationships are highly likely. HIV/AIDS poses a big threat to development of the area because of increasing dependency ratio with an increasing number of orphans and street children. These could reverse progressive gains made in poverty reduction. The youth (15-49 years) are the hardest hit and this is a threat to the labour force of the region.

Assuming that some workers will be recruited from other parts of the country where HIV-AIDS infection rate is comparatively high (the national average is 5% while the average within the project area is about 2.6%), then there is the possibility of an increase in new HIV-AIDS infections in the project area. Prevention of the transmission of HIV-AIDS, therefore, represents the single most important public health issue that is predicted to be associated with the project.

Operation phase
This is rather difficult to predict given that the socio-economic dynamics will change substantially during the life of the project.

Mitigation measures

A programmatic approach is proposed as contained in the chapter on HIV-AIDS and the ESMP

- *Mount regular HIV-AIDS awareness campaigns. Condoms should be made available to construction crews.*

- *Contractors should provide workers with sufficient accommodation for married couples to stay together.*

- *The Contractors should consider hiring a permanent nurse to attend to emergencies and to mount awareness campaigns amongst the workers.*

- *Health service providers should be regularly consulted to determine any changes in disease patterns which may be associated with road construction.*

- *KeNHA should hold regular discussions with their counterparts on any health implications of on-going road construction.*

9.3.14 Road safety

Baseline
The road is currently a two way traffic, a situation that has led to many fatal accidents on the road. Illegal speeding has been common especially by mid-size goods traffic transporting khat (miraa) to Nairobi. Most accidents occur between Makutano and Kenol.

Construction phase
Construction traffic, poor traffic control and inadequate signage could lead to road safety issues. Accidents, emanating from speeding vehicles and construction machines (among the operators during construction), may increase. Accidents could likely to occur in sharp corners at Mahiga-ini, Mung'etho, Sagana, Kambiti, Kibirigwi and, Kaseve site. In order to minimize the accidents, these sites should be provided with road marks, regulatory and cautionary signs and speed limits to reduce the accidents.

During construction the road environs could experience fugitive dust that could cloud vision of motorists and pedestrians alike.

Operation phase
Improved roadway complete with an additional two lanes and improved geometrics will undoubtedly encourage more vehicular traffic and higher average speeds. There will be increased possibility for accidents between vehicles, and with non-motorized transport such as cyclists, pedestrians and both domestic and wild animals.

Although the improved road will be designed to make it safer to travel at higher speeds, the likelihood of collision between vehicles will be reduced, but there could still be collisions between vehicles and/with pedestrians and livestock.

Mitigation measures

- *Contractors to develop the health and safety policy and procedures and educate all workers on the policy and the procedure*

- *Access roads for haulage trucks, used during road construction, should not be located near schools, hospitals and residential areas.*

- *Install appropriate reflectorized signs at road diversions.*

- *Provide sufficient road signs*

- *Suppress fugitive dust by regular watering especially during the dry season*

9.3.15 Resettlement and Compensation

A separate Resettlement Action Plan Report has been prepared where compensation and relocation measures and mitigation actions on land and property acquisition are clearly spelt out.

9.3.16 Socio-cultural impacts

Baseline
The project area is densely populated, with density of about 370 people per square kilometre and is mostly rural. The Kikuyu community is the predominant community although there are many other communities present in the urban centres and within business premises in the area.

Construction phase
The Contractor is not obligated to employ the local community and this could bring people of alien culture to that of the dominant Kikuyu community. This could bring resentment amongst the Kikuyu community considering that there is a large population of young unemployed locals.

Operation

There is a tendency for infrastructure to attract immigrants to the area. This has occurred with the Thika superhighway and is projected to occur with this project. Property values will increase due to high demand and this could empower a section of the community while disenfranchising others. The projected immigrants will originate from elsewhere in Kenya and could lead to enhanced social interaction and networking that will further erode the Kikuyu traditional ways of life as many adapt to hybrid cultures. In addition, there will be cultural diffusion and to some extent, erosion of some values and practices.

Relocation of graves could be a major concern especially the road sections from Sagana to Marua and the Karatina bypass.

Mitigation measures

- *Proactive planning on the part of the local county government*
- *Inform the community about the possibilities for changes in the local demography but without stoking resentment towards immigrants*

9.4 Climate change and potential impacts on project and project adaptations

9.4.1 Temperature

According to the Kenya National Climate Change Response Strategy, climate change is already being experienced in Kenya. For example From the early 1960s, Kenya has experienced generally increasing temperature trends over vast areas. Over the inland areas, the trends in both minimum (night/early morning) and maximum (daytime) temperatures depict a general warming (increasing) trend with time. However, the increase in the minimum temperatures is steeper than in maximum temperatures. The result of the steeper increase in minimum temperature and a less steep increase maximum temperature is a reduction in the diurnal temperature range (difference between the maximum and minimum temperatures (Table 11).

Table 22: Minimum Temperature trend from 1960 – 2010

Region	Trend	Magnitude (0)
Western	Increase	0.8-2.9
Northern & North-Eastern	Increase	0.7-1.8
Central	Increase	0.8-2.0
South Eastern Districts	Increase	0.7-1.0
Coastal Strip	Decrease	0.3-1.0

Table 23: Maximum Temperature trend from 1960 – 2010

Region	Trend	Magnitude (0)
Western	Increase	0.5-2.1
Northern & North-Eastern	Increase	0.1-1.3
Central	Increase	0.1-0.7
South Eastern Districts	Increase	0.2-0.6
Coastal Strip	Increase	0.2-2.0

From the Table above, the region has experienced an increasing temperature trend for the past 50 years and this increase may continue into the future.

9.4.2 Rainfall

Neutral to slightly decreasing trends are manifested in the annual rainfall series over most areas of Kenya. This is mainly due to an associated general decline with time of rainfall in the main rainfall season of March-May (the 'Long Rains') over most areas.

There is a general positive trend (increase) in rainfall events of September to February period suggesting a tendency for the 'Short Rains' (October-December) season to be extending into what is normally hot and dry period of January and February over most areas. This may be attributed to possibly more frequent occurrences of El-Niño events occasionally coupled with relatively warmer sea surface temperatures over the western Indian ocean (along the coast of east Africa) and relatively cooler than average sea surface temperatures (SSTs) to the east of the Indian Ocean. This sea surface temperature pattern is conducive for enhancing rainfall over the country. Even in the absence of El-Niño conditions, this pattern over the Indian Ocean results into heavy rainfall during the 'Short Rains' season as was the case in 1961-62 and the recent 2006-07 rainfall events.

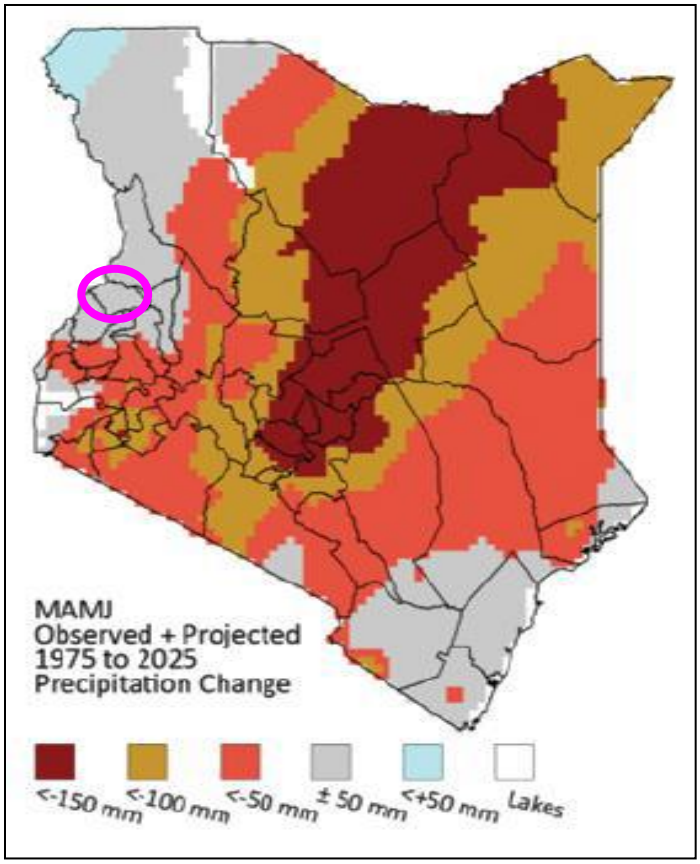


Figure 37: Predicted precipitation changes with climate change

The figure above provides predictions in changes that are expected in precipitation to year 2025. The predictions indicate that the central region could experience a reduction in rainfall by up to 150mm. In this regard we do not expect that the drainage structures would be inadequate within the design life of the road.

Furthermore, and in general, annual highest rainfall events indicate the 24-hour intense rainfall amounts observed in the recent years are relatively lower than those in the early 1960s. Effectively, these values have been reducing (negative trend) with time.

Potential Impacts

As can be gleaned from the preceding sections, climate change could have low to insignificant impacts when the most critical factor, drainage is considered. However we conducted a screening procedure on all relevant climate related factors to assess climate related risks. The initial screening has been done by filling in a checklist. Risks considered are those resulting from temperature increase, precipitation change, wind speed change, sea level rise, solar radiation change, water availability, flooding, tropical storms, wildfire and landslide.

Table 24: Climate Risk Screening

Environmental Factors	Risk To Project
Temperature increase	Low
Wildfire	Low
Precipitation increase	Infignificant

Flood	Insignificant
Landslide	Low
Precipitation decrease	Low
Wind speed increase	Low
Sea level rise	-
Solar radiation change	Low

The project scores low to insignificant on all accounts and therefore the impact is adjudged insignificant. Nonetheless the design has adapted high capacity drainage structures that should accommodate any major changes in flows through the drainage structures.

Climate Change Adaptation Measures

The project drainage catchment lies in the Upper Tana (Sagana) catchment that includes much of the eastern slopes of the Aberdare Mountains and the south- west/southern slopes of Mount Kenya. The relief is sharp with numerous perennial streams descending in deeply incised valleys separated by long narrow ridges.

The source of the Tana River is the Sagana River, is the major river crossing, it rises on the south-west flank of Mount Kenya (mean annual rainfall > 2,000 mm), with its tributaries the Thigo and Nairobi. On its downstream part receives also water from the Mount Kenya through the Ragati River Catchment.

The flood frequencies used in the design of road drainage structures are as follows:

Type	Probability (%)	Return Period (years)
All bridges in the main alignment (only exceptional interruption of service allowed)	2	1 in 50 years checked against 1 in 100 years
Box culverts	4	1 in 25 year flood, checked for overtopping against 1 in 50 year flood. Invert to be a minimum of 1.5D below the road surface
Pipe culverts and side drains	10	1 in 10 year flood, check for overtopping against 1 in 25 year flood

It is our opinion that with the prediction of slight reduction of rainfall in the central region, the design factors are sufficient to accommodate future changes in flows.

10 POTENTIAL CUMULATIVE IMPACTS

Both AfDB Safeguard Policies and the Kenyan EIA Regulations emphasises the need for cumulative impacts to be considered at a project level. Cumulative impacts are those new impacts, or enhancements of existing impacts, that occur only because of the interaction of the construction and operation of the proposed Kenol – Marua (A2) upgrade project with "other" projects and plans, or from the interaction of different aspects of the proposed road project.

Impacts may occur from the compounding of an issue (e.g. pollution from different sources affecting the same receptor) or from changes to the baseline (e.g. future development may change the landscape character and thus the impact of the road in the future baseline). Where a particular impact affects different receptors, this is not a cumulative impact but a direct impact which is not considered any further in this Chapter. For example, the adverse impacts from silt laden runoff could have a detrimental impact on water quality, as well as contribute to a temporary increase in flood risk by contributing to blockages of small watercourses. In some circumstances standard assessment methods used in this ESIA take cumulative impacts into account. For example, the assessment of air quality and noise from the operation of the road (which are based on predicted traffic flows) considers the change in future traffic flows caused by other proposed developments that could induce or divert traffic onto the A2 road.

Likewise, the assessment of the impacts of the road on the economic viability of impacted farms considers cumulatively a number of separate issues in the one assessment. Further, silt pollution may be caused by a variety of reasons and from different locations of the site, which is considered cumulatively in the assessment presented in Chapter 8 of this report.

10.1 Methodology

A qualitative assessment of the potential cumulative impacts has been undertaken. Good practice guidelines recommend that an EIA should assess the impacts of the development cumulatively with other developments only when there are likely to be significant impacts. When evaluating the potential for significant impacts there is often considerable uncertainty in the assessment.

There are specific impacts on over 50 receptors, mainly towns and market centres, schools and places of worship and health facilities that have been described in Chapter 8. The descriptions of these impacts basically provide combined impacts on specific resources or receptors in regards to the execution of the project. A summary of the likely potential cumulative impacts has been provided in Table 25. The significance of these impacts has then been discussed qualitatively in Section 9.4.

10.2 OTHER DEVELOPMENTS

In order to assess cumulative impacts as a result of proposed development in the vicinity of the proposed road, information regarding proposed developments is required. Based on the information the Consultants could gather there are no major proposed projects other than the completed Thika Superhighway. From our assessments, only developments within 5km of the proposed road could be considered, as beyond the arbitrary study area cumulative impacts are unlikely to occur.

10.3 Identification of Potential Cumulative Impacts

Table 15.1 provides a summary of the likely potential cumulative impacts that may result from the construction and operation of the proposed road, and in combination with other proposed developments that may come up during the construction phase of the project.

Table 25: Summary of Likely Potential Cumulative Impacts

Environmental Topic	Potential Cumulative Impacts	
	Construction Phase	**Operation Phase**
Air Quality	Cumulative impacts will only occur during the construction phase if the construction of other nearby projects coincides with that of the proposed road. If this is the case, even greater attention should be paid to the mitigation measures outlined in Chapter 8 and the ESMP to ensure the cumulative impact will remain of minor adverse significance.	The local air quality assessment has taken into consideration cumulative impacts as the projected traffic data was applied in the assessment. It is anticipated that the proposed dualling of the road will have a minor beneficial impact on local air quality (despite a net adverse impact on a few properties close to the site, there will a far greater number of potential receptors that will benefit from reductions in carbon mono oxide emissions within the larger area. As indicated in the analysis, there is likelihood of people migrating into the area because of cheaper land but better access hence number of receptors may increase. The impacts of the proposed road on regional air quality and greenhouse gases are predicted to be negligible.
Ecology and Nature Conservation	Cumulative impacts will only occur during the construction phase if the construction of other nearby projects coincides with that of the proposed project. If this is the case, even greater attention should be paid to the mitigation measures outlined in Chapter 8 to ensure any cumulative impact from the construction works on ecology and nature conservation is avoided.	This will remain speculative depending on possible new projects during the operation phase.
Landscape and Visual	There will be some cumulative visual impacts for areas overlooking the construction Providing adequate mitigation is provided no significant adverse cumulative impacts are anticipated.	The cumulative impact of the proposed interchanges, structures, and other infrastructure and link roads will be particularly significant which, along with the existing road infrastructure and linkage with urban Thika and Nyeri, will contribute to the increasing urbanisation of that area, resulting in a gradual change of character. Significant areas of ground between Thika and Makuyu could in future be zoned as areas suitable for future development.

		The introduction of the new dual carriageway, interchanges and infrastructure to the landscape may contribute to a potential future cumulative urbanising impact, along with the future development of Muranga University, changing the character of the area from rural to urban edge.
Land Use	Providing adequate mitigation is place no significant adverse cumulative impacts are anticipated.	The proposed dual carriage way will have a cumulative impact on agriculture in the area. The route and the economic growth it is planned to stimulate will ultimately affect the way the land is farmed and increase the overall impact. Land take will increase as new development takes place. Although, more land will be required it is unlikely that a large area of the best and most versatile land will be lost and is therefore not significant on a National or Local level. In terms of the cumulative impact on agricultural practice, the impact of the proposed improvement on husbandry is much harder to assess. In general, private real estate development projects pay a large dividend to land owners over and above the agricultural value. As is reported in Chapter 8, in future, there may be a tendency to sell agricultural land to private developers thus changing land use significantly. This particular impact remains difficult to assess and quantify. However the rapid developments along Thika Highway is a pointer to a possible rapid land use change.
Noise and Vibration	In light of possible land use change there is the potential for cumulative noise impacts of the proposed development in conjunction with other new developments that may concurrently be executed in the vicinity arising from simultaneous demolition and construction works. However each development is expected to have separate EIA and EMP to mitigate the impacts. Practice for Control of Noise from Construction and given localised nature of noise impacts associated with the construction of each foreseeable development	The noise assessment has taken into account cumulative impacts as the traffic data considers all proposals especially diverted traffic onto the new dual carriageway. Cumulatively it can be mentioned that in the future some areas could be affected depending on development controls that will be applied as land-use is likely to change. For example, residential apartments may come up close to the highway especially closer to Kenol.

	it is unlikely that cumulative impacts will occur.	
Pedestrians, Cyclists, Equestrians, and Community Impacts	Providing adequate mitigation is in place, cumulative impacts are not considered to be significant during construction.	The design has considered NMT and footbridges. No adverse cumulative impacts are expected
Vehicle Travellers	No developments are located such that they would have a major impact on the operation of the current network during their construction.	The traffic data indicates shorter travel time and more comfortable travel. Whereas individual accidents may increase, cumulatively it is projected that accident events per million vehicles will be reduced.
Road Drainage and the Water Environment	Providing adequate mitigation is in place no significant adverse cumulative impacts are anticipated.	The proposed dual carriage way will have a larger paved surface thus cumulatively there will be more run-off. The total loading of road runoff in the town with vehicle derived pollutants could therefore increase. Although difficult to determine the significance, since there are no known treatment measures serving road runoff from the current road or any road in Kenya, the impact is likely to be adverse.
Geology and Soils	Providing adequate mitigation is place, no significant adverse cumulative impacts are anticipated.	The impact on geology and soils could only relate to sharing material sources, i.e. gravel and hardstones, with other projects and only if the same sources shall have not been properly closed and rehabilitated. Currently no significant adverse cumulative impacts are anticipated.

10.4 SIGNIFICANCE OF CUMULATIVE IMPACTS

It is predicted that significant cumulative impacts could occur on ecology and nature conservation and land use. Proposed development could result in additional permanent loss of habitats that could lead to more significant adverse impacts. Cumulative impacts will only occur during the construction phase if the construction of other nearby projects coincides with that of the proposed road project. If this is the case, even greater attention should be paid to the proposed mitigation measures to ensure the cumulative impact of the construction works on ecology and nature conservation is minimised.

The assessment has concluded that significant cumulative impacts can also occur on landscape and visual amenity. It is predicted that although some adverse visual impacts can arise during construction and assuming adequate mitigation is provided, these impacts will not be significant. During operation, cumulative impacts will be significant within farmlands and urban fringe between Kenol and Makuyu resulting in a gradual change of character. Landscape changes may contribute to a potential future cumulative urbanising impact changing the character of the area from rural to urban edge. Due to expected future residential and commercial developments along Contract 1, cumulative impacts relating to land use and noise and vibration are expected.

No significant cumulative impacts are expected on archaeology and cultural heritage, air quality, vehicle travellers, water quality and geology and soils. In some cases the implementation of good practice mitigation is required.

11 SUMMARY ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental Management Plan (ESMP) is prepared to show how site specific concerns and mitigation measures are addressed through the detailed design, pre-construction, construction and post-construction / operation phase of the Project. The detailed ESMP is contained in a separate Annex to this report.

The ESMP has been developed with project knowledge and information available to date. Some of the Project's final details, such as proposed locations of construction camps, actual locations of borrow areas to be used by the Contractor, disposal areas for construction debris among other issues, are unknown at the present time. As project commencement and scheduling plans are developed and changed, components of the EMP might require amending. This is therefore a working document, which can be updated whenever new information is received or site conditions change.

11.1 Objectives of the ESMP

The Environmental and Social Management Plan (ESMP) describes the range of environmental issues associated with the Project and outlines corresponding management strategies that will be employed to mitigate potential adverse environmental impacts. The ESMP conveys the Project's environmental and social constraints.

The Project will comply with all local laws and regulations, which seek to ensure that the construction work does not adversely affect the environment and social community resources.

The Supervising Consultant may periodically revise the ESMP in consultation with the Contractor, and subject to the approval from the Ministry of Roads Kenya and the National Environment Management Authority. Revisions may be made to accommodate changes in work, weather and site conditions.

The ESMPshould be made available to all Project Staff.

The main objectives of the ESMP are:

- To bring the project into compliance with applicable national environmental and social legal requirements;
- To outline the mitigating/enhancing, monitoring, consultative and institutional measures required to prevent, minimize, mitigate or compensate for adverse environmental and social impacts, or to enhance the project beneficial impacts;
- To address capacity building requirements within the relevant Ministries if necessary.

11.2 Responsibilities

In order to ensure the sound development and effective implementation of the ESMP, it will be necessary to identify and define the responsibilities and authority of the various persons and organizations that will be involved in the project. The following entities will be involved on the implementation of this ESMP:

- KeNHA;
- Ministry of Transport;
- National Environmental Management Authority;
- Resident Engineer.
- Environmental officer
- Social Officer and Community Liaison;
- Contractor;

11.2.1 KeNHA

The project road is under the jurisdiction of KeNHA (the project proponent). Therefore, the responsibility for ensuring that mitigation measures specified in this ESMP and the contract documents are implemented will lie with them.

11.2.2 Ministry of Transport and Traffic Police

Road safety and accident prevention is the responsibility of the Ministry of Transport and the Traffic Police. It will be the responsibility of the two organs to ensure that road safety policies detailed below is implemented:

- Mandatory use of seat belts;
- compulsory driver training and testing;
- prohibition and punishment of driving while impaired by drugs or alcohol;
- traffic safety education for children; and
- Testing and inspection of all vehicles according to national vehicle safety standards.

The Ministry of Transport and Traffic Police should also ensure the following:

- Ensuring that post-accident emergency assistance and medical care are available to all accident victims;
- Developing an accurate accident data recording system;
- Conducting research and regularly monitoring the state of road safety;
- Determining the need for further road improvements (based on accident data); and
- Encouraging research and development of new, safety-oriented road technologies.

11.2.3 National Environmental Management Authority (NEMA)

The responsibility of the National Environmental Management Authority (NEMA) is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment and to ensure that all mitigation measures proposed are actually implemented.

11.2.4 The Resident Engineer and Environment / Social Officer

The Resident Engineer (RE) will be appointed by KeNHA or Supervising Consultant and will be required to oversee the construction programme and construction activities performed by the Contractor, in compliance with the present EMP. The RE should have an Environmental and social officer (ESO) in his team to co-ordinate all aspects of the environment during project implementation. This will include following the construction to monitor, review and verify the implementation of the project's EMP.

During construction, the ESO will be responsible for the following tasks:

- Updating environmental aspects (not covered in the ESIA / ESMP) during project implementation;
- Auditing environmental and safety aspects at the work sites;
- S/He shall participate in the definition of the no working-areas and the location of campsite, borrow pits, quarries and other areas;
- Recommending solutions for specific environmental and social issues;

- S/He shall facilitate the creation of Community Liaison Groups and shall monitor the compliance of the social clauses of the Contract, in terms of local labour force and HIV/AIDS campaign;
- Overseeing strategies for sensitising the local population on health and safety problems;
- Attending consultations held at key stages of the project with the community and interested parties;
- S/He will be required to liaise with the respective Environmental Authorities on the level of compliance with the ESMP achieved by the Contractor on a regular basis for the duration of the contract;
- Controlling and supervising the implementation of the ESMP;
- Preparing quarterly environmental and social progress or "audits" reports on the status of implementation of measures and management of work sites.

11.2.5 The Contractor

The Contractor will be appointed by the KeNHA and will be required to comply with the requirements of the ESIA/ ESMP and the Standard Specifications for Road Works in Kenya, which include specifications for Environmental Protection and Waste disposal, Borrow Pit and Quarry Acquisition and Exploitation, Landscaping and grassing and so on.

11.2.6 Local Authorities

The relevant departmental officers in the local authorities should be called upon where necessary during project implementation to provide the necessary permits and advisory services to the project implementers. Some of the areas for which the officers will be required include:

- Approving locations for establishing work camps;
- Involvement in relocation of project affected persons along the road;
- Liaising with the NGOs in the project area to assist in the sensitization campaigns for HIV/ AIDS and public health to the workforce and the local community;
- Issuing permits for tree felling, vegetation clearing, exploitation of quarries and borrow sites (whenever necessary);
- Identifying locations for disposal of construction debris;
- Issuing permits or relevant documentation for health and safety monitoring in accordance with local health and safety legislation and / or ILO standards.

11.3 Environmental & Social Management Plan

The set of instructions provided in this Chapter and summarized in Table 26 constitute the Environmental & Social Management Plan (ESMP).

The following issues require special attention:

- Material sources, especially the quarry sites and borrow bits;
- At the locations for livestock grazing and crossings, signage must be erected. Exact locations to be identified by the local administration in consultation with the locals.
- Designs must take into considerations the soil conditions especially the poorly drained soil areas;

- Informative signs shall be considered for all social amenities (educational institutions, hospitals, trading centres etc);
- The Contractor shall ensure that all pertinent permits, certificates and licenses have been obtained prior to any activities commencing on site and are strictly enforced / adhered to;
- The Contractor shall maintain a database of all pertinent permits and licenses required for the contract as a whole and for pertinent activities for the duration of the contract.

The Table below presents a tabulated environmental and social management plan. It includes the impacts, mitigation measures, responsible parties and the estimated costs.

Table 26: Environmental and Social Management Plan

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		Construction Phase				
1.	Construction material sourcing	1. Contractor to develop a site specific material site rehabilitation plan to be approved by the RE before excavating any materials. Such a plan must indicate the GPS coordinates of the site(s) 2. The Contractor will be responsible for ensuring that appropriate authorisation and licences to use the proposed borrows pits and quarries has been obtained before commencing activities; 3. Carry out inspection of each of the site's soil stability before excavation; 4. All borrow pits sites shall be clearly indicated on a plan and approved by the RE; 5. Borrow pits and quarries shall be located more than 20 meters from watercourses to minimise storm water runoff into watercourse; 6. The Contractor shall give 14 daysnotice to nearby communities of his intention to begin excavation in the borrow pits or quarries; 7. Prepare health and safety plan before any work on the quarries is commenced; 8. Cordon off the quarry and borrow areas to keep livestock and children off; 9. The Contractor shall rehabilitate and decommission all borrow pits and quarries 10. Stockpile top soil on site and use during rehabilitation of the borrow site and quarries;	• Rehabilitation of Quarry and borrow sites after completion of construction.	Contractor	Construction	Sh. 3,000,000 for rehabilitating material sites

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		11. Plant suitable saplings where it is deemed feasible; 12. In case of blasting: i. The Contractor will obtain a current and valid authorization from the Department of Mines and Geology prior to any blasting activity. ii. A qualified and registered blaster shall supervise all blasting and rock-splitting operations; iii. The contractor shall develop a safety policy on site. 13. Upon completion of works, the borrow areas should be graded and backfilled with top soil that formed the overburden. The sites should be re-vegetated preferably with local species of plants. 14. ALL QUARRIES SHOULD BE SUBJECTED TO AN ESIA STUDY BY THE CONTRACTOR				
2.	Air Pollution	1. Sensitize workers on air pollution. Maintained all construction machinery serviced in accordance with the owner's manual; 2. Workers shall be trained on dust minimization techniques; 3. The removal of vegetation shall be avoided until such time as clearance is required and exposed surfaces shall be re-vegetated or stabilized as soon as practically possible; 4. Water sprays shall be used on all earthworks areas and transport routes close to towns and settlements whenever it fails to rain for at least two days. The contractor should prepare a watering schedule to be approved by the RE	• To reduce pollution of ambient air	Supervising Engineer and the Contractor.	Construction	Apply Best Practices Sh. 2,500,000 for dust suppression at main centres only. Sh. 750,000 for provision of dusk masks.

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		5. To minimize further generation of dust, vehicles delivering soil materials shall be covered to reduce spills and wind-blown dust; 6. Any complaints received by the Contractor regarding dust should be recorded and communicated to the RE; 7. Comply with all legal and statutory requirements as contained in EMAC air quality regulations. 8. Project-specific design improvements to limit motor vehicle air pollution impacts should be prepared and implemented. 9. Crusher plants to be installed with dust suppressants.				
3.	Noise pollution	1. The Contractor shall keep noise level within acceptable limits and construction activities shall, where possible, be confined to normal working hours across Kenol area, Sagana and Karatina. 2. Schools, hospitals and other noise sensitive areas which lie within 200m of the road shall be notified by the Contractor at least 5 days before construction is due to commence in their vicinity 3. Construction workers will be required to use PPEs appropriately 4. Equipment should be maintained regularly to reduce noise resulting from friction; 5. No unnecessary hooting by project vehicles within 200 m of noise sensitive receptors. 6. Any complaints received by the Contractor regarding noise will be recorded and communicated to the RE.	• To avoid exposure of the community living around the project area and workers to noise nuisance	Contractor	Construction	Best Practices, no additional cost

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
4.	Vegetation loss	1. To avoid conflicts on trees within the Road reserve, a clear understanding of ownership should be reached with the immediate neighbours before any tree if felled. 2. Except to the extent necessary for establishing the construction site and carrying out the construction works, vegetation shall not be removed, damaged or disturbed nor should any unauthorized planting of vegetation take place; 3. The clearance of the site for construction purposes shall be kept to a minimum. The use of existing un-vegetated or disturbed areas for the Contractor's Camp, stockpiling of materials etc., shall be encouraged; 4. Areas to be cleared should be agreed and demarcated before the start of the clearing operations; 5. Clearing and removal of vegetation, especially at borrow sites must be carried out in such a way that damage to adjacent areas is prevented or minimized; 6. Areas with dense indigenous vegetation are not to be disturbed unless required for construction purposes, nor shall new access routes be cut through such areas; 7. Trees should be trimmed rather than removed wherever possible; 8. The use of fuel wood by construction workers should be discouraged. Workers should be encouraged to use clean energy sources. 9. The contractors to ensure suppliers are legally compliant and environmentally sensitive.	• To protect vegetation	Contractor	Construction	As in Item 1

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
5.	Impacts on soils and drainage including landslides	1. As far as possible earthworks should avoid the wet seasons that are always intense to prevent soil erosion and landslides; 2. Excavated materials and excess earth should be kept at appropriate sites approved by the Supervising Engineer; 3. Wherever possible, the earth dumping sites will be designed in such a manner as to facilitate natural water discharge; 4. The contractor should adhere to specified cut and fill gradients and planting embankments with shrubs and grass to reduce erosion and take care of stability problems of road embankments. Areas cleared for improving sight distance should be planted with grass to reduce erosion (where possible); 5. The Contractor shall protect areas susceptible to severe erosion such as across steep slopes by installing necessary temporary and permanent drainage works. 6. Areas affected by construction related activities and/or susceptible to erosion or landslides must be monitored regularly. 7. On areas where the risk of erosion is evident, stabilize the areas and prevent erosion. These may include, but not be limited to: i. Confining construction activities; ii. Using cut off drains; iii. Using mechanical cover or packing structures such as geofabric to stabilize steep slopes or gabions, mattress and retaining walls;	• To conserve soil and avoid stripping of top soil	Contractor	Construction	To be included in drainage structures cost Set aside Sh. 3,500,000 for off-road environmental measures

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		iv. Mulch or chip cover; v. Constructing anti-erosion berms; vi. The erosion prevention measures must be implemented to the satisfaction of the RE; vii. Where erosion does occur on any completed work/working areas, the Contractor shall reinstate such areas and areas damaged by the erosion at his own cost and to the satisfaction of the RE and ESO. 8. Cut areas susceptible to landslides should be protected immediately after the works, and works should not be prolonged at such sites unnecessarily				
6.	Water resources	1. The Contractor must adhere to water quality regulations described in Legal Notice No. 120 of the Kenya Gazette Supplement No. 68 of September 2006. 2. Ensure community complaints related to water abstraction activities are promptly mitigated	• To ensure the community's right to access water is not infringed continued supply of water	Contractor	Construction	No additional cost required
7.	Contractors camp	1. The site for the Contractor's Camp shall be determined in collaboration with the RE taking into consideration the following: i. The security situation in the area (expressed authority must be given by the Officer Commanding Police Division)	• To ensure proper siting of contractor's camp	Contractor	Construction	To be specified in the BoQ

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		ii. Involve local community and administration in site selection. iii. Decommission the camps and Reinstate the land to its natural 2. The Contractor shall implement the following as required with the approval by the RE: iv. The contractor shall prepare a waste management plan. v. A suitable water drainage system to prevent soil erosion. vi. A suitable potable water supply; vii. Suitable ablution facilities. viii. Facilities for cooking; ix. Facilities for solid waste collection; x. Facilities for waste water management.				
8.	• Sanitation	1. The Contractor shall comply with laws and by-laws relating to public health and sanitation; 2. All temporary/ portable toilets or pit latrines shall be secured to the ground. 3. The type and exact location of the toilets/septic tanks shall be approved by the RE. 4. All toilets shall be maintained by the Contractor in a clean sanitary condition. 5. A wash basin with adequate clean water and soap shall be provided alongside each toilet.	• To ensure proper sanitation	Supervising Engineer and Contractor	Construction	To be specified in construction contract

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		6. Ensure that solid/liquid exhausts are disposed by licensed agents or through approval by the local Public Health Office.				
9.	• Workshops	1. All maintenance of equipment and vehicles shall be performed in the workshop. 2. If it is necessary to do maintenance on site, but outside of the workshop area, the Contractor shall obtain the approval of the RE prior to commencing activities; 3. The Contractor shall ensure that there is no contamination of the soil, vegetation or surface water. 4. The workshop shall be kept tidy at all times and shall have the following as a minimum: i. An impermeable floor either constructed of concrete or suitable plastic fabric ii. The floor shall be bunded and sloped towards an oil trap or sump. iii. Drip trays shall be used to collect the waste oil and lubricants. iv. The drip trays shall be inspected and emptied daily; v. Drip trays shall be closely monitored during wet weather	• To ensure proper maintenance of equipment and machinery and cleanliness in the workshop	Contractor	Construction	Best Engineering Practices
10.	Solid wastes	1. The contractor should develop a waste management plan; 2. All personnel shall be instructed to dispose of all waste in a proper manner; 3. Contractor shall provide litter collection facilities;	• To maintain sound waste management practice.	Supervising Engineer and the Contractor.	Construction	Sh. 2,500,000 for waste disposal site and its management.

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		4. The final disposal of the site waste shall be done by approved waste disposal agents; 5. Wherever possible, materials used or generated by construction shall be recycled; 6. Provision for responsible management of any hazardous waste generated according to NEMA regulations on waste management. 7. Dispose of surplus material ("spoil") only at designated sites and by approved methods. 8. The spoil designated area need to be more than 20 meters from watercourses. 9. The development and rehabilitation of spoil areas shall include the following activities; i. Stripping and stockpiling of topsoil; ii. Contouring of spoil site to approximate natural topography and drainage and/or reduce erosion impacts on the site; iii. Placement of excavated subsoil and then topsoil over spoil material; iv. Contouring and re-vegetation; v. The Contractor shall ensure that the placement of spoil is done in such a manner to minimise the spread of materials and the impact on surrounding vegetation and that no materials 'creep' into 'no-go' areas.				The operational costs to be contained in BoQ
11.	Liquid wastes	1. No grey water runoff or uncontrolled discharges from the site/working areas;	• To maintain properly	Supervising Engineer and the Contractor.	Construction	As contained in Item No. 11

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		2. Water containing such pollutants as cements, concrete, lime, chemicals and fuels shall be discharged into a conservancy tank for removal from site. 3. The Contractor shall also prevent runoff loaded with sediment and other suspended materials from the site/working areas. 4. Potential pollutants of any kind and in any form shall be kept, stored and used in such a manner that any escape can be contained and the water table not endangered; 5. Wash areas shall be placed and constructed in such a manner so as to ensure that the surrounding areas (including groundwater) are not polluted; 6. The Contractor shall notify the RE of any pollution incidents on site.	dispose wastewater			
12.	Fuels, Oils, Hazardous Substances and other Liquid Pollutants	1. Hazardous materials shall be stored above flood level and at least 20 metres from any watercourse; 2. Areas for the storage of fuel and other flammable materials shall comply with standard fire safety regulations; 3. Chemicals and fuel shall be stored in storage tanks within a secure compound. All chemicals and fuels shall be stored in accordance with their Material Safety Data Sheet (MSDS); 4. Storage areas or secondary containment shall be constructed of waterproof reinforced concrete or approved equivalent, which is not adversely affected by contact with chemicals captured within them; 5. Pipe-work carrying product from the tank to facilities outside the containment shall be provided with secondary containment;	• To ensure proper handling of fuels and hazardous substances	Supervising Engineer and the Contractor.	Construction	Best Engineering practices

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		6. Tank equipment such as dispensing hoses, valves, meters, pumps, and gauges shall be located within the containment or provided with own containment; 7. Fence of the tank compound with locks or other adequate security controls at the site; 8. Appropriate training for the handling and use of fuels and hazardous material is to be provided by the Contractor as necessary. This includes providing spill response and contingency plans; 9. Extreme care will be taken when transferring chemicals and fuels from storage vessels to equipment and machinery on an impervious sealed area which is kerbed and graded to prevent run-off. Chemical and fuel transfer areas shall drain away from the perimeter bund to a containment pit. 10. All chemicals stored within the bunded areas shall be clearly labelled detailing the nature and quantity of chemicals within individual containers; 11. Any chemical or fuel spills shall be cleaned up immediately. The spilt liquid and clean-up material shall be removed, treated and transported to an appropriate site licensed for its disposal; 12. Stormwater shall be diverted away from the fuel handling and storage areas. An oil water interceptor shall be provided to treat any rainwater from fuel storage and handling areas.				
13.	Asphalt, Bitumen and Paving	1. The plant should be situated on flat ground; 2. Topsoil shall be removed prior to site establishment and stockpiled for later rehabilitation of the site;	• To ensure proper siting and operation of asphalt,	Supervising Engineer and the Contractor.	Construction	No additional cost

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		3. Bitumen drums / products shall be stored in an area approved by the RE. This area shall be indicated on the construction camp layout plan. The storage area shall have a smooth impermeable (concrete or thick plastic covered in gravel) floor. The floor shall be bunded and sloped towards a sump to contain any spillages of substances; 4. The area shall be covered to prevent rainwater from contacting the areas containing fuels, oils, bitumen etc and potentially generating contaminated runoff; 5. The plant shall be secured from trespassers and animals through the provision of fencing and a lockable gate to the satisfaction of the RE; 6. Well-trained staff shall be responsible for plant workings. 7. Within the bitumen plant site, areas shall be demarcated/marked for plant materials, wastewater and contaminated water; 8. An area should be clearly marked for vehicle access; 9. Drums/tanks shall be safely and securely stored; 10. Materials requiring disposal shall be disposed off by a licensed waste disposal agent	bitumen and paving			
14.	Cement / Concrete Batching	1. Concrete batching plant shall be located more than 20 m from the nearest stream/river channel; 2. Topsoil shall be removed from the batching plant site and stockpiled; 3. Concrete shall not be mixed directly on the ground;	• To ensure proper siting and operation of cement/concrete batching	Supervising Engineer and the Contractor.	Construction	No additional cost

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		4. The concrete batching works shall be kept neat and clean at all times; 5. Contaminated storm water and wastewater runoff from the batching area and aggregate stockpiles shall not be permitted to enter streams but shall be led to a pit where the water can soak away; 6. Unused cement bags are to be stored so as not to be effected by rain or runoff events; 7. Used bags shall be stored and disposed of in a manner which prevents pollution of the surrounding environment (e.g. via wind blown dust); 8. Cleaning of equipment and flushing of mixers shall not result in pollution of the surrounding environment; 9. Suitable screening and containment shall be in place to prevent windblown contamination associated with any bulk cement silos, loading and batching; 10. Waste concrete and cement sludge shall be scraped off the site of the batching plant and removed to an approved disposal site; 11. All visible remains of excess concrete shall be physically removed on completion and disposed at an approved disposal site. Washing the remains into the ground is not acceptable; 12. All excess aggregate and sand shall also be removed; 13. After closure of the batching plant or any area where concrete was mixed all waste concrete/cement sludge shall be removed together with contaminated soil. The surface shall then be				

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		ripped to a depth of 150mm and the topsoil replaced evenly over the site and re-grassed.				
15.	Diversion and access roads	1. The Contractor should adhere to the road reserve as much as possible in locating the diversion if required. If diversion routes go beyond the road reserve, necessary permission should be sought; 2. Where possible the diversion must be limited to already connecting routes in the area; 3. The Contractor shall comply with all applicable laws and by-laws in Kenya with regard to road safety and transport; 4. Access to the construction site and works area shall utilize existing roads and tracks where possible; 5. Upgrading of the access roads shall be undertaken within the existing confines of the road, unless otherwise agreed with the RE; 6. All diversion and temporary access routes shall be rehabilitated at the end of the contract to the satisfaction of the RE; 7. Damage to the existing access roads and services as a result of construction activities shall be repaired to the satisfaction of the RE. The cost of the repairs shall be borne by the Contractor; 8. To avoid dusts and air pollution, the Contractor must sprinkle water in the diversion route, as necessary, this must be supervised by RE.	• Use of existing roads and proper use of diversion and access roads	Supervising Engineer and the Contractor.	Construction	Cost of watering as contained in item 2
16.	Disruption of Access to Property	1. Disruption of access to property must be kept to a minimum at all times. Where such disruption is unavoidable, the Contractor	• Minimise disruption of	Supervising Engineer and the Contractor.	Construction	Standard procedures to be followed

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		shall advise the affected parties and the RE at least seven working days in advance of such disruption.	access to property			
17.	Relocation of public utilities	1. Undertake inventory of existing utilities in the project area before beginning construction; 2. Relocation of services is provided for in the BOQs 3. Notice should be given to the utility users prior to any interruption in supply; 4. Liaise with relevant parties	• Minimum disruption of access to public utilities	Supervising Engineer, Contractor, Kenya Power	Construction	To be contained in RAP and BoQ
18.	Delays in transportation	1. To avoid delays to road users, the contractor will be required to plan itineraries for site traffic on a daily basis. Traffic management and control is mandatory throughout the project; 2. Temporary road signs that are visible both during the day and at night indicating road works and restrictions will be required; 3. The contractor should also set aside parking bays for heavy goods vehicles and public transport vehicles; 4. Areas where construction is taking place should have clearly marked speed reduction signage.	• Traffic management plan	Supervising Engineer, and Contractor	Construction	Standard procedures to be followed
19.	Emergence of unplanned settlements	1. To forestall the growth of unplanned settlements around the construction camps and other work sites, KeNHA and local administration will need to undertake routine and strict surveillance around the work sites; 2. To mitigate against the potential increase of persons who may be affected by the project, presently and in future, the KeNHA should inform the district administration to stop further developments within the right of way. They should also	• To curb against unplanned settlements	County Administration	Construction	No cost at construction stage

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		undertake regular surveillance along the project road to ensure that new developments are not erected within the right of way.				
20.	Discrimination on employment opportunities	1. To avoid conflicts with the local people on employment is it proposed and important that the Contractor employs the locals in liaison with local leaders and administration in unskilled and semi-skilled duties; 2. To promote the livelihood of vulnerable groups such as the women-headed households, the Contractor should make deliberate efforts to include and retain women in construction 3. Make deliberate efforts to include at least 33% of women to be included as employees within the road construction project 4. Contractor to put in place a code of conduct to prevent sexual harassment / exploitation of women employees	• Employment of local communities	Contractor and local administration	Construction	Prudent hiring practices
21.	Occupational Health and Safety	1. The Contractor shall comply with all standard and legally required health and safety regulations as promulgated by Factories and Other Places of Work Act and also the ILO Guidelines on Safety and Public Health in the construction activities; 2. The Contractor shall provide a standard first aid kit at the site office; 3. There should be a Safety Officer on site who has first aid training and knowledge of safety procedures; 4. Speed limits appropriate to the vehicles driven are to be observed at all times on access and haul roads; 5. No unauthorized firearms are permitted on site;	• To reduce chances of accidents	Supervising Engineer and Contractor.	Construction	PPEs to be included in the BoQ

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		6. The Contractor shall provide the appropriate Personal Protective Equipment for staff; 7. The contractor must have insurance cover for the workmen.				
22.	Public Health	1. The Contractor shall be responsible for the protection of the public and public property from any dangers associated with construction activities, and for the safe and easy passage of pedestrians and traffic in areas affected by the construction activities; 2. All works which may pose a hazard to humans and domestic animals are to be protected, fenced, demarcated or cordoned off as instructed by the RE. If appropriate, symbolic warning signs must be erected; 3. The HIV/AIDS prevention campaigns should be conducted at the camps as well as in the trading / market centres. The contractor shall take an active role in civic and public health education to his employees. The campaign shall include the training of facilitators within the workers, information posters in more frequented areas in the campsite and public areas, availability of promotional material (T-shirts and caps), availability of condoms (free), and theatre groups. The contractor will co-ordinate with the Provincial and District HIV/AIDS control councils, health officers and the NGOs undertaking education and sensitization programmes; 4. The contractor will provide condoms at appropriate places in the work camps. The campaigns will be continuously done by the relevant Government organization even during operation phase of the road;	• To reduce transmission of diseases; • To create awareness of the HIV/AIDS.	Supervising Engineer, Contractor, NGOS, Provincial and District HIV/AIDS control councils, and health officers	Construction	HIV/AIDS awareness costs normally contained in the BOQ No. 25

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		5. The implementing agency for HIV/AIDS campaign shall monitor activities regularly to assess effectiveness and impact. This should include an initial, interim and final assessment of basic knowledge, attitude and practices taking account of existing data sources and recognizing the limitations due to the short timeframe to show behavior change. The assessment will be supported by qualitative information from focus group discussions. 6. The contractor should follow the recommendations of the Kenya National Aids Strategic Plan in communicating prevention measures				
23.	Disruption of Community	1. Are adequately addressed in the Resettlement Action Plan	• To minimize disruptions	KENHA	Pre-construction	
24.	Site Security	1. Security arrangements must be included in the Bills of Quantities to avoid any delays which might be caused due to insecurity; 2. The Supervising Engineer and Contractor in liaison with the security organs must create awareness to the security situation on the ground all the times; 3. Appropriate fencing, security gates, shelter and security guards are to be provided at the Construction Site to ensure the security of all plant, equipment and materials, as well as to secure the safety of site staff; 4. The Contractor must ensure that good relations are maintained with local communities and their leaders to help reduce the risk of vandalism and theft;	• To improve site security and avoid cases of theft	Supervising Engineer and Contractor.	Construction	

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		5. Site staff that are found to be involved in incidences of theft or pose other security risks to the local community are to be dismissed and reported to the authorities.				
25.	Fire Prevention and Control	1. The Contractor shall take all reasonable and precautionary steps to ensure that fires are not started as a consequence of his activities on site; 2. The Contractor shall ensure that there is basic fire-fighting equipment available on site; 3. Flammable materials should be stored under conditions that will limit the potential for ignition and the spread of fires; 4. 'Hot' work activities shall be restricted to a site approved by the RE; 5. Smoking shall not be permitted in those areas where there is a fire hazard. These areas shall include: i. Workshop; ii. Fuel storage areas; iii. Any areas where vegetation or other material is such as to make liable the rapid spread of an initial flame; 6. The Contractor shall ensure that all site personnel are aware of the fire risks and how to deal with any fires that occur. This shall include, but not be limited to: i. Regular fire prevention talks and drills; ii. Posting of regular reminders to staff;	• Fire prevention and control	Supervising Engineer and Contractor.	Construction	Fire management equipment to be included in the BoQ

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		iii. Any fires that occur shall be reported to the RE immediately and then to the relevant authorities; iv. In the event of a fire, the Contractor shall immediately employ such plant and personnel as is at his disposal and take all necessary action to prevent the spread of the fire and bring the fire under control; v. Costs incurred through fire damage will be the responsibility of the Contractor, should the Contractor's staff be proven responsible for such a fire.				
26.		**Operation Phase**				
27.	Erosion and water quality	1. Maintenance engineers from KeNHA shall inspect all drainage structures and outfalls; 2. All the damaged culverts, wing walls and aprons shall be repaired and additional measures for velocity reduction and erosion protection shall be implemented in KIRIe or development of erosion.	• To ensure drainage systems are in good condition	KeNHA	Operation	Included in design
28.	Road Accidents	1. Proper design of road safety features is a very effective way to prevent accidents. The Resident Engineer and the Contractor involved with the implementation of the design of the road should: i. Examine road design standards, safety equipment specifications and training to ensure that design details take account of safety concerns and that specific safety features are correctly designed and installed;	• To avoid road accidents	Kenya Road Safety Authority, KeNHA and Traffic police	Construction and operation	Included in design, Kenya Road safety Authority to include in usual budget

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		ii. Require that road design audits be done, at final design stages, by specialists in road safety and traffic operations; and iii. Draft traffic management plans, including details of signs, markings, and intersection layouts, channelization of flows, access restrictions, footpaths, bus stops, and provisions for non-motorized vehicles; iv. Painting of edge lines in order to separate shoulders; v. Establishment of non-motorised vehicle waiting area; vi. Improvement of visibility; vii. Provision of speed limit signs; viii. Construction of bumps to reduce speeds; ix. Improvement of crossing sites paintings of zebra crossings; x. Regulations, educations and safety trainings. 2. Active police enforcement of speeds; 3. Road safety and accident prevention campaigns are recommended at the end of construction. To monitor the effectiveness of the road safety information and education campaigns, the following measures are recommended: 4. KeNHA shall monitor traffic accidents through records kept at the local police stations along the project road; 5. KeNHA and the relevant Livestock Office shall record accidents with livestock;				

Item No.	Environmental / social aspect	Recommended mitigation, monitoring and/ or management measure	Goals	Responsibility for implementation	Time frame	Indicative Cost Estimate
		6. A report will be required after two years of monitoring and the results used to recommend further mitigation measures, if necessary.				
29.	HIV/AIDS	1. Sensitisation and awareness campaigns should be the responsibility of the National Aids Control Councils in Kenya together with their district co-ordinators. 2. Prevention measures to include access to free condoms to all workers within the project	• To reduce prevalence rates	Contractor and National Aids Control Councils	Operation	Contained in BoQ
30.	Urbanization	3. Proactive planning by all the Counties traversed by the project road	• To forestall unplanned urban development	County Governments	Operation	-

11.4 ENVIRONMENTAL RISK MANAGEMENT, OCCUPATIONAL HEALTH AND SAFETY

The issues raised in this chapter are meant to have the project implemented with none or minimal safety and health concerns to the workers involved in the construction and the public. The project must also meet the statutory health and safety obligations as outlined below.

11.4.1 Approval of Plans

Before commencing construction, after the design stage, the proponent needs to make an application to the Director of Occupational Safety and Health Services for approval of plans.

The Occupational Safety and Health, Act 2007 section 125 (1)states; *'No building shall be erected or converted for use as a workplace and no structural alteration and no extension shall be made to any existing workplace except in accordance with plans showing details of the proposed construction, conversion, alteration or extension, approved by the Director.*

(2) Upon receipt of a written application supported by such particulars as may be prescribed for the approval of any plan described in subsection (1), the Director shall

a) *If he is satisfied that the plans provide for suitable premises for use of a workplace of the type proposed, issue a certificate of approval for such plans; or*
b) *If he is not satisfied, refuse to issue a certificate of approval and shall state in writing to the applicant the reasons for such refusal'.*

11.4.2 Occupational Safety and Health during construction Works

11.4.2.1 Hoarding of site works

On award of contract, the proponent shall hand over the site to the contractor. The contractor is obliged to seclude these working area from the rest of the buildings and area within Kabete laboratories by hoarding. This will help avoid exposing non interested parties to the various hazards in the works area.

11.4.2.2 Registration of Construction Site

The contractor appointed to carry out this works shall carry out his operations in accordance to the requirements of OSHA and particularly the 'Building Operations and Works of Engineering Construction) Rules, 1984'.

Rule no: 6 (1) Notification of commencement or taking over of operations or works.

'A main contractor shall, within seven days of commencing or undertaking building operations or works of engineering construction, notify the Chief inspector in writing of:

a. *The contractor's name and postal address;*
b. *The address or location of the site of the operations or works;*
c. *The date of commencement*
d. *The expected date of completion;*
e. *Whether mechanical power is used or not;*
f. *The number of persons expected to be employed'.*

Rule no: 7 (1) on the appointment of a safety supervisor states;

'Every contractor who employs more than twenty persons shall, for every site on which he is the contractor appoint one or more persons experienced in the operations or works carried out at the site and suitably qualified for the purposes to:

(a) *Advise the contractor as to the observance of the safety, health and welfare requirements under the Act and under these Rules; and*
(b) *Supervise and ensure the observance of those requirements and promote the safe conduct of work generally at the sites'.*

11.4.2.3 Excavations

Precautions shall be made to prevent persons falling into excavated areas during construction.

Rule no: 8 (1) of building operations and works of engineering construction rules, 1984 deals with prevention of danger in excavations, etc

'The walls and roofs of any excavation, shaft, earthwork or tunnel, deeper than 1.2 metres shall be reinforced with timber of suitable quality or with other suitable material to prevent, so far as is reasonably practicable danger or injury resulting from a fall or dislodgement of earth, rock or other matter from the walls or roof, to any person employed or making the inspection or examination under rule 9'.

Rule No: 13 Fencing of excavations further states that;

'A Contractor shall ensure that any excavation, shaft, pit or opening in the ground more than two metres in depth shall be securely covered, fenced or otherwise provided with a suitable barrier when access by workmen, plant and equipment or material to it or from it is not necessary'.

11.4.2.4 Dust and Fumes

During construction dust will be generated. Precautions must be taken to prevent inhalation of dusts and fumes by the workers. This may cause health effects on those exposed. The adjacent existing laboratories will be in operation and therefore exposure to dust will be detrimental to those working in the laboratories.

Rule number 20 of the Building and works of engineering construction rules, 1984 states that;

'In any building operation or works of engineering construction where dust or fumes likely to be injurious to the health of persons employed are given off, all reasonably practicable measures be taken to prevent the inhalation of the dust or fumes by the persons employed by ensuring adequate ventilation or providing suitable respirators at the place where the operation or work is carried on'.

11.4.2.5 Lighting

During construction effective steps shall be taken to provide lighting for the works to be carried out safely .The Occupational safety and Health Act, 2007 section 50 (1) states;

'An occupier shall ensure that effective provision is made for securing and maintaining sufficient and suitable lighting, whether natural or artificial, in every part of his workplace in which persons are working or passing'.

Rule No 47 of Building and Works of Engineering Construction, Rules, 1984 on lighting of workplaces states that;

'There shall be adequate and suitable lighting in:

a) *every working place and approach thereto;*
b) *every work place where here is lowering and raising operations with the use of lifting appliances are in progress; and*
c) *All openings dangerous to persons employed'.*

11.4.2.6 Lifting

During construction there will be a lot of lifting of weights. Lifting shall be mechanized in many instances and where it must be done manually the training on safe lifting methods has to be done. Rule No 53 of the Building and works of engineering construction rules, 1984 on lifting of excessive weights states that;

' A person shall not be employed to lift, carry or move a load so heavy as to be likely to cause injury to him'.

11.4.2.7 Working platforms

During construction processes working platforms will be erected. Scaffolding structures are used to support these platforms. Scaffoldings must be strong and stable to be able to support the kind of weights expected.

Rule Number 57 of the Building and Works of engineering construction rules, 1984 on Construction and material states that;

'*(1) Every scaffold and every part thereof shall be of good construction, of suitable and sound material and of adequate strength for the purposes for which it is used'.*

11.4.2.8 Sanitary conveniences

The contractor is obliged to provide sanitary conveniences for his employees, visitors and other stakeholders. The Occupational safety and health, act 2007 section 52 (1) states that;
'Sufficient and suitable sanitary conveniences for the persons employed in the workplace shall be provided, maintained and kept clean, and effective provision shall be made for lighting the conveniences; and, where persons of both sexes are or are intended to be employed (except in the case of workplaces where the only persons employed are members of the same family dwelling there), such conveniences shall afford proper separate accommodation for persons of each sex'.

11.4.2.9 Fire and Fire prevention

All construction works shall be carried while strictly following the 'The Factories and Other Places of Work (Fire Risk Reduction) Rules of 2007 (Legal Notice no. 59 of 2007). OSHA, 2007, however has requirements that have to be met in overall fire obligations.

Section 78**.** (1) *'All stocks of highly inflammable substances shall be kept either in a fire-resisting store or in a safe place outside any occupied building:*

- *Provided that no such store shall be so situated as to endanger the means of escape from the workplace or from any part thereof in the event of a fire occurring in the store'.*

Section 81 (1) *'In every workplace or workroom there shall be:*

(a) Provided and maintained, and conspicuously displayed and free from any obstruction so as to be readily accessible, means for extinguishing fire, which shall be adequate and suitable having regard to the circumstances of each case; and

(b) Present, persons trained in the correct use of such means of extinguishing fire during all working hours.

(2) Every workplace shall be provided with adequate means of escape, in case of fire, for the persons employed therein, having regard to the circumstances of each case.

3) All the means of escape referred to in subsection (2) shall be properly maintained and kept free from obstruction'.

11.4.2.10 Supply of drinking water

The contractor's employees and those visiting site shall require to have a supply of drinking water for their use whilst the works are going on. Section 91 of OSHA, 2007 states;

'(1) Every occupier shall provide and maintain an adequate supply of wholesome drinking water at suitable points conveniently accessible to all persons employed'.

11.4.2.11 Hygiene

Hygiene is paramount both for the contractor, his workforce and for the proponent who is responsible for the road works work under strict conditions. Section 92 of OSHA, 2007 on washing facilities states that;

'(1) Every occupier shall provide and maintain for the use of persons employed, adequate and suitable facilities for washing, which shall be conveniently accessible and shall be kept in a clean and orderly condition'.

11.4.2.12 First Aid

In case of injuries on site the contractor shall require first aid dispensation before seeking for further medical attention. The provision has to be in accordance to first aid rules, 1974. OSHA section 95 states that;

'Every occupier shall be provide and maintain so as to be readily accessible, a first-aid box or cupboard of the prescribed standard'.

11.4.2.13 Protective clothing and appliances

All hazards on site shall either be eliminated, processes substituted to safer methods, safe procedures and controls utilized. In cases where this is not possible or safety needs to be enhanced then provision of personal protective equipment is very important so as to provide protection. Section 101 of OSHA states that;

(1) Every employer shall provide and maintain for the use of employees in any workplace where employees are employed in any process involving exposure to wet or to any injurious or offensive substance, adequate, effective and suitable protective clothing and appliances, including, where necessary, suitable gloves, footwear, goggles and head coverings'.

11.4.2.14 Safety and Health committees

The requirements of the Legal notice number 31 on Safety and Health committee rules must be met by the contractor during his activities on site. Section 9 of OSHA, 2007 states that;

'(1) 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; or

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

11.5 Traffic Safety

Dualling of the Kenol – Sagana – Marua may result into increased accidents particularly to the pedestrians and motorcyclists due to the following reasons:

- Increase in traffic speed due to improved road
- Luck of public awareness about road safety

General increase in traffic volume

The Table below provides safety recommendations that have been factored in design

General Safety Recommendations

General Accident Situation	Designed Countermeasure
Pedestrian/vehicle conflicts	• pedestrian / vehicle segregation (sidewalks or wide shoulders) • raised pedestrian crossings • speed control • Footbridge
Vehicular Loss of control	• road markings • delineation • speed controls • guardrails

Darkness	• reflective signs • reflective road markings • delineation
Poor visibility	• improve sightlines • realignment • conspicuity
Oncoming vehicle glare	• Ample median • Provision for tree planting within the median
Poor driving behaviour/ lane discipline	• road markings • enforcement/Awareness • median barriers
Collision with roadside obstacles	• better delineation • guardrails • frangible posts
Skidding	• restoring surface texture
Turning movements	• turn prohibition • channelisation / right turn lane • acceleration / deceleration lanes
Light / heavy vehicle conflicts	• bus bays / lay bys • Manageable gradients
Parked vehicles	• parking controls • parking provision
Roadside Stalls	• Service roads/ Wide shoulders

A general safety scheme for towns and major centers has been set up, consisting of:

- Town sign with end of town sign on opposite side facing the town near or shortly before start of built-up town section.
- Rumble strips across the carriageway and shoulders at the same location as the town sign. These rumble strips will alert the motorist of the speed limit sign ahead.
- Speed limit sign, 50 km/h, about 50 m after the town sign and at end of the 50 km/h sign facing the town in the opposite road side. End of prohibition sign for the 50Km/h speed is provided at the end of the town.
- Speed hump sign about 100-150m ahead of speed humps/raised pedestrian crossings and with a sub-sign specifying number of humps, if more than one speed hump is provided in the town.
- Raised pedestrian crossing (a flat speed hump) at the town Centre where many pedestrians need to cross the project road. These are also provided with a pedestrian crossing sign.
- Footbridge provided as a composite bridge with grade separated bridge at Makutano for pedestrian crossings.

- Bus bay in each road side with the left side bus bay staggered forward (if practical) and a speed hump or raised pedestrian crossing in between the right and left side bus bay. Hereby bus passengers will be inclined to pass the road behind the bus which is safer than crossing ahead of the bus due to better visibility, especially if the bus actually move on before the passenger is crossing the road.
- Wide asphalt concrete paved shoulders, 2.00m wide for the outer shoulder in both sides of the road even in the built-up part of the towns and villages.
- Junctions, all junctions in relation to type of side road and volume and composition of traffic on the side road has been designed with ancillary lanes to enhance some safety.
- Provision of Raised footpaths for separation of motorist and pedestrians in major towns (Karatina)
- Provision of Localized street lighting for the major towns

12 CONCLUSIONS AND RECOMMENDATIONS

The ESIA study has found that the project will have fundamental social impacts within the project's area of influence, most of which are related to land acquisition and property compensation. These could in turn impact on the livelihoods of the poor especially roadside traders and farmers. These concerns are well covered in the resettlement plan and a detailed compensation mechanism has been proposed. If the RAP recommendations are followed, then the livelihood impacts will be fully mitigated. The other social impacts include potential segmentation of communities across the road, land and property acquisition and socio-cultural impacts such as relocation of graveyards and cultural erosion over time. Some of these socio-cultural and socio-economic impacts can be fully mitigated through compensation and proper design of the road. Foot bridges and underpasses could be incorporated to mitigate community segmentation and to enhance road safety. The above potential socio-economic impacts notwithstanding, overall the socio-economic impacts will be positive as it is for the larger societal good. The other tangible benefit is the projected rapid appreciation of property values especially in Muranga, between kenol and Makuyu.

Impacts on the bio-physical environment are medium to low and most of them can be avoided or mitigated. The most important impact relates to expanded impervious surface that will double the run-off from the pavement. It is estimated that on average additional 756,000 m^2 of paved surface will be created. This will increase the amount of run-off that will require to be channelled in a way it does not lead to new erosion and gullies. This could be mitigated through proper channelling of run-off and vegetating outfalls . Material sites especially quarries and borrow pits could alter the general landscape and also lead to land degradation. This is a major impact considering that very large quantities of materials will be needed for construction.

Cumulative impacts will only occur during the construction phase if the construction of other nearby projects coincides with that of the proposed road project. If this is the case, even greater attention should be paid to the proposed mitigation measures to ensure the cumulative impact of the construction works is minimised. More importantly there is possibility of the new developments that may be triggered by the project to source construction materials from the same quarries. This is difficult to estimate at this time.

During operation, cumulative impacts will be significant within farmlands and urban fringe between Kenol and Makuyu resulting in a gradual change of character. Landscape changes may contribute to a potential future cumulative urbanising impact changing the character of the area from rural to urban edge. Due to expected future residential and commercial developments along Contract 1, cumulative impacts relating to land use and noise and vibration are expected.

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