# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENTSTUDY REPORT FOR THE PROPOSED UPGRADING OF THE

# NGINYANG'-LOKORI-LOKICHAR ROAD (C113/C46) TO

# BITUMEN STANDARDS

Kenya National Highways Authority

Quality Highways, Better Connections




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Otieno Odongo & Partners Consulting Engineers (a registered firm of experts with the National Environment Management Authority bearing license No. 1596 confirm that the contents of this report are a true representation of the Environmental and Social Impact Assessment of the proposed upgrading of the Ng'inyang-Lokori-Lokichar Road (C113/C46) to bitumen standard.

Signed
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# EXECUTIVE SUMMARY

## Introduction

The Government of the Republic of Kenya (GoK) through the Development vote has assigned Otieno Odongo & Partners Consulting Engineers to undertake Preliminary and Detailed Engineering Design for upgrading the Ng'inyang – Lokori – Lokichar Road (C113/C46) to bitumen standards. The Project Road is under the management of the Kenya National Highways Authority (KeNHA). The road is an existing alignment and it traverses several sub counties namely East Pokot, Turkana Central, Turkana East and Turkana South located in two Counties namely Baringo and Turkana County of the Rift Valley Region. The road which is currently an earth road in some sections and narrowing to a path in others due to over grown bushes measures approximately 200km. The project road starts at Ng'inyang and runs in a Northerly direction through Kapedo, Napeitom, and Lokori where it joins C46 and ends at Lokichar at the Junction with Road A1. The design has proposed a realignment of about 3km at at Lokichar Shopping Centre joining A1.

The existing road alternates between earth and gravel surface. The drainage along this section of road is also poor, with flood water ponding on the road whenever it rains. This is caused by the fact that the existing road level is lower than the surrounding ground. It is also worth noting that the infiltration rates are low hence during rainfall, most of the water floods the road section.

The Section between Lokichar and Ngamia 1 oil Well has wide flood crossings and the drainage structures, mainly drifts and pipe culverts, which are inadequate. Improved gravel sections were noted within the same stretch this is between km 200-175. The design has proposed a realignment at Lokichar Shopping Centre.

The road width is not clearly defined over the earth sections. The average carriageway width at the gravelled sections is approximately 5 m wide with 2 m wide shoulders. Drainage is not taken care of adequately. Due to the drainage problems noted above the road alignment has to be lifted, which means existing gravel cannot be utilized for the final pavement.

The scope of the assignment encompassed undertaking an Environmental and Social Impact Assessment (ESIA) as per the Environmental Management and Coordination Act 1999 which requires all new projects to carry out an ESIA study at the project planning phase in order to ensure that significant impacts on the physical and social environment are taken into consideration at the construction, operations and decommissioning stages. The EISA study also provide guidelines that aims at harmonizing the coexistence of the project with the surroundings and at the same time facilitates key stakeholders make informed decisions during evaluation and approval of the project.

## Legal Regulatory Framework

The ESIA for the of the proposed road was undertaken in accordance to the Environmental Management and Coordination Act (EMCA), 1999 and its subsequent supplements; the Environmental (Impact Assessment and Audit) Regulation, 2003;

EMCA (Waste Management) Regulations, 2006 and EMCA (Water Quality) Regulations, 2006; EMCA (Controlled Substance)Regulations, 2007; EMCA (Noise and Vibration Control) Regulations, 2009; EMCA (Emissions Control) Regulations,2006; EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009; EMC(Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations,2006; the Land Act 2012, Water Act, Irrigation Act among other pertinent legal and institutional framework regulating roads development.

## Rationale of the SIA and EIA Studies

The SIA and EIA studies provide an analysis of the implications of the planned investment on the social and biophysical environment in the project areas. It addresses key environmental and social aspects of the proposed investment project in relation to other land uses and likely impact on the communities in the project area.

The objective of the ESIA is to analyse and evaluates the anticipated impacts of the proposed road upgrading project to bitumen standards on the physical, biological, socio-cultural and socio- economic environment and prepare an EIA report recommending appropriate solutions to minimize any undesirable effects resulting from the road improvement. The scope of the analyses based on the assignments TOR was to include, but not limited to the following factors:

- The role of the project in the development plans at national and regional level;
- Preservation of areas and land use of particular value including agricultural and, natural conservation areas, forests and other important natural resources, cultural and historic sites, etc;
- Assessment of direct impact on agriculture and forestry, particularly the utilization of the fuel wood and water;
- Disturbance if vegetation, and plans for re-vegetation; The prevention of soil erosion and sedimentation;
- The presentation of health hazards arising from pounding water and pollution of water courses and/or sources;
- Measures for the rehabilitation of construction materials, borrow pits and quarries; Health and sanitation for the road construction labour units;
- The avoidance of reduction of visual intrusion; and
- Assessment of the impact on demographic factors including the prevention of undesirable roadside developments, and recommended regulations and measures to limit negative impact on adjacent communities and areas.

## Scope of the ESIA

The ESIA study was undertaken in accordance with the Environmental Management and Co- ordination Act (EMCA), 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003.

The study established the environmental and, social status of the project areas and thereafter develop guidelines to enable harmonize the coexistence of the project with the surroundings and at the same time provide information that shall facilitate the key stakeholders make informed decision during evaluation and approval of the project.

The EIA study was conducted by a team of experts who applied the ESIA study methodologies namely scoping, screening and detailed assessment. The methodologies were applied in collection of primary and secondary data during field studies, public consultations and desk top studies. This methodologies enabled the consultant develop baseline information on the environmental and social status of the project area.

The key activities undertaken during the assessment included the following:

- Consultations with the key project stakeholder including the project proponent, community members, administrative authority, opinion leader and sub county departmental heads. The consultations were based on the proposed project, site planning and the project implementation plan;
- Physical inspections of the proposed project area which included observation of available land marks, photography and interviews with the local residents;
- Evaluation of the activities around the project site and the environmental setting of the wider area through physical observations and literature review;
- Review of available project documents;
  and
- Report writing, review and submissions.

## Project description

The proposed project shall involve upgrading the existing earth road connecting Ng'inyang to Lokichar to bitumen standard. The road is generally in ridable standards apart from sections towards Kapedo which is very rocky. The road alignment is still available in most ections of the road this is it free of any development apart from sections at the trading centres where it is encroached with business structures and at Napeitom village which is developed on the alignment to control movement into the village due to the high insecurity in the area. The alignment traverses several seasonal river beds and is aligned with Indigenous trees in several sections especially near the river beds.

The project shall follow the existing alignment as much as possible and the road shall be provided with drainage structure and road furniture and, amenities. The drainage structures to be developed shall include bridges and culverts. The road furniture to be developed shall include road crossing, service roads, bus bays, truck layby, and provisions for wayside amenities among others. The key activities to be undertaken during the development shall include:

- Filling and shaping of the road section;

- Cutting of earth section to facilitate widening of the road;

- Upgrading or construction of longitudinal and cross drainage structures;

- Provision of sub-base, base course and double surface dressing ending with finishing course of bitumen surface standard; and
- Provision of technical services to guide the development and this shall include engineering and environmental services.

**Project Stakeholders**

Stakeholder's analysis for the project was undertaken and the key stakeholders identified included: the Governmental Officials in the various departments found in the project area and Local Leaders. All the key stakeholders were consulted on the proposed project through one to one interviews and stakeholders forums.

Simple methods such as networks, literature review and interviews were used in the process of stakeholder identification. The main stakeholders consulted included departmental heads, Sub county and Local Administrative Officers, and the general public. The overall goal of the consultation process was to disseminate Project information and to incorporate the views of stakeholders in the design of the Environmental and Social Impact mitigation measures, Management and Monitoring Plan.

Several stakeholders' forums were held for this project and the main agenda of the meeting was evaluation of the proposed project which included discussion of perceived project impacts, their mitigations and how to holistically incorporate environmental consideration in the project planning and implementation. The stakeholders meeting indicated that there is need to develop the proposed road as it shall enhance linkages within the project area which currently has no major road linking its surrounding and major towns.

From the consultations it can be said that the communities are very much interested to see that the road is developed as it shall provide a better environment for the movement of people and goods thus lead to economic and social growth.

**Study Findings**

Findings on the Bio-physical environment:

- Bio-Physical Environment: The project area has several natural resources such as water ways, sand, hills/volcanic deposits and indigenous vegetation.
- The project area is characterised as an arid/semi-arid area and this could be depicted with the vegetation cover found in the area which consist mainly of Acacia sp. The vegetation cover is mainly concentrated along the seasonal river beds/storm water ways. Efforts of afforestating the area are under way but the main challenge is sources of water for watering the plants though techniques such as mulching are being applied to curb the rate of evatranspiration. Ground cover of vegetation along the road alignment varies seasonally with rainfall and grazing intensity.
- Wetlands and water sources: All the rivers along the road alignment flow to the

South Easterly direction. The catchments lie within the Rift Valley Basin. There are a number of perennial and ephemeral rivers on the alignment. The Kerio and Nginynang Rivers are the perennial rivers in the area. The area also has several springs located along the road reserve but only the one at Lokwamusing located 20m from road alignment is protected and used as a watering point by the community members. Sources of fresh water in the area are scares and ground water in the area is salty thus community living far from fresh water sources get their water from the Sandy river beds found in the area. The road traverses several vast flood plains this was evident during the rainy season as masses of water could be seen while during the dry season this was indicated with the existence of sand and, rock deposits in the plains and the road and several water ways that cuts across the road. The sections seen to have large plains were between Lokichar -Lokiro and towards Ng'inyang. Marshy land was seen at chainage 37+000 and is located along a vast storm water way.

- Volcanic deposits and floods situation; The project area has several hills remnants of volcanic activities. The hills are the main sources of the storm water run-off thus flooding the area during the rainy season. The flash floods are normally accompanies with rooks, sands and tree stamps. At times the storm water comes from Uganda thus the area can flood despite the fact the area has not received any rain.
- Mineral Resources: The area is rich in natural resources and has potential zones with soda ash, salt, gold, oil and energy generation sources.
- Soil Erosion: Level of soil erosion in the areas was seen to be high due to poor land management, overstocking of livestock and the flash floods which has led to land degradation.
- Wildlife: The project area is a buffer zone for small animals such as the gazelle and it also has a section of Grassland Savannah near Ng'inyang at km 43+00 inhabited with the lions and other big five animals.

Archaeological and Cultural sites; Sites of cultural importance found in the area included Stone works at Lokori located over 1km from road reserve, graves within the road reserve along the entire road stretch and a habitat cultural site used by the Turkana locally known as Ekang'wata Chiror located at Napeitom village 10m from the road alignment.

**Findings on the socio-economic environment**

- Socio-economic activities: The main socio-economic activity in the project area is pastrolism. Other income generating activities noted were trading in commodities, charcoals and food stuffs.
- Socio-economic infrastructure: The project area had very few socio-economic infrastructure as most of the area had no communication facilities such as telephone services, access roads etc . The area had primary schools near the four main centre and one secondary school at Lokori namely as Kangetet girls secondary school. Plans for developing a polytechnic are underway at Lokori.
- Land Use: The main land use in the project area is pastoralism as the people in the project area keep large herds of cattles and the area being an ASAL they are forced to move from place to place with their herds in search of water and pasture. Irrigation farming is undertaken at Morlem Irrigation Scheme located in Lokori in Turkana East seven (7) kilometres from the road alignment. The scheme sources its

water from Kerio River but their main challenge is links to the markets which has exposed them to exploitation by the middlemen.

- Settlements: The project area is sparsely settled and communities lives in pockets of villages along the way. The area has four main settlement areas namely Kapedo, Napeitom, Lokori and Lokichar which also acts as the main economic centre.
- Encroachment of the road reserve: It was noted that the community members have developed a few structures within the road reserve at Lokichar, Lokori, Napeitom and Kapedo. The level of encroachment is minimal and since there will be no land acquisition livelihood restoration programmes shall be developed once the final design has been done.
- Tourism: The area has potential for tourism development due to existence of wildlife, archaeological sites and rich culture.
- The area is largely occupied by the Pokot and Turkana communities who have been feuding for years. Due to the fore mentioned the area is considered insecure as the communities attack each other at random. Insecurity in the area normally lead to displacement and resettlement of people such as the occupants of Napeitom village were resettled a year ago within the road reserve. The community erected their village on the road alignment so as to control movement of people into and out of the area thus to ensure no surprise attack is done upon them and their off springs.
- The communities in the area still live by their cultural traditional practices thus still leave in villages consisting of several housing clusters occupied by extended families, wear traditional attires, the male are polygamists, boys and men are herders thus few children go to school. The village setup is also used to beef up security of the family members and the men team up and stay vigile at night to counter any attack from the enemies.
- Cattle rustling are rampant in the area which also engages the youth making them not attend school in areas with schools while in areas without schools the youth engage in it as they have no other occupation.
- Due to the high level of insecurity incase death of community members occur at particular area, the deceased is buried in the area he/she died this was evident with the number of grave yards found along the road reserve especially at Kapedo.
- The youth enterprise fund provides it's services in the area but they face several challenges as the local youth have no access to markets thus their repayment for funds allocated in low and the challenge is accentuated due to lack of proper roads thus the officers cannot monitor their activities or follow up on overdue payments

**Findings from the stakeholder's consultations**

The public participation revealed that both the anticipated positive and negative impacts of the project were similar throughout the road's stretch. All the communities living along the road were optimistic on the benefits of the road though they raised some negative issues which they stated should be militated against. The major positive impacts mentioned by the community members were the benefits they shall achieve due to enhancement of transport sector which included:

- Increase in irrigation farming in Lokori due to direct links to the markets;
- Diversification of economic activities which will reduce over independence in livestock keeping, pastrolism and help develop the trading industry;

- Improvement of the areas security due to a good road that shall allow frequent patrols by security personnel and at the same time development of police posts;
- Improvement of the trading centre's status as they are located on a busy corridor but due to the poor state of road they do not flourish as it is not used by the potential customers;
- Development of the mining and tourism sector. It is anticipated that the oil exploration going on in Turkana North will yield good quantities for economic exploration thus the road will play a big role during development and management of the oil rigs;
- Reduction in travel time and, transportation costs and introduction of comfortable/various modes of public transport;
- Attraction of other socio-economic infrastructure in the area such as schools, hospitals, financial institutions among others and will also facilitate the activities of the Non-Governmental Organisations such as response time to emergency situation, dissemination of health information and medical supplies, supply of relief food among others;
- Improve accessibility to the area with workers and extension officers from various fields such as education, agriculture, fisheries, youth enterprise development among others; and
- Road will enhance reconciliation between the Pokot and Turkana communities as they shall trade together and work together during road construction.

The negative impacts raised were substantial but could be mitigated if an appropriate management, monitoring and implementation plan is drawn and implemented simultaneously with the project's core activities. The consideration raised by the community members to help reduce negative impacts included:

- Provision of employment to the locals;
- Development of construction camps in areas easily accessible by the locals or provision of transport to work;
- Giving the community abandoned materials sites and burrow pits for use as water storage structures; and
- Giving equal employment opportunities to both the Turkanas and the Pokots.

**Potential Environmental and Social Impacts**

The development of road infrastructure can cause a wide range of positive and negative impacts on a number of receptors. The significant environmental and social impacts identified for the proposed project included:

- Destruction of physical environment through quarrying, extraction of construction materials, clearing of vegetation cover at material sites and excavation;
- Relocation of about 20 traders and a homestead on the road reserve at Kapedo, Napeitom, Lokori and Lokichar;
- Over abstraction of water for construction activities leading to increased water demand in the area as the study has shown that the project area has limited fresh

water sources;

- Air and noise pollution due to quarrying activities, movement of vehicles and production of emissions such as dust, fuel emissions, flying quarry particles among others;
- Instances of decreased health and poor sanitation due to absence of effluent handling facilities;
- Water logging and poor drainage during project implementation if outfall are not developed appropriately;
- Erosion and destruction of vegetation;
- Increased incidences of road accidents especially at trading centres and those involving livestocks; Conflicts on importation of labourers;
  Chances of interfering with archaeological sites at Lokori and habitat cultural sites at Napeiron village; and
- Project workers attacks by bandits found in the area.

**Positive Impacts**

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. Recommendations provided in the EMP included: preservation of indigenous trees, coordinate with area planners to develop camp sites at strategic locations, avoid undertaking works especially quarrying of materials near the archaeological site and, settlements and conducting periodic consultative meetings with community members to discuss issues of concern and their solutions, formation of umbrella bodies with adequate representation of the community members, provision of portable exhaustible toilets to the workers, water palliation to reduce dust evolution and other fugitive emissions, use of hand tools or machines with silencers to reduce noise levels and ambient air pollution, restoration and landscaping of area after construction, provision of employment to community members where applicable and adequate security to the project workers, use clean fuels to reduce Green House Gas emission, provide livelihood restoration assistance to those relocated from the road reserve, compensate privately acquired land among other measures.

The project is envisaged to benefit the local community by opening up the area to employment, increased economic activities and other associated opportunities

arising from the proposed project. The project will also enhance the national economy through increased flow of goods and services, increased pace of movement, payment of taxes on purchased goods and also by contributing to poverty alleviation through increased food production, acquisition of material goods and services among others. The road shall also play a major role in increasing access for provision of emergency services especially being an area that always faces draught related problems like famine and malnutrition.

The community members along the road and in neighboring areas are ready to have the project implemented and they considered the negative impacts to be manageable, if appropriate plans are developed simultaneously with the project. The community members understand that the key to improving their living standards, meeting the requirements of the ever growing population and explorations in the areas is by rehabilitating the existing road. They anticipate this shall improve their accessibility to basic services, service providers, goods suppliers and markets for their farm produce and livestock.

**Project Alternative Consideration**

The project alternatives were evaluated in terms of site, technology scale and waste management. In regards to project site, the road alignment is already in existence and the construction shall be done on the existing alignment with a few re-alignments in areas such as

- Near Napeitom village so as to avoid the cultural sites;
- Areas requiring vertical alignment so as to reduce the steepness thus enhance safety; and
- Areas of requiring horizontal alignment so as to enhance visibility.

In terms of technology several project components were evaluated and these included:

- The type and size of pavement layers as this determined the material input, project durability and environmental sustainability. The pavement choices were either Asphalt Concrete or surface dressing the former was found to be more durable and needed less maintenance which is good both economically and

environmentally.

- Types of green environmental technology to be incorporate in the project such as energy input for the various project components and this involved proposing use of green energy such as solar at the camp site. In terms of sanitation provision of wastewater treatment facilities were proposed as the area has no sewer services. For vehicles dependent on fuel proposal to use clean fuels and use of vehicles and machineries with Environmental Management Systems such as those with efficient combustion systems, noise abatement technology among others.
- Environmental and Social Management and Mitigation Plan (ESMP)
- The options to minimize or prevent the identified adverse social and environmental impacts as well as a monitoring plan have been proposed in chapter 9 and 10 of this report. Most of the identified mitigation measures are based on good engineering practices. The ESMP describes the implementation schedule of the proposed mitigation measures as well as planning for long-term monitoring activities. It defines roles and responsibility of different actors of the plan. Table 1 below gives an outline of anticipated potential impacts and their proposed mitigation measures.

Table 1: Environmental and Social Management Plan

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| Destruction of Physical Environment | Soil compaction and erosion<br>Increased river sediments<br>Obstruction of natural water channels<br>Abandoned disused quarries<br>Contamination with melted bitumen | Develop soil erosion control measures which should include removal of excavated materials to avoid being blown or washed away, provide silt management structures (silt fences, hay bales etc), line drains and stone protection (rip rap) at steep areas, revegetate road embankments and cut areas with fast growing plants and reduce side drains or stabilize them to reduce erosion and drainage outfall should be lined and provided with silt basins/traps;<br>Limit the circulation of heavy machinery to minimal areas to reduce soil compaction and vegetation clearance.<br>Locate access roads perpendicularly or diagonally to the slope rather than along steep slopes;<br>Salvage the rock materials on the existing road alignment especially between Lokori and Kapedo in order to reduce need of excavating or sourcing new material;<br>Rehabilitate, landscape/levelling, tree planting and re-vegetation once the construction or excavation activities are complete. Some critical sites may need fencing to promote faster regeneration of lost cover and avoid erosion.<br>Avoid melting bitumen on private/productive land; and<br>Use cleaner and environmental friendly methods in handling bitumen like use of |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| | | Enclosed furnaces for melting bitumen, enclosed transportation vehicles and all should be installed with Environmental Management Systems to curb pollution. |
| Increased Water Demand/Supply & Water Quality | Increased abstraction of water for construction<br>Contamination of water bodies through car washing, disposal of solid waste, discharge of effluent , bitumen, oil leaks etc<br>Reduced amount of downstream river flow Decreased water quality and increased incidences of waterborne diseases | Observe the Water Act 2002 and the 30% water reserve rights for downstream users;<br>Develop and implement water management plans to include measures on conservation and controlled usage of the resource such as rain water harvesting and underground water exploration;<br>Observe the Water Resource Management Rules of 2007 and its subsequent guidelines the Water Allocation Guidelines in regards to borehole drilling, ground water abstraction, surface water (rivers, spring and Lake) abstraction and the proscribed development on the river riparian areas ;<br>Obtain water abstraction permit and use metering methods to ensure water is abstracted to recommended limit;<br>Consult with community members when identifying water sources to avoid conflicts and abstract water according to conditions of acquired permits taking into consideration the quantified reserve for the water body in question; |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| | | Implement appropriate construction site management practices like excavating areas to be worked on only, control flow of excavated materials, cover areas once work is completed; and<br>Develop site effluent control and management plans which should include appropriate collection, treatment and disposal of generated effluent, strategic locations of outfall to natural drains to avoid impacts of flooding or water logging. |
| Destruction of Flora and, Fauna, Wildlife- Human Conflict and Birds | Loss of vegetation cover/Deforestation<br>Destruction of indigenous tree species along the road reserve and where materials shall be sources Perturbation of terrestrial, aquatic and avian wildlife along the road especially near the springs between Lokori and Ng'inyang<br>Increase in poaching due to improved transport and number of immigrant workers<br>Disturbance of terrestrial, aquatic and avian wildlife (competition for food and water resources) | Restrict project activities to core project areas to avoid spillover effects to surrounding environment to allow for growth of annual shrubs which provide medicinal and nutritional value to the local community;<br>Develop appropriate methods of handling uprooted plants to avoid spreading of invasive species. Undertake species specific control measures eg manual control by uprooting and burning before flowering. Depending on seriousness of invasion, Integrated control measures are recommended (physical, chemical and cultural practices) ;<br>Project sites, camps and vehicles movement should be concentrated in sites with minimal stand of vegetation; |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| | | Preserve indigenous plants as much as possible and those uprooted should be replaced with appropriate tree species adapted to the area and those that protect soil and conserve water near watering points;<br>All trees uprooted to pave way for material excavation, road expansion and access routes/roads should be replanted with indigenous trees;<br>Planting and tending of vegetation especially those with medicinal value this can be done in collaboration with the Kenya Forest Service and the local community;<br>Avoid fires and smoking of cigarettes in areas with indigenous vegetation as area is dry land and a small spark can cause fire which shall affect vegetation and wildlife<br>Use alternative sources of fuel to replace woods fuel and other non-green energy sources;<br>Provide road warning signs in wildlife dispersals areas between Lokori and, Kapedo especially around Lokuagipi laga and at km 43+00 where there is a Savannah Grassland near Ng'inyang that is inhabited by lions and other big five animals is found;<br>Collaboration with wildlife specialists such as the Kenya Wildlife Service who are already operating in the area to protect wildlife. |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| | | The contractors code of conduct should also include conditions on wildlife conservation and measures to be undertaken invent of violation by the project personnel;<br>Avian nestling sites found along the road should be relocated before trees are cleared for the road construction;<br>Promote the development of community tree nurseries. This can be done in collaboration with the Kenya Forest Service who are mandated through the Act to work with community members in Forest conservation and who are currently working with the community members to afforestation the area; and Institute Environmental conservation measures as part of the project. |
| Inappropriate Drainage | Increased erosion and siltation of water bodies<br>Flooding of rivers, settlement area, farms Lack of access to poorly drained areas by the communities | Install appropriate drainage structures across river crossings or natural storm water ways such as culverts, bridges and mitre drains<br>Avoid loading rivers with silt at drainage outfall;<br>Avoid directing outfalls to farmland and other properties by directing drain's outfalls to natural drains/storm water channels found in the area;<br>Train locals on self-initiative on storm Water harvesting at homes and institutions to enable curb water shortage problem and also reduce pressure of storm water amounts on Drainage Systems/structures;<br>Undertake periodic maintenance of drainage structures to avoid blockage due to vegetation growth, siltation and solid waste; |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| Oil Spills and contamination | Unproductive land Water contamination Destruction of ecosystems | Avoid melting, spilling and burying tar in productive land;<br>Use cleaner production mechanisms and environmental management systems where appropriate;<br>Avoid spilling oil and other waste into water bodies;<br>Bund all fuel storage tanks and concrete floors of garage and areas where fuel is being handled;<br>All waste oil, lubricant and their packages should be collected in non-leaking containers for recycling or disposal at designated area or by a NEMA registered waste handler;<br>All waste water from oil handling areas should be channelled through an oil/water separator; and<br>Avoid using pumps within the river riparian and pumps should be placed atleast 10-20m from highest flood mark using long abstraction pipes. |
| Air Quality, Noise and Vibration | Degradation of air quality and ambient noise due to excavations operations<br>Degradation of air quality by vehicles emissions, bitumen burning and dust during excavation operations<br>Interference with domestic animals and wildlife due to excessive and destructive noise and vibration | Operate equipments with air pollution control/environmental management systems such as bitumen melting plants/furnaces, enclosed asphalt mixers among others;<br>Insulate noisy machines when working near animal habitats and settlements; Maintain vehicles and machinery in good condition in order to minimize gaseous emissions and noise;<br>Avoid bitumen melting activities in open spaces use certified enclosed systems to melt and transport bitumen; and<br>Avoid noisy operations in the night near settled areas and animal habitats; |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| | | Avoid quarrying activities near settlements, institutions and cultural sites and provide warnings before blasting commences;<br>Undertake periodic monitoring of impacts through measurement surveys for noise, vibration and emissions and conduct periodic public consultations to gauge effectiveness of mitigations measures. |
| Encroachment, Displacement and Resettlement of Project Affected Person | Loss of property in areas like Kapedo, Napeitom, Lokori and Lokichar;<br>Destruction of road and reduction of its life span<br>Increased road maintenance costs Relocation of market and businesses Interference with historical and cultural sites | Use of appropriate structures/markings to define the road reserve;<br>Development of structures to deter encroachment;<br>Communicate with community members early enough before commencement of works;<br>Locate areas for relocating PAP to avoid interfering with livelihoods;<br>Observe national and international requirements on Involuntary Resettlement. Institute the Resettlement Action Plan (RAP) to be developed after detailed design |
| occupational, Environment Health and Safety | Increased incidence of Injuries, road accidents and occupational health hazards to workers and public at large<br>Increased incidences of STI, HIV/AIDS, school drop outs, unwanted pregnancies, alcoholism, communicable diseases among other<br>Interference with local culture and values<br>Increased informal settlement | Provide road safety facilities including road signs, speed breaks, bus stops, footpath, foot bridges among other safety facilities;<br>Provide workers with Protective Professional Clothing and Equipments (PPC&E);<br>Conduct social awareness campaign in the project areas;<br>Recruit locals as skilled and non-skilled labourers as much as possible or as required;<br>Provide housing and appropriate sanitation facilities to project workers including mobile toilets at road side sites; |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| | Increased incidences of water and soil contamination<br>Decreased level of sanitation<br>Incidences of suffocation and poisoning | Provide neutralizing and detoxification foods like milk to workers handling chemicals;<br>Complying with work place legal requirements;<br>Employment of competent work force or conduct training and induction courses to workers before project commencement in order to reduce accidents; Instituting Safety drills, disaster preparedness and management programmes; Implement HIV/AIDS and other communicable diseases awareness and prevention programmes in conjunction with relevant ministries;<br>Improve sight distance of areas known to be black spots;<br>Provide climbing lanes in steep areas; and<br>Undertake period EHS (Occupational, Environmental Health and Safety) monitoring to ensure safety rules are adhered to. |
| Socio-economic Concerns | Resources competition Loss of cultural heritage Gender equity<br>Alcoholism and drug abuse<br>Interference with existing local infrastructure such as access roads<br>Insecurity<br>Interference with socio-cultural practices such as access or use of local shrine namely Kayas | Accord local community employment and business opportunity as a priority; Identify areas of cultural importance such as graves and archaeological sites to avoid interference with them during material excavations especially the stone works in Lokori and the Ekang'wata Chiror located at Napeitom village 10m from the road alignment. The areas should be marked before project commences and all<br>personnel made aware of the sites existence and protection procedures ;<br>Establish labour camps at reasonable distance from villages, shopping areas and other local social places so as to avoid escalating social vices such as alcoholism, STI's among other vices ; |

| Component | Potential Impacts | Mitigation Measures |
|---|---|---|
| | | Where possible offer women equal employment opportunities as men; Contractor in collaboration with proponent should develop corporate social responsibility programmes (CSRP) such as provision of clean water to the local communities, animal drinking points; sharing of medical facilities with the locals among others.<br>Contractor should hold continuous site meetings with workers and community members through releveant experts such as the sociologists and environmentalist;<br>Develop programmes that can promote peace and harmony such as sports, cultural events among others.<br>Rehabilitate infrastructure damaged due project road activities; Compensate PAP appropriately on acquired land, materials and for loss of livelihood; and<br>Provide security to project workers<br>Develop proposed animal underpass crossing in to enable them and the community members' access water safetly. Strategic locations for proposed under passes are: Lokwamising at km 146+000; Napeitom at km 91+200; Kapedo bridge at km 24+075; GSU at km 27+075 and Kariamarow at km 34+075 |

## Environmental and Social monitoring

Monitoring helps determine the effects of the project activities on the environments and enhances understanding of cause effect of impacts and the effective way of mitigating against them. It ensures compliance with regulatory measures and understanding the degree of implementation of EMSP and its effectiveness. A monitoring plan has been developed for the project and is based on the findings of stakeholder's consultations and identified potential impacts. Monitoring shall be done at the various phases of the project as follows;

- Pre-construction stage: At this stage monitoring of the parameters is meant to establish the baseline information of the target parameters in the project area. The main baseline indicators parameters to be measured and documented should cover environmental issues such as air quality (noise, emissions and vibration), water quality, sedimentation level, status of land degradation and biodiversity audit at material sites. Collection of baseline information including measurements and, laboratory analysis, monitoring of compensation and, resettlement activities is estimated to cost Kshs. 2,254,000. The breakdown of each itemized expenditure is provided in the environmental and, social management and monitoring plans found under chapter 9 and 10 respectively.

- Construction stage: At this stage monitoring is meant to establish the pollution levels that arise from the construction activities. The findings are compared to the baseline information documented at the pre-construction phase and action is taken if the measured indicators deviate from the acceptable standards. At this stage monitoring shall be supported with environmental inspection. The estimated annual monitoring cost at this phase is Kshs. 9,550,000 while the environmental road inspection services by the supervising consultant shall cost Kshs. 10,920,000.

- Operation stage: Monitoring at this stage is meant to check on the impacts that might arise as the result of normal use of the infrastructure. The estimated annual monitoring cost at this phase is Kshs. 3,500,000 while the environmental road inspection services by the supervising consultant shall cost shall also cost about one third of the management fee during construction translating to Kshs. 3,940,000.

- Decommissioning: Decommissioning is anticipated after the projects life span which is 20 years after completion of construction. In many cases for a road project this phase is associated with rehabilitation of the road. It involves removal of the road structure and constructing it in some cases only sections which are considered stable are maintained and areas which are not stable are redone. It is important that materials salvaged from such sections be reused as much as possible in the rehabilitation of the road.

The main parameters to be measured during monitoring include; air quality, water quality, social issues, security, vegetation covers, environmental risks and hazards, safety hazards and actual happenings among others. The detailed financial requirements for undertaking the environmental management and monitoring in the report are estimated for environmental services only for the three main phases of the project namely pre-construction, construction, operation while the cost of undertaking actual project activities for mitigating against the anticipated project impacts are provided for in the engineering design Bills of Quantities. The cost of the decommissioning phase shall be guided by outlined activities and costs for the other phases as provided for in the report.

**Environmental Audit**

Part V of the EIA regulations requires that environmental audits be undertaken one year after the commencement of the project. The aim of the audit is to unveil the actual performance of ESMP and allow for incorporation of effective measures as the development proceeds. As per the Audit regulations undertaking of the environmental audits would be the responsibility of the developer (KENHA) and shall be undertaken by the supervising consultant on its behalf.

**Resource Evaluation or Cost Benefits Analysis**

The economic evaluation of a project is assessed by comparing the proposed investment or project with the base-line project alternative or the base case. In order to perform the economic evaluation, the road upgrading alternative was compared with the base case (Alternative 0) of the road.

The relative impact of the upgrading alternative is represented by the net effect of the benefits and costs they induce. The most desirable alternative is usually the one that maximises the net benefits. Reduced Vehicle Operating Costs (VOCs) and reduced travel time costs due to the improved road condition were considered to represent the benefit side of the Cost-Benefit equation.

The following costs were taken into consideration:

- User Cost Inputs;
- Road Upgrading/Improvement costs;
- Maintenance costs;

**Conclusion**

The proposed road project is economically feasible as shown by the various studies undertaken such as the economic feasibility and the ESIA. The findings show that the road shall improve commercial accessibility to the project area and provide the communities with connectivity to social facilities and markets. It has the potential to open up the area and subsequently connect it to markets and suppliers in the country; Uganda, Ethiopia and Southern Sudan while at the same time boost the tourism industry in the entire region. Besides, the road will greatly reduce the travel time between the local areas and thus increase socio-economic activities in the area and, enable communities optimize on the existing economic activities and the same time increase access to the area in times of emergency such as during droughts, famine, local fueds, cattle rustling among other issues that affects the area.

There is general acceptability of the project but on the other hand there are anticipated negative environmental and social implications that need to be addressed thus appropriate mitigation measures should be integrated in the all project implementation phases to ensure its sustainability.

## RECOMMENDATIONS

The proposed project has been found to be feasible and timely for the economic development and growth of the project area and to ensure it meets its objectives holistically it is recommended that: -

- Mitigation measures proposed in the ESMP should form an integral part of decision making during the planning and construction of the project road;

- Continuous monitoring of project impacts, effectiveness of the mitigation measures and consultations with community members should be undertaken and details recorded; and

- Institute effective communication, education and awareness towards the project beneficiaries for enhanced acceptability and social harmony.

## ACKNOWLEDGEMENT

The ESIA team wishes to convey its sincere appreciation to all stakeholders who in one way or the other supported the completion of this work. Special thanks to the security officers, the area Chiefs and the entire communities whom their participation and views have contributed greatly in the development of this report. We especially appreciate the input by the Late Chief of Lokori who lost his life due to the intense insecurity in the area and may his Soul Rest in Peace and the foundation he laid in pursuit for peace in the area be propagated by his people so as the area can have a peaceful environment for both the locals, Governmental representatives and the business community.

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| | |
|---|---|
| AC | Asphalt concrete |
| ARP | Abbreviated Resettlement Plan |
| BOQ | Bills of Quantities |
| C113/C46 | Road Number |
| CBO | Community Based Organisations |
| CBR | Carlifornia |
| CCD | Convention of Control of Desertification |
| CDM | Clean Development Mechanism |
| CITES | Convention on International Trade in Endangered Species |
| COx, CO | Oxides of carbon |
| CSRP | Corporate Social Responsibility Programmes |
| dBA | Decibels |
| D.C | Sub county Commissioner |
| DEAP | Sub county Environment Action Plan |
| DE | Design Engineer |
| DEO | Sub county Environment Officer |
| DEMC | Sub county Environment Management Committee |
| DFO | Sub county Forest Officer |
| DLO | Sub county Labour Office |
| DPHO | Sub county Public Health Officer |
| DRE | Sub county Roads Engineer |
| EET | Environmental Engineers Team |
| EHS | Environmental Health and Safety |
| EHSO | Environmental Health and Safety Officer |
| EIA | Environmental Impact Assessment |
| EII | Environmental Impacts Identification Checklist |

| | |
|---|---|
| ESIA | Environmental Social and Impact Assessment |
| EMC | Environmental Management and Co-ordination |
| EMCA | Environmental Management and Co-ordination Act |
| EMMP | Environmental Management & Monitoring Plan |
| EMP | Environmental Management Plan |
| EMU | Environmental Management Unit |
| ES | Environment Supervisor |
| GOK | Government of Kenya |
| GWP | Global Warming Potential |
| HC | Hydrocarbon |
| HIV/AIDS | Human Immunodeficiency Virus/Acquired Immune |
| IC | Impact Categorisation |
| IEC | Information Communication Communication |
| KENHA | Kenya National Highway Authority. |
| KFS | Kenya Forest Service |
| KWS | Kenya Wildlife Serive |
| LMO | Living Modified Organisms |
| LN | Legal Notice |
| NEAP | National Environmental Action Plan |
| NEMA | National Environment Management Authority |
| NGO | Non Governmental Organisations |
| NoX | Oxides of Nitrogen |
| NPEP | National Poverty Eradication Plan |
| OHS | Occupational Health and Safety |
| OHSO | Occupational Health and Safety Officer |
| PAP | Project Affected Persons |
| Pb | Lead |
| PC | Public Consultation. |

| | |
|---|---|
| PDP | Physical Development Plan |
| PEC | Poverty Eradication Commission |
| PIC | Public Information Centre |
| PIU | Project Implementation Unit |
| PLHIV | People Living with HIV |
| PM10 | Particulate Matter of ten microns |
| PPC&E | Protective Personal Clothing & Equipments. |
| PRSP | Poverty Reduction Strategy Paper |
| RE | Resident Engineer |
| RIAM | Rapid Impact Assessment Matrix |
| RDM | Road Design Manual |
| RO | Road Officer |
| SACCO | Savings and Credit Cooperatives |
| SEA | Strategic Environmental Assessment |
| SERC | Standards and Enforcement Review Committee |
| SIA | Strategic Impact Assessment |
| STI | Sexually Transmitted Infections |
| UNEP | United Nations Environmental Programme |
| UNFCCC | United Nations Convention to Combat Desertification |
| TOR | Terms of Reference |
| VCT | Voluntary Counseling Testing |
| WRMA | Water Resourcer Managemtn Authority |
| WHO | World Health Organization |
| WSSD | World Summit for Social Development |

# 1. INTRODUCTION

## 1.1. Project Background

The Government of the Republic of Kenya (GoK) has earmarked funds through the Development vote for use in engaging the services of a Consultancy Firm to undertake Preliminary and Detailed Engineering Design of Ng'inyang – Lokori – Lokichar Road (C113/C46).

The overall project components include:

1. Preliminary Design and
2. Detailed Engineering Design;

Otieno Odongo & Partners Consulting Engineers was appointed to undertake the above mentioned services which encompassed an ESIA study.

The Project Road traverses several sub counties namely East Pokot, Turkana Central, Turkana East, and Turkan South located in two Counties namely Baringo and Turkana located in the Rift Valley Region. The project road measure approximately 200km and starts at Ng'inyang in East Pokot Baringo County and runs in a Northerly direction through Kapedo, Napeitom, and Lokori located in Turkana Central and East where it joins C46 and ends at Lokichar at the Junction with Road A1 in Turkana South.

## 1.2 Project Justification

The aim of the project is to upgrade the existing 200km earth road to bitumen standards so as to open up the project area to enable it attain the objectives of vision 2030. The main objective of the ESIA studies is to provide the key stakeholders with sufficient information on how the service level of the road can be enhanced to obtain a sustainable safe road which facilitates economic growth and improves living standards in the areas traversed by the road while maintaining a sound environment.

The need of developing the road is to facilitate trade within the area and the neighboring countries by breaching the existing communication and business gap in the Northern part of the country and its environs. The project shall play a major role in opening up the area to new heights of business activities including eco-tourism, industrialization, market diversification financial institutions among others and at the same time provide access during times of emergency such as drought, famine,

local feuds, cattle rustling among others. This shall in turn play a major role in improving the living standards of the people in the area who perceive themselves to be marginalised and delineated from other communities in the country. The development shall also increase access socio-economic infrastructure such as schools and hospitals which will in turn lead to increased literacy levels and enable the locals engage is sustainable socio-economic activities.

## 1.3 Rationale of the ESIA Studies

Economic and social development is significantly dependent on efficient road transport infrastructure which facilitates delivery of agricultural produce, merchandise and commodities to markets as well as easy access to basic services (health, schools, water, trading centres, and administrative offices etc.) by the people. The benefits from efficient road transport are felt at all levels of the society, directly or indirectly, such as to include improved national economy, social income, wealth and job creation, health care, public transport and general service delivery. Improvement of all these areas is desirable for the current national aspirations including inter- sectoral growth collaborations. Success of Vision 2030 initiative is basically a function of the infrastructure, efficient road network being the key unit.

Development of new roads and improvement of existing facilities have positive and, potential negative effects on the physical, biological, chemical and socio-economic environments. The social wellbeing of the communities as well as natural habitats depends on how well these negative impacts are mitigated. Among the potential negative impacts from road construction projects could include: environmental pollution from construction activities, risk to health and safety of the residents and employees, demand of construction materials such as water, wood, gravel and hard stones; increased run off, socio-cultural changes including loss of farming land, demolition of structures, displacement of human settlement/commercial centres, interference with animal drinking points and foot paths, increased traffic, increased ambient air pollution, increased potential for road accidents, increased surface run off, flooding and associated disasters among other impacts.

In view of the above observation, environmental concerns need to form an integral part of the planning and development process of a project and not an afterthought as it

facilitates the proponent foresee potential project impacts that can be optimized or mitigated. This is normally achieved through identification of impacts through a comprehensive Environmental and Social Impact Assessment Study (ESIA) which included proposed mitigation measures for the anticipated impacts and development of a monitoring plan to guide gauge the adequacy of the implemented mitigation while at the same time enable identify impacts unforeseen during the study. The study enables obtain baseline information describing the current environmental status of the project area, opinion of the local communities; and establish the potential social and economic benefits of the project. The study findings enable appropriate remedy be integrated in the project plans, design and construction period. The effectiveness of the remedy is managed and monitored with the guidance of the Environmental and Social Management and Monitoring Plan as provided in the ESIA report.

The study of the proposed project road revealed that it's impacts shall be mainly short term and reversible impacts as the road alignment already exists and the road reserve is adequate to accommodate the road side project activities even in areas of encroachment the traders shall be moved to other areas as the area has vast unoccupied land.

The principal legislation guiding ESIA process in is the Environmental Management and Coordination Act (EMCA) of 1999 and its supplementary regulations which include the Environmental (Impact and Audit) Regulations 2003 (E (IA&A)). The regulation requires the ESIA process to include a scooping exercise, adequate public consultations, impacts identifying, development of an environmental and social management plan (ESMP) and developing an environmental and social monitoring plan. This requirements is supported by several other national polices, Acts and sectoral regulatory framework as discussed under chapter 2 of this report.

The team of experts followed the due legal requirement for the ESIA study by undertaking the following:

- Scoping exercise: This process was undertaken in steps between 25/10/2011-16/12/2011 to enable determine the scope of issues to be addressed in the EIA.
- Detailed Assessment: This process was undertaken from January to February 2012 and it involved several impact evaluation and analysis. The activities

undertaken to facilitate impact evaluation included field surveys, stakeholders and, public consultations, literature review, impact identification, analysis and design of mitigation measures.

## 1.4 Purpose and Objective of the Study

The overall objective of the proposed project is to develop a reliable road network that shall enhance intra and inter region economic development by integrating trade activities between the sub counties found in the project area, the neighboring major towns and neighboring countries like Ethiopia, Sudan and Uganda which will shall be achieved by linking the corridor to the Northern Corridor road A1 leading to Lodwar.

The objective of the ESIA was to analyse and evaluate the anticipated impacts of the proposed project road on the physical, biological, socio-cultural and socio-economic environment based on the various project phases namely planning, design, construction and operation and maintenance.

The assessment study was conducted from mid-January to September 2012 and it involved studying the whole length of the road totalling 200 km and the preliminary design reports. The specific objectives of this study included the following;

- Identifying and assess all potential environmental and social impacts of the proposed project;
- Identifying all potential significant adverse environmental and social impacts of the project and recommend measures for mitigation;
- Verify compliance with the environmental regulations and relevant standards;
- Identify problems (non-conformity) and recommend measures to improve the environmental management system;
- Generate baseline data that will be used to monitor and evaluate the mitigation measures implemented during the project cycle;
- Recommend cost effective measures to be used to mitigate against the anticipated negative impacts;
- Prepare an Environmental and Social Impact Assessment Report compliant to the EMCA, 1999, the Environmental (Impact Assessment and Audit) Regulations, 2003 and other supplements of EMCA detailing findings and recommendations;

- Identify and quantify different categories of project affected people (PAPs) who would require some form of assistance, compensation, rehabilitation or relocation; and
- Provide guidelines to stakeholders participating in the mitigation of adverse social impacts of the project.

## 1.5 Scope of Work and Limitation to the Study

The scope of the ESIA study which is based on general ESIA study ToR as provided in the projects documents requires the study to encompass undertaking the following:

- The role of the project in the development plans at national and regional level; Preservation of areas and land use of particular value including agricultural and, natural conservation areas, forests and other important natural resources, cultural and historic sites, etc;
- Assessment of direct impact on agriculture and forestry, particularly the utilization of the fuel wood and water;
- Disturbance of vegetation, and plans for re-vegetation;
- The prevention of soil erosion and sedimentation;
- The presentation of health hazards arising from pounding water and pollution of water courses and/or sources;
- Measures for the rehabilitation of construction materials, borrow pits and quarries;
- The avoidance of reduction of visual intrusion; and
- Health and sanitation for the road construction labour units;
- Assessment of the impact on demographic factors including the prevention of undesirable roadside developments, and recommended regulations and measures to limit negative impact on adjacent communities and areas.

## 1.6 Approach and Methodology of Study

The approach and methodology applied during the study enabled collection of both primary and secondary data. The consultant used both qualitative and quantitative methods to obtain the data. Qualitative data was obtained through field visits/site walks, photography, and stakeholders' consultation while quantitative data was

obtained through literature review.

### 1.4.1 Approach

The approach to this exercise was structured such as to cover the requirements of the EIA Regulations 2003 and other supplements of EMCA. It involved largely an understanding of the project background, the preliminary designs and the implementation plan as well as commissioning. In addition, baseline information was obtained through physical investigation of the site areas, public consultations with members of the community in the project areas, survey, and photography, discussions with the Proponent and literature review.

### 1.4.2 Methodology

#### 1.4.2.1 Environmental Screening

In screening the Consultant set out to confirm whether or not this project falls within a category that requires ESIA prior to commencement. In addition, other considerations during the screening process included a preliminary assessment of the environmental sensitivity of the areas along the proposed road alignment; this comprised of a desktop study involving the analysis of project maps and proposed line route, as well as literature review of previous studies done for in areas along the proposed project area.

It was determined that transportation infrastructure development activities such as the development of the proposed road are listed under the second Schedule of the EMCA as one of the projects requiring an ESIA study. The project proponent has therefore commissioned this study in line with the provisions of the Act.

#### 1.4.2.2 Study Team and Scoping

The project scoping stage which followed the screening stage was applied to narrow down the project issues to that requiring detail analysis. The process involved conducting discussions with the proponent and, the key stakeholders on the project issues and, collection of primary and secondary data. Below are the key activities that were undertaken during the study:

- Consultations with the proponent regarding the proposed project details,

the site planning and implementation plan;

- Desk review of available documentation on the project;
- Field investigations along the proposed road using participatory rapid assessment method with assistance of tools such as literature material, questionnaires, observation, photography, surveys using geographical positioning system device (GPS), and in-depth interviews as well as informal discussions with people from the immediate neighbourhood;
- Public and stakeholders consultative meetings were conducted along the project corridor in form of stakeholders' forums, public forums and interviews. This also involved in- depth discussions with the Sub county Commissioners, heads of departments in the project sub counties, the area chiefs and key informants such as service managers and providers.
- Evaluation of the project setting and baseline conditions;
- Analysis of the potential impacts of the proposed project on the biophysical and socio cultural/ economic environment;
- Formulation of appropriate mitigation measures and development of an environmental and social management plan, monitoring plan, and guidelines for capacity building in environmental and social management;

**Report writing**;

The study was undertaken by a team of experts in the following professionals:

- Lead EIA Experts (Environmental Scientists)
- Highway Engineers
- Ecologist/Natural Resource Expert
- Sociologist/Socio-Economist and
- Surveyors

### 1.4.2.3 **Desktop Reviews/Study**

Desktop studies were conducted through review of secondary data to establish the following:

- Legal Policies, Legislative and Institutional Framework governing the proposed project;

- Licenses and permits requirements and conditions;
- Project area baseline information including documented sensitive environmental receptors;
- Types of waste to be generated, proposed management and disposal methods; and
- Potential positive and negative impacts.

The secondary data was collected from the following documents:

- Policies, Acts and Regulations;
- Sub county Development Plans;
- Kenya National Bureau of Statistics 2009 Census documents;
- Project area topographical and cadastral maps;
- Previous project study documents; and
- Literature materials on project including those on Plant Species, Culture, Road Development and Management including the area socio-economic profiles reports, biodiversity inventory records at Kenya Wildlife Services (KWS), National Museums of Kenya (NMK), Nature Kenya (NK) and Kenya Forest Services (KFS). Publications of the International Union for Conservation of Nature (IUCN) , The World Wide Web (Internet) was used to get Google maps for the project area as well as other relevant information.

#### 1.4.2.4 **Field Assessment and Baseline Survey**

Detailed field surveys for this study were undertaken within the proposed project area and its surrounding from the September to December 2011. This involved conducting systematic field traversing to quantify perceived impacts on:

- Land ownership, usage and conflicts;
- Vegetation covers of the area;
- Underground and surface waters;
- Waste management; and
- The general sensitive environmental receptors found within the project area.

The ESIA team also traversed the whole project area to identify the status of the environment and socio-economic indicators. This enabled establish the following:

- Baseline data on the bio-physical and socio-economic and socio-cultural environment;
- Project Affected Persons (PAP) and Project Affected Households (PAH);
- The level of project impact on affected persons and the environment;
- The opinion of the stakeholders on the proposed project including the local communities; and
- The project alternative considerations.

#### 1.4.2.5 **Public Participation**

The overall goal of the consultation process was to disseminate project information and to incorporate the views of stakeholders in the engineering design and the Environmental and, Social mitigation measures, management and monitoring plan. The specific aims of the consultation process were to:

- Improve Project design and, thereby, minimize conflicts and delays in implementation;
- Facilitate the development of appropriate and acceptable entitlement options;
- Increase long term Project sustainability and ownership;
- Reduce problems of institutional coordination; and
- Increase the effectiveness and sustainability of income restoration strategies, and improve coping mechanisms.

The consultations for this study were undertaken in October and December 2011.

In the consultation process two categories of stakeholders were identified and consulted These included:

Key Informant stakeholders at Government level: The stakeholders identified for this category included

- Sub county officials and local government leaders in East Pokot and Turkana

  Sub countys including the Sub county commissioner, Chiefs and Administration Police ;
- Kenya Wildlife Services;
- Heads of departments including Sub county Youth Office East Pokot Sub county
- among other officers;
- Other stakeholders consulted included NGOs within the core impact area.

The meetings with the governmental officials were held in their offices and the meetings were guided using data collection tools such as questionnaires and checklists.

General Public Forums: This group was identified based on the core impact area and were addressed through various consultative public meetings. The meetings were attended by men, women and the youth. The composition of the groups was determined after consultation with the relevant sub county officials and local government leaders. The meetings with communities in the project sites were more detailed and were attended by a cross-section of people. First a brief description of the project was explained to them thereafter they were given time to raise their views after which discussions on the extent of the project and mitigation measures were discussed. The attendance and proceeding of the meetings were recorded by a secretary chosen among the attendees and evidence of the same is annexed to this report.

The aim of the entire consultation process was to seek the opinion and concerns of stakeholders including the community members on the proposed projects so as to involve them in the overall planning of the mitigation measures of the identified impacts. The stakeholders identified both positive and negative anticipated impacts from the project but they stated the positive impacts outweighed the negative impacts as long as mitigation measures are integrated into the project plans.

## 1.5 Environmental Impacts Evaluation Tools

Various data collection and identification tools were used to guide identification; assessment and analysis of impacts in order to enable quantify them and identify appropriate mitigation measures. Impact evaluation was undertaken in three steps:

- The first step was identification of impacts based on Environmental Impacts Identification Checklist (EII) found under annex 8 this report;
- The second step was impact assessment using matrices; and
- The third step was impact analysis.

### 1.5.1 Identification of Impacts

The consultant used the EII Checklist based on road development needs which considers various aspects of the natural and human environments that are likely to be

affected by the project during the construction and operation phases of the project. The parameters included in the checklist to enable evaluate impacts were:

- Available local resource and associated socio-economic aspects;
- Biophysical, chemical and landscape aspects;
- Air and water quality aspects; and
- Occupational health and safety, natural hazards and construction related aspects.

### 1.5.2 **Assessment of Impacts**

The impacts identified were further evaluated using the Rapid Impact Assessment (RIAM) Matrix as shown under annex 9 of this report and then categorised using the Impact Categorization (IC) Matrix as shown under annex 10 of this report The RIAM was used to assess the effect of potential impacts on biophysical and socio-economic components. The assessment of impacts focused on their magnitude, significance, permanence, and whether the impact is cumulative and reversible or irreversible. The IC Matrix was used to categorize impacts into negative and positive impacts based on the project activities. The impacts were also grouped according to environmental components (biophysical and socio-economic) likely to be affected. The result of assessment using the RIA and IC matrices are discussed under section 5.3 this of this report.

### 1.5.3 **Analysis of Impacts**

After categorisation of the impacts, they were analysed using the Impact Evaluation (IE) Matrix, which is complemented by grid method for determination of significance of the impacts as shown in annex 11 of this report. The technique considers the characteristics of impacts based on the following factors:

- Type of impact - whether positive or negative
- Its effects - whether direct, indirect or cumulative
- Intensity - whether low, intermediate or high
- Magnitude - whether site specific, local or regional
- Duration - whether permanent, or temporary; short term or long term;
- Reversibility - reversible of irreversible
- Significance - whether low, intermediate or high.

In order to determine the significance of impacts the IE Matrix is complemented by Grid method, which considers intensity, magnitude and duration of impacts. The frequency of occurrence of each factor for a given impact has been used to obtain the characteristics of impacts as discussed under section 5.4 of report.

## 1.6 Report Structure

This report is divided into thirteen (13) chapters: Chapter 1 provides the introduction of the report, describes the project background and the methodological approach of undertaking the study. Chapter 2 focuses on the policy, legal and institution framework governing road projects. Chapter 3 gives the detailed project description including activities to be undertaken at each phase of project development. Chapter 4 provides the project areas baseline information including the area's economic and social conditions analysis. Chapter 5 identifies the, assessed and analysed environmental and social impacts while chapter 6 provides information gathered through stakeholder's consultations. Chapter 7 discusses the identified project alternatives while chapter 8 describes the proposed mitigation measures aimed at minimising the projects impacts. Chapter 9 focuses on the environmental and, social management plan while the monitoring plan is provided in chapter 10 while chapter 11 discusses on the project's cost-benefit analysis and chapter 12 discusses the decommissioning plan. The summary, conclusions and recommendation of the study is provided in chapter 13.

The appendices, containing key information collected during the study are attached at the end of this report.

## 1.7 Project Cost

The project is estimated to cost Kenya Shillings Thirteen Billion, Three Hundred and Six Million, Seven Hundred and Seven Thousand, Seven hundred and seventy and thirty nine cents (Kshs.13,306,707,770.39). The National Environment Management Authority (NEMA) vide Legal Notice (LN) Number 30 published in the Kenya Gazette Issue Number 14, requires project proponent to pay 0.01% of the total project cost to the Authority as ESIA license processing fees. Despite the quoted percentage, the Authority has regulated the minimum and maximum amount to be paid for the EIA license at Kenya Shillings Ten Thousand (Kshs. 10,000.00) and Kenya Shillings One

Million (Kshs. 1 M) respectively. The proponent will thus be required to pay Kshs. One Million as EIA processing fee as the 0.05% of the project cost has surpassed the maximum limit. The L.N also permits the project proponent's to make the payment of the EIA license processing fees in two equal instalments. The first instalment is paid on submission of the EIA report while the second instalment is paid on approval of the project and before issuance of the EIA license.

### 1.8 Duties of the Proponent

It will be the duty of the proponent to ensure that all legal requirements as pertaining to the development are met as specified by the law.

### 1.9 Duties of the Contractor

The contractor shall be responsible for undertaking all project works which should be integrated with impact mitigation and monitoring measures as discussed under sections 8, 9 and 10 of the report aimed at protecting and conserving the environment.

# 2. POLICY, ADMINISTRATIVE AND LEGAL FRAMEWORK

## 2.1 National Legal and Institution Framework

Kenya has approximately 77 statutes that guide environmental management and conservation. Most of these statutes are sector specific, covering issues such as public health, soil conservation, protected areas conservation and management, endangered species, public participation, water rights, water quality, air quality, excessive noise control, vibration control, land use among other issues.

The National Environment Management Authority (NEMA) in conjunction with the various lead agencies requires ESIA studies to be undertaken for proposed projects and that all their aspects adheres to Institutional and Regulatory Frameworks requirements. The institutional and regulatory framework directly governing road development projects are: Environmental Management and coordination Act (EMCA) of 1999 and its subsequent supplements the Environmental (Impact Assessment and Audit) Regulation, 2003; EMC(Waste Management) Regulations, 2006 and EMC (Water Quality) Regulations, 2006; EMC (Controlled Substance) Regulations, 2007; EMC (Noise and Excessive Vibration Pollution Control) Regulations,2009; EMC (Emissions Control) Regulations,2006; EMC (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009; EMC(Conservation of Biological Diversity and Resources, Access To Genetic Resources and Benefit Sharing) Regulations,2006, Land Act No.6 2012, The National Construction Authority Act, 2011, Public Roads and Roads Access Act (Cap. 399), Forest Act, Physical Planning Act (CAP 286), Local Government Act (CAP 265), Traffic Act Chapter 295, Water Act 2002, Public Health Ac (Cap. 242), Lakes and River Act Chapter 409, Wildlife Conservation and Management Act, Cap 376 and the Penal Code (CAP 63) 514 among others. These pieces of legislation and their relation to the project are discussed in the sections below.

### 2.1.1 Environmental Management and Coordination Act No 8 of 1999

This project report has been undertaken in accordance with the section 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. In order to achieve the goal of the Act, proposed projects listed under the Second Schedule of Act must undergo an Environmental and Social Impact Assessment.

Part V section 42, subsection 1 directs that no person shall among others deposit any substance in a water body if the substance will have adverse environmental effect on the water. According to section 45 of the Act, hilly or mountainous areas are at risk when they are prone to erosion, high rate of vegetation removal or land use activities likely lead to environmental degradation. Section 47 defines these measures, among them being control of soil erosion. Excavations of road construction material have potential for such effects as the project area has several hilly and low lying section which shall be either cut or filled to improve the vertical or horizontal alignment thus likely to expose the area to erosion.

Part VIII section 72 of the Act prohibits discharging or applying pollutants materials into aquatic environment. 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. Materials used in road construction have potential of intoxicating both the above and underground water bodies. It is recommended that the project team meets the requirements of the Act which aims to reduce environmental pollution.

***The proponent is incompliance with the Act by undertaking this ESIA study which has incorporated mitigation measures aimed at guiding the construction team to abate the anticipated project negative impacts while enhancing the positive impacts.***

### 2.1.2 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 study. It also provides guidelines on the payment of the EIA license fees, conduction of environmental audits and development of project monitoring plans. This study is in compliance with the requirements of the regulation. It is therefore recommended that the subsequent requirements of the Regulations which includes conducting continuous monitoring and annual audits be observed.

Vide LN No. 30 published in the Kenya Gazette Issue Number 14 the EIA license application fee was reviewed from 0.1% to 0.05% and the maximum payable fee limited to Kshs. 1M. Based on the project cost as discussed under section 1.7, the projects' EIA license fee will be KSh. 1M.

### 2.1.3 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 large quantity of solid waste during construction which will need to be managed through reuse, recycling or appropriate disposal. Based on the nature of the project, the amount of materials to be discarded as waste during the project implementation will be minimum. It is recommended that the proponent put in place measures to ensure that construction materials requirements are carefully budgeted and to ensure that the amount of construction materials left on site after construction is kept minimal. It is further recommended that the proponent should consider the use of recycled or refurbished construction materials including those excavated from existing road as some sections of the road are very rocky. 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. To comply with the requirements of the regulations the proponent should undertake the following in addition to the above-mentioned recommendations:

- Should not dispose any waste on the highway, street road, recreational area and public places;
- Segregate waste and group them according to their similarity for example plastics, toxic, organic etc;
- Ensure all waste is deposited in a designated dumping area approved by the local authority;
- All waste handlers engaged by the proponent should be licensed by NEMA and possess all relevant waste handling documents such as waste transport license, tracking documents, license to operate a waste yard, insurance cover, vehicle inspection documents among others;
- Implement cleaner production principles of waste management strategy namely reduce, reuse and recycle;

- Label all hazardous wastes as specified in section 24 (1-3) of the regulation. The fourth schedule of the regulations lists wastes considered as hazardous to include solvents, emulsifiers/emulsion, and waste oil/water and hydrocarbon/water mixtures. Road projects involve use of inputs which are likely to generate the mentioned wastes and thus there will be need for them to be handled as required by the regulations.

### 2.1.4 EMCA (Water Quality) Regulations, 2006

These Regulations provides guidelines on the use and management of water sources; the quality of water for domestic use and irrigation. The proponent will be required to observe the requirements of the Regulations which prohibit anyone to undertake development within a minimum of 6m and maximum of 30m 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 substance discharged into the water bodies should meet the standards set under third schedule of the regulation whose copy is found under annex 5 of this report.

The project design team has been advised on the requirements of this regulation and they have incorporated the regulations in the design document.

### 2.1.5 EMCA (Controlled Substances) Regulations, 2007

These Regulations controls the production, consumption and, exports and imports of controlled substances. Controlled substances are grouped into three lists according to the regulation and the groups are as written 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 equipments, dehumidifiers, insulation boards, panels and pipe covers, pre-polymers etc. It is recommended that this regulation be observed to ensure equipment, machinery, vehicles and chemicals containing such components are not

imported for project use.

### 2.1.6 EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2009

These Regulations provides 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 and copy of the first schedule indicating the permissible noise levels for different noise sources and zones in found under annex 2 of this report. The project team should observe the noise regimes for the different zones especially when working in areas termed as silent zones which are areas with institutions, worship places. 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 and night levels are maintained at 35 dB (A). The time frame for construction sites are adjusted and the day is considered to start at 6.01 a.m. and ends at 6.00 p.m. while night duration from 6.01 p.m. to 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. Section 15 requires owners of activities likely to generate excessive noise to conduct an EIA.

Section 14 (1) provides requirements for construction, demolition, mining or quarrying in regards to noise and vibration control and this includes control of machines to be used, location of quarries using explosives (which is set at not less than two kilometres away from human settlements) and limits levels of vibration from quarrying sites at 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source.

It is anticipated that the proposed project will generate excessive noise and/or vibration due demolition excavation works and quarrying of construction materials this noise will

originate from the construction equipments, vehicles and the workers since the road neighbours homesteads, institutions in some sections it is therefore recommended that the construction team develop mitigation to reduce noise propagation in the sensitive project area.

### 2.1.7 EMCA (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009

The aim of these Regulations is to ensure conservation and sustainable use of wetlands in Kenya. The regulations provide guidelines on wetland management even for those found on private land. The Regulation indicates that clear guidelines on management of the different types of wetlands found in the country has not been developed thus it is recommended that while working in aquatic environments the relevant Lead Agencies should be consulted to guide on the correct application of the law. Despite that the regulation also recommends use of precautionary principal when working near wetlands in order to conserve them thus existing regulation on wetland management should be applied. This shall include observation of the riparian conservation regulations, water abstraction regulations among others.

The project area has several rivers and unprotected springs which will be need protection against pollution.

### 2.1.8 EMCA (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006

The Regulations requires proponents to conduct EIA 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 avoid them from affecting the project area negatively in terms of invading wetlands, other vegetation cover and surrounding lands. The construction team should avoid destruction of indigenous vegetation and species audit should be undertaken before clearing areas for material excavation or other work related activities. The harvested material should be destroyed appropriately to avoid spreading of invasive species.

### 2.1.9 EMCA (Fossil Fuel Emission Control) Regulations, 2006

These Regulation aims at eliminating or reducing emissions generated by internal combustion engines to acceptable standards. The regulation provides guidelines on use of clean fuels, use of catalysts and inspection procedures for engines and generators. This regulation is triggered as the proponent will use vehicles and equipments that depend on fossil fuel as their source of energy. It is recommended the requirements of the regulation be implemented in order to eliminate or reduce negative air quality impacts. Copies of sections of the regulation indicating the standards of recommended emission levels are attached to this report under annex 3

### 2.1.10 National Construction Authority Act, 2011

The law was enacted to bring law and order in the construction industry and it provides guidelines of registering contractors and looks into their conduct to ensure they work according to the industry standards.

*It is recommended that all contractors engaged in the project works should be registered with the Authority.*

### 2.1.11. Land Act No. Of 2012

The Land Act No. 6 of 2012 has repealed the Wayleave Act, Cap 292 and the Land Acquisition Act 295 and thus covers all issues regarding land ownership in the country. The Act provides guidelines on land acquisition.

*Land Acquisition for project development shall be minimal where realignment is proposed at Lokichar Shopping Centre.*

### 2.1.12 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 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 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 to keep the area clean and without nuisance should be undertaken in accordance to the Act in order to safeguard the health of the workers and the public at large.

### 2.1.13 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.

*There will be need to rehabilitate access roads used during the road construction to their pre-project status if not better condition*.

### 2.1.14 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 recommended that all sections of the Act related to this project, such as provision of protective clothing, clean water and insurance cover be observed so as to protect all from adverse effects of work related injuries or other health hazards.*

### 2.1.15 Physical planning act, 1999

Section 29 of the said Act empowers the local Authorities to reserve and maintain all land planned for open spaces, parks, urban forests and green belts. The same section allows for prohibition or control of the use and development of an area.

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

### 2.1. 16 The Wildlife Conservation and Management Act, Cap 376

This Act provides for the protection, conservation and management of wildlife in Kenya. The Act deals with areas declared as National Parks, under the Act. The Act controls activities within the park, which may lead to the disturbance of animals. Unauthorized entry, residence, burning, damage to objects of scientific interest, introduction of plants and animals and damage to structure are prohibited. The provisions of this Act should be applied in the management of the project.

*The proposed project area has no registered wildlife reserves but is dispersal area for wildlife from park outside the project area like The Kainuk Gamne Reserve and Lake Turkana Game Reserve. located over 60km from the project road.*

### 2.1. 17 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 to obtain a permit from the Water Resource Management Authority and should form 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 Impact Assessment. Schedule 6 of the water rules states the activity that should not be undertaken in the riparian and these include planting of exotic species and construction of structures. It

is important that the designs of drainage structures across riparian should take into consideration this requirements and thus develop structures that have minimum impact on the riparian.

2.1.18 Local Government Act Chapter 265

The Act also contains provisions empowering local authorities to control discharges. Under section 163 a local authority may control or prohibit activities, both industrial and domestic, which constitutes 'a source of danger, discomfort or annoyance to the neighbourhood', as an offensive trade or as has been gazetted by the Minister. Section 165 empowers the local authority not to grant licenses to activities that does not propose adequate treatment method of waste.

*All waste emanating from the project should be handled as required by law. All project sites should be provided with waste handling facilities designed to ensure minimum impact is transferred to the environment. This shall include providing waste water treatment and recycling facilities and the treated water should meet the recommended standards for water to be discharged into the environment or quality meeting health standards if it is to be recycled.*

2.1.19 Work Injury compensation Benefit Act 2007

This Act provides guideline for compensating employees on work related injuries and diseases contacted in the course of employment and for connected purposes. The act includes compulsory insurance for employees. The act defines an employee as any worker on contract of service with employer.

*This Act is triggered by the proposed project thus it is recommended that all workers contracted during the project implementation phases have the required insurance covers so that they can be compensated in case they get injured while working.*

2.1.20 Traffic Act Chapter 403

This Act consolidates the law relating to traffic on all public roads. The Act also prohibits encroachment on and damage of roads including land reserved for roads.

2.1.21 Use of Poisonous Substances Act Cap 247

This Act provide for the protection of persons against risks of poisoning by certain

substances. The purpose of this Act is to protect persons against risks of poisoning by poisonous substances arising from the use, storage, importation, sale, disposal and/or transport.

*The project shall involve use of chemical substances thus they should be stored appropriately and workers provided with protective clothing while handling them. Food supplements like milk should be provided to works exposed to such substances in order to enable their bodies detoxify.*

2.1.22 Forest Act Cap 385

The Act guides on the establishment, development and sustainable management, including conservation and rational utilization of forest resources for the socio-economic development of the country.

The Act also provides guidelines for management and, registration of forests and is supported by the Forests Act of 2005 (No. 7 of 2005) and the Forests (Participation in Sustainable Forest Management) Rules, 2009 Kenya Gazette Supplement No. 754.

Section 41 requires the Kenya Forest Service (KFS) to engage community participation in sustainable state forest management. Section 42 gives the types of agreements for community participation which includes:

a) a community forest management agreement which shall be issued to a forest association to undertake community forestry activities; and

b) a cultivation-permit which shall be issued to members of a forest association to undertake non-resident cultivation.

Section 25 guides on registration of private forests on farms and services provided by the KFS upon registration.

*The proposed project does not neighbour a gazetted forest but several indigenous trees dot the project area and thus should be preserved as much as possible. In areas where tress must be cleared new ones of the same species should be replanted. Tree planting programmes and associated costs should be developed in collaboration with the community and KFS to ensure they are natured to maturity*

*Based on the amount of vehicle emissions expected to be generated by the vehicles that shall ply the roads during its life time, there will be need to plant atleast 10,000 trees to act as carbon sinks. It is therefore recommended that the proponent collaborate with the Kenya Forest Service (KFS) and the community members under the guidance of the Act to plant indigenous trees to help abate the project emission impacts.*

### 2.1.23 The Explosive Act Cap 115

The Act regulates the manufacture, storage, sale, transportation, importation, exportation and use of explosive. The law requires all those undertaking the above activities to acquire a license from the mines and geology department. The exploitation of materials may involve use of explosives thus the contractor will be required to possess the required license.

### 2.1.24 The Malaria Prevention Act (CAP 246)

This Act provides measures to curb the breeding of mosquitoes at development sites. Measures proposed in the act to control the breeding of the vector include: maintenance of free drainage channels, removal of stagnant water from any land around an area to prevent larvae breeding, removal of waste and broken bottles among other measures. The proponent is recommended to implement measures to control the malaria disease vectors by implementing the mitigation measure proposed in the regulations. *This shall be achieved by backfilling quarries and burrow pits, providing appropriate drainage channels for waste water, collecting and depositing waste appropriately among other measures.*

### 2.1.25 The Penal Code (CAP 63)

The regulation provides guidelines on protecting the public against ill health and offensive trade activities such as noise and smell among others.

*The proponent should observe the regulation by mitigating against excessive noise and, vibration and by controlling pollution of water bodies and land.*

### 2.1.26 Sexual Offence Act No.3 of 2006

The Act was assented on 14th July 2006 and came into operation on 21st July 2006. The Act describes the types of sexual offences punishable by law and this includes rape, attempted rape, assault, defilement, gang rape, indecent act with a child or adult, promotion of sexual offence with children, child trafficking, child sex tourism, child prostitution, child pornography, sexual harassment, cultural and religious sexual offences among others.

*Road projects are known to be associated with several sexual vices including exploitation and prostitution it is important that project personnel are made aware of such legal provisions and that code of work place practices includes observation of the provisions of this law.*

### 2.1.27 The Standards Act Cap 496

This Act is implemented by the Kenya Bureau of Standards who provides standards on the requirements of equipments and project materials. Standards regulating security and safety of the public also have to be observed during the design phase of the project.

The proponent is required to implement the requirements of this Act especially those on standardisation of project inputs and equipments in order to reduce waste and pollution.

## 2.2. National Environmental Administrative Framework

### 2.2.1 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.

### 2.2.2 The National Environment Management Authority

The responsibility of the National Environmental 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 project report for the proposed project, visit the project site to verify information provided in the report and issue an EIA license if it considers that all the issues relevant to the project have been identified and mitigation measures to manage them proposed.

### 2.2.3 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).

SERC through EMCA has established standards for the various environmental parameters that require management such as the water quality standards, noise and vibration control standards, waste management standards among other standards mentioned in this report. The committee through the compliance and enforcement department found in NEMA monitors the compliance level of various projects to ensure pollution control standards are implemented. The committee also follows pollution complaints reported by the public.

### 2.2.4 The Provincial and Sub county Environment Committees

The Provincial and Sub county Environmental Committees contribute to decentralization of activities undertaken by NEMA thus enable local communities have access to environmental management information and also enables the Provincial and Sub county Environment Committees conduct quick site visits and review reports of localised proposed project in time.

NEMA is currently restructuring itself to meet the requirements of the new constitution thus the provinces committee is currently being substituted with the County Environmental Committee. Though this shall not affect the review process of the project much as it's administrative boundary in terms of region have not changed.

## 2.3 National Policy Framework

Several policies have been developed over the years to guide the development of plans, Acts and regulations for various sectors so as to ensure both economic and social sustainability of projects. The key policies that have guided the environmental and social sector are discussed below.

### 2.3.1 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 gender and geographical disparities and 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 disadvantage 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 to be implemented by the Poverty Eradication Commission (PEC) formed in collaboration with Government ministries, Community Based Organization (CBO), private sector, Non-Governmental Organization (NGO), bilateral and multilateral donors.

### 2.3.2 The Poverty Reduction Strategy Paper (PRSP)

The PRSP has the twin objectives of poverty reduction and enhancing economic growth. The paper articulates Kenya's commitment and approach to fighting poverty; with the basic rationale that the war against poverty cannot be won without the participation of the poor themselves. The proposed project through improving transport in the area will, contribute towards economic growth, as well as relieve the daily pressure of poverty for sustainable number of people by enabling them reach the markets and suppliers on time.

### 2.3.3 National Environmental Action Plan (NEAP)

The NEAP for Kenya was prepared in mid 1990s. It was a deliberate policy whose main effort is to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources forms an integral part of societal decision-making.

The application of this plan is widening as the government through NEMA does not approve a development project unless the impacts of the proposed project are evaluated and mitigation measures proposed for incorporation in the project's development plan which is in line with the requirements of the NEAP.

### 2.3.4 Environmental and Development Policy (Sessional Paper No.6 1999)

As a follow-up to the foregoing, the goal of this policy is to harmonize environmental and developmental goals so as to ensure sustainability. The paper provides comprehensive guidelines and strategies for government action regarding environment and development.

It is recommended that the requirements of this policy are observed by:

- Taking measures to enhance the water catchment by planting trees, using clean energy to reduce defforestatrion;
- Undertaking environment friendly practices during project implementation;
- Taking measures to reduce pollutants leading to eutrophication of water bodies both above- and underground water bodies; and
- Rehabilitate project affected areas and public infrastructure among other

### 2.3.5 National Gender and Development Policy, 2003

Since the country gained independence in 1963, national and sectoral policies have had different impacts on Kenyan women and men, and more often than not have overlooked

gender concerns. The The National Policy on Gender and Development provides a basis for the Government to underscore its commitment to advancing the status of by addressing any existing imbalances through policy Formulation. The implementation of the policy takes into account different needs and skills of men and women.

The Policy is consistent with the Government's efforts of spurring economic growth and thereby reducing

poverty and unemployment, by considering the needs and aspirations of all Kenyan men, women, boys and girls across economic, social and cultural lines. Which is also consistent with the Government's commitment to implementing the National Plan of Action based on the Beijing Platform for Action (PFA).

*The overall objective of the policy is to enable both men and women hace equal access to economic and employment oportunities. It is required that the project's plans, guidelines and code of practise, integrates and strenthen polices and strategies that enhances both men and women's role in economic development. This should include implementing laws governing reproduction health, equal emplyment oppotunities among others.*

### 2.3.6 Kenya National Aids Strategic Plan III 2009/10-2012/13

The plans whose motto is delivering on universal access to services aims to achieve the country's targets for quality integrated services at all levels to prevent new HIV infections, reduce HIV-related illnesses and deaths, and mitigate the effects of the epidemic on households and communities. The plan focuses on delivering on Vision 2030, as well as realise the targets set by the United Nations General Assembly for scaling up HIV prevention, treatment, care and support, and mitigation of its socio- economic impacts.

The targets of the plan by 2013 is to have the following impact;

- Reduced number of new infections by at least 50%;
- Reduced AIDS-related mortality by 25%;
- Reduced HIV-related morbidity;
- Reduced socio-economic impact of HIV at household and community level;

HIV/AIDS is having a significant and increasing impact in Kenya. Statistics show a prevalence of 10-15% along some of the major roads in the country. Interventions that stimulate the movement of people increase both the exposure to the HIV virus and the spread of the virus. Road construction has been identified as one

such intervention thus the need to integration HIV/AIDS awareness and prevention activities into the road construction programmes. A budget for HIV Awareness, Prevention, Training and, Care have been included in the project budget. The funds will be used to undertake campaigns on disseminating HIV/AIDS information, providing prevention supplies such as condoms both male and female, training of the locals to be in a position to train other colleagues and the local communities around the project (peer education). Colloborate with the Ministry of Health for supplies of medication on those dependent on them.

## 2.4 International Policy Framework

Kenya is a signatory as well as a party to various international conventions, treaties and protocols relating to the environment which aims at achieving sustainable development. According to the Registrar of International Treaties and other Agreements in Environment (UNEP 1999), there are 216 treaties, 29 of which are of interest to Kenya. The country is a signatory to 16 such agreements, which range from use of oil, protection of natural resources and protection of the atmosphere. The agreements are both regional and international and became legally binding on Kenya upon ratification thereof by the rightfully designated Kenyan Authority. The agreements of interest to Kenya can be categorized as those for protecting natural resources, atmosphere and social wellbeing of man.

### 2.4.1 Protection of Natural Resources

There are 12 agreements of significance to Kenya under this category which the country has signed and ratified. This section reviews a number of policies that are triggered or met by the proposed project.

#### 2.4.1.1 United Nations Framework Convention to Climate Change (UNFCCC) of 1992

The convention requires parties to take climate change considerations into account in their relevant social, economic and environmental policies and actions. The proponent has undertaken this EIA with the aim of minimizing adverse effects of the project on the economy, public health and on the quality of the environment. The requirements of this convention can be achieved by mitigating against impacts on climate change by

undertaking activities such as growing trees suitable for the area to act as carbon sinks along the highway. The community members in the proposed project area depend majorly on wood and kerosene as their source of energy which are known to directly affect the ecosystem in terms of pollution and effects on water catchments. The proponent is advised to enhance the positive impacts of the project through engaging activities that control climate change for example developing tree planting programmes with line ministries and the community members and conserving the catchment through water conservation.

#### 2.4.1.2 Convention on Biological Diversity, 1992

The Convention requires Parties to use EIA effectively to avoid or minimize significant adverse impacts on biodiversity; it introduces Strategic Environmental Assessment (SEA) to assess environmental implications of policies and programmes particularly for those with major implications on natural resource use. The Convention also led to the establishment of Cartagens Protocol on Biosafety 1999 namely "The Cartagena Protocol on Biosafety to the Convention on Biological Diversity" which was adopted on 29th January 2000 entered into force on the same date. Kenya signed the protocol on 15th May 2000; ratified it on 24th January 2002 and became a party member on 11th September 2003. The protocol is an international treaty governing the movements of Living Modified Organisms (LMOs) resulting from modern biotechnology from one country to another. The proponent is advised to observe the requirements of this regulation if programmes such as landscaping are incorporated and will involve use of plant species some of which can be biotechnology products. The use of LMO can have adverse environmental impacts if the correct material is not used leading to destruction of the micro-ecosystems, food webs and even invasion of farms.

#### 2.4.1.3 The Convention on Wetlands of International Importance (Ramsar, 1971)

The convention seeks to ensure the wise use of all wetlands and provides stringent guidelines for the conservation of those wetlands listed in the List of Wetlands of International Importance. The proposed project is not located within an Important Bird Areas (IBA) according to the Ramsar Sites list. Despite that the area was seen to have

several birds nestling areas on trees along the road thus they will need conservation.

### 2.4.1.4 Kyoto Protocol to the United Nations Framework Convention on Climate Change

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The Clean Development Mechanism (CDM), defined in Article

12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO2, which can be counted towards meeting Kyoto targets.

The proponent can work on possibilities of participating in the carbon trade through its tree planting activities if the emissions along the road are found to be below the required threshold. The evaluation can be done by a certified expert on climate change programmes.

### 2.4.1.5 The World Commission on Environmental and Development (The Brundtland Commission of 1987)

The commission focuses on the environmental aspects related to development and requires all development projects to be sustainable economically, socially and environmentally. The principle of the organisation emphasis that development project should not have permanent negative effects on the biosphere and in particular the ecosystems.

It is recommended that the project proponent incorporate mitigation measures to ensure that the project impacts on the ecosystem are reduced. The consultants used participatory methods to involve the target group and concerned stakeholders in order to inform and enlightened them on the likely negative environment and social impacts in order to enable them to prepare mitigation measures so as to ensure the proposed project is sustainable throughout its life span.

#### 2.4.1.6 Convention concerning the Protection of World Cultural and Natural Heritage, 1972

The convention requires parties to adopt effective measures that include assessment of the feasible project alternatives to prevent or minimize or compensate for adverse impacts and assess the nature and extent of potential impacts on natural heritage resources, and designing and implementing mitigation plans. The convention also protects threatened plants.

*The proposed project road design does not traverse areas considered to be of cultural importance despite the an archaeological site is found a few kilometres from the road in Lokori centre and thus will need project from impacts such as vibration. Since the road is located along a known archaeological route based on historical data chance findings of material of historical importance might occur and thus incase of occurrence, the site should be protected from interruption and emergency evacuation of the materials undertaken with the assistance of experts from the Museums of Kenya who shall further test material for its cultural significance..*

#### 2.4.1.7 Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, 1990

This convention protects forests as habitat for endangered species. The proposed project area has no gazetted forests in its immediate environment but is rich in plants and wildlife thus will need protection from project impacts.

#### 2.4.1.8 The Convention of Control of Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly In Africa (UNCCD) (1997)

This convention requires Parties to promote cooperation among affected parties in the fields of environmental protection and the conservation of land and water resources, as they relate to desertification and drought. The proponent is advised to engage in activities geared towards eradicating drought through developing tree programmes with relevant ministries/local communities, encouraging clean energy use, eliminate use of controlled substances and incorporating water conservation measures in the project.

### 2.4.1.9 The Basel Convention

The overall goal of the convention is to protect human health and the environment against the adverse effects resulting from generation, movement and management of hazardous waste. This Convention requires that the Parties exercising their right to prohibit the import of hazardous wastes or other wastes for disposal should inform the other Parties. It also requires parties to ensure that the transboundary movement of hazardous wastes and other wastes is reduced to minimum levels consistent with sound environmental management of such wastes, and that it is conducted in a manner which will protect human health and the environment against the adverse effects which may result from such movement. The proposed project will involve use of solvents, emulsifiers, petroleum products and thus the requirements of the agreement should be observed by not importing or accepting expired inputs or others termed as hazardous.

### 2.4.1.10 Other Multilateral Environmental Agreement

Other agreements ratified by GOK include:

- Stockholm Convention on Persistent Organic Pollutants (POPs).
- Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol).
- Convention for the Protection of the Ozone Layer (Vienna Convention).
- The Rio Declaration (1992) and Agenda 21.
- United Nations Environment Programme (UNEP) Principles on Shared Natural Resources (1978).

# 3. PROJECT DESCRIPTION

## 3.1 Project Justification

The aim of the project is to improve the transportation situation in East Pokot and Turkana Central, East and South sub counties so as to increase economic interaction and growth with other regions and the neighboring countries such as Southern Sudan, Uganda and Ethiopia. The road forms part of main link between the project area and major towns such as Kitale, Nakuru and Lodwar and thus to neighboring countries. The project area has economic potential in the mining, agricultural, industrial and commercial sectors but have not been fully exploited due to lack of an efficient road transport system. Currently the project road is a deteriorated earth surface road which hinders the efficient movement of goods and services in the region.

The road is important as it connects Kenya to Southern Sudan and Ethiopia through the Northern Corridor. The proposed project has been designed to have a life span of 20 years after its construction period which is likely to commence in 2014 and end in 2016/7.

## 3.2 Project Location and status of Existing pavement

The project road is located in the Northern Western Part of Kenya and it connects East Pokot to Nakuru and Turkana Sub counties to Kiltale and Lodwar. The project road is currently an earth surface road with some section being naturally rocky. The route starts at Ng'inyang in East Pokot and runs in a Northerly direction through Kapedo, Napeitom, and Lokori where it joins C46 and ends at Lokichar at the Junction with Road A1 in Turkana South.

The existing road between Ng'inyang and Lokichar (Km 0 to Km 200) alternates between earth and gravel surface. The drainage along this section of road is also poor, with flood water ponding on the road whenever it rains. This is caused by the fact that the existing road level is lower than the surrounding ground. It is also worth noting that the infiltration rates are low hence during rainfall, most of the water floods the road section.

The Section between Lokichar and Ngamia 1 oil Well has wide flood crossings and the drainage structures, mainly drifts and pipe culverts, which are inadequate. Improved gravel sections were noted within the same stretch this is between km 200-175.

The road width is not clearly defined over the earth sections. The average carriageway width at the gravelled sections is approximately 5 m wide with 2 m wide shoulders. Drainage is not taken care of adequately. Due to the drainage problems noted above the road alignment has to be lifted, which means existing gravel cannot be utilized for the final pavement.

## 3.3 General Layout, Size and Capacity of Existing Pavement

The general layout of the road relative to the project area is shown in the maps provided in figure 3.3.1 below.

Plate 3.2(a): Showing section of existing road alignment

Plate 3.2(b): Herd of camel in search of pasture moving along the road

Plate 3.2(c): Scoured section on the existing road alignment

Plate 3.2(d): Sandy planes on sections neighboring the existing road alignment

Plate 3.2(e): Lokichar trading centre neighboring the existing road alignment

Plate 3.2(f): Settlements at Lokichar trading centre neighboring the existing road alignment

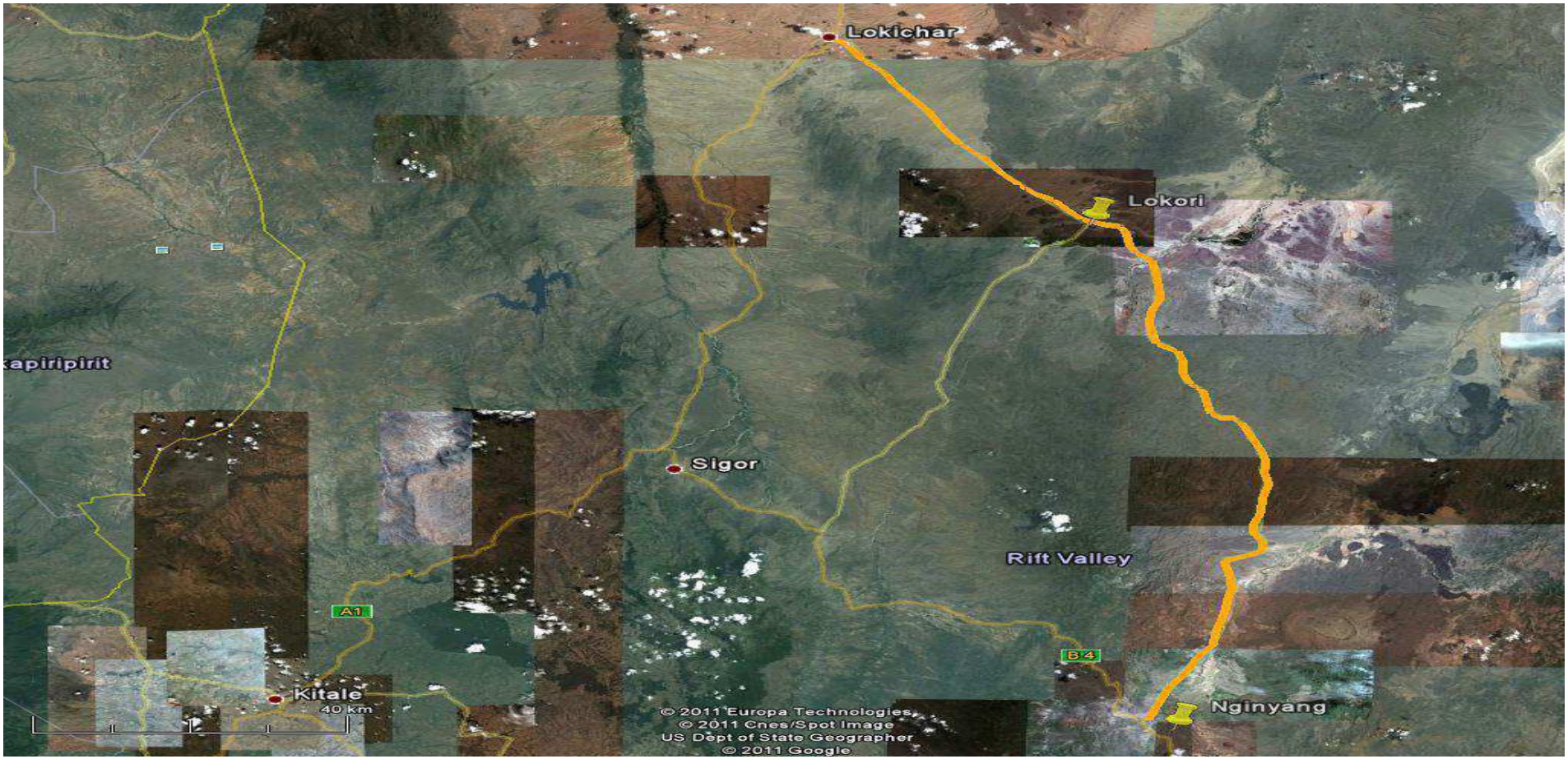


Figure 3.3.1: Location map showing the road alignment

## 3.4 The Road Reserve

As per article 2.4 of Kenya Road Design Manual (Part-I) proposed ROW has been considered as
40m for the entire stretch in general, except for some exceptional locations like proposed wayside amenities, Project Implementation Unit buildings and junctions where more land is required to be acquired.

The actual road reserve is not formally protected; marked or fenced thus several informal structures and businesses are being undertaken within it at the main trading centres namely Kapedo, Lokori and Lokichar. At Napeitom a village has been established on the existing road alignment as a security measure to enable the locals control all the movements into and out of the area so as to avoid unexpected banditry attacks.

It is recommended that the proponent take up the required 40m width as early as possible so as to curb further encroachments especially after the road development, create room for future expansion and road safety. Clearing of the road reserve at the trading areas will require compensation and resettlement which will have to be undertaken before project commencement.

## 3.5 Project Design

The proposed project is still at feasibility stage but almost moving to the next stage of detailed designs. The preliminary engineering designs for the main road have been developed and consist of the components described below.

### 3.5.1 Typical Cross-Section

Based on the predicted traffic growth in year 10 after rehabilitation of the road, the typical road cross-sections were chosen according to Table 4.2.2 of the Road Design Manual. Using the manuals criteria the following cross-sections were proposed for the project.

*Table 3.4.1: Typical cross-section selection*

| | | |
|---|---|---|
| TCS-I | : | Typical cross section of 2-lane carriageway without service road and with cut- off ditches on both sides |
| TCS-II | : | Typical cross section of 2-lane carriageway without service road and with side ditches on both sides |
| TCS-III | : | Typical cross section of 2-lane carriageway without service road and with cut- off ditch on left side and side ditch on right side |
| TCS-IV | : | Typical cross section of 2-lane carriageway without service road and with side ditch on left side and cut-off ditch on right side |
| TCS-V | : | Typical cross section of 2-lane carriageway without service road and with guard rails on both sides |
| TCS-VI Lokori and | : | Typical cross section of 2-lane carriageway with service road at |
| TCS-VII | : | Typical cross section of 2-lane carriageway at high embankment |
| TCS-VIII | : | Typical cross section of 2-lane carriageway at super elevated stretches |
| TCS-IX | : | Typical cross section of 2-lane carriageway at realignment stretches |

### 3.5.2 Geometric Design

Highway alignment and cross-section has been followed.

### 3.5.3 Design Speed

The design speeds adopted the project road varies between 70 km/h to 100 km/h depending on traffic condition and terrain of the area.

### 3.5.4 Horizontal Alignment

In general neither the horizontal nor the vertical geometry of the existing road is good due to the presence of a number of sharp curves and frequent ups and downs. The abutting landuse pattern is mostly of barren type with presence of agricultural land at few locations. Although land acquisition is reported not to be that problematic as there is plenty of unoccupied land surrounding the project corridor, attempts were made to design the road on the existing alignment or at least as much as possible.

### 3.5.5 Vertical Alignment

Vertical alignment of the project road shall occur at in areas listed in table found under annex 13

### 3.5.6 Drainage Structures

A road, either in cut or fill, inevitably suffers from a main risk of erosion from runoff. As a result, the road must allow for channelising of runoff into structures proposed transferring the flow without damaging any element of the road.

The drains collect the runoff from the road surface, side slopes and adjacent impluviums. Geographical characteristics, soil condition and rainfall intensity are some of the main factors which influence the shape, location and capacity of drains. The drain should have sufficient capacity to carry natural peak runoff without scouring embankment or any part of the road.

Based on the calculation of flow to be transferred through the drain and taking into account the drain characteristics, it should be necessary to find critical length for the drain at which discharge of the flow is required.

There will subsequently be a choice between several possibilities based on the topographical conditions. Whether the road section is in fill or cut Embankment height

Discharge the drain flow into a natural outlet, via a transfer structure (divergent drain or culvert)

#### 3.5.6.1 Selection of Drain Sections

The choice of cross-section of the drains is generally limited to two types, viz. cut-off ditch and side ditch. As far as project road is concerned, the terrain is rolling. Unlined trapezoidal drain sections have been proposed depending upon the requirement. The typical drain sections have been shown in drawing volume and a list of the proposed drainage structures and some of their locations is provided in sections below.

#### 3.5.6.2 Pipe culverts

Cross pipe culverts have been sized up for 10 year retention period peak flows across the road for appropriate catchment size. The following configurations of cross pipe culverts along the road have been proposed.

Between Ngiyang – Lokichar sections of the road 395 pipe culverts measuring 1 x 900mm and 200 measuring size 2 x 900mm have been proposed.

3.5.6.3 Box culverts:

Box culverts have been sized up for 50 year return period peak discharges and this resulted into the following sizes of box culverts across various locations of the road.

Between Ngiyang – Lokichar the following box cuilverts have been proposed.

70 No. of size 2.5m x 2.5m

No. of size 2 x 2.5m x 2.5m
36 No. of size 3 x 3.5m x 5m

### 3.5.6.4 Bridges

Bridges have been sized up for 100 year return period peak discharges and this resulted into the following sizes of bridges across various locations of the road.Table **3.5.6.4: Proposed location of bridges along the project road**

| Location | 100 year Design flood (flow Qpeak | Width (L) (m) | Height ( H) (m) |
|---|---|---|---|
| Km 2+440 | 1681 | 65 | 7 |
| Km 12+745 | 386 | 20 | 5 |
| Km 24+257 | 737 | 60 | 5 |
| Km 27+405 | 221 | 30 | 4 |
| KM 44+250 | 715 | 40 | 5.5 |
| Km 49+105 | 1674 | 65 | 7 |
| Km 49+300 | 143 | 20 | 3.5 |
| Km 52+960 | 219 | 20 | 3.5 |
| Km 60+692 | 115 | 20 | 3.5 |
| Km 73+792 | 768 | 45 | 5 |
| Km 82+287 | 452 | 40 | 4.5 |
| Km 91+792 | 520 | 45 | 4.5 |
| Km113+845 | 258 | 25 | 4 |
| Km119+434 | 2030 | 65 | 7 |
| Km121+967 | 1441 | 50 | 7 |

### 3.5.6.5 Protections Works in Flood Prone Embankments

Sections of the road, in particular at Lokichar show the soils are very erodible as they are mainly sandy soils. Also in Ng'inyang areas adjacent to the Ng'inyang River and the hill slopes are very vulnerable to erosion. To address this problem extensive protection works are proposed at Lokichar, Ng'inyang and hill slopes along the project road. In addition it is proposed that erosion protection bio-engineering geotextiles be laid underneath the stone protection (rip rap) on very erodible side slopes before top soiling and grassing. Protections works in the form of stone pitching with filter media have been proposed at the erosion stretches as well as where embankment height is more than 3.0m. The geotextile provide a long-term confinement of the cut slope or fill materials. Being constructed of soft and pliable needle-punched polyester, a quality geotextile will remain stable and functional for many years, in spite of potential exposure to the sun's ultraviolet rays and/or concentrated hydrocarbons, such as gasoline, diesel fuel, oil, or hydraulic fluid.

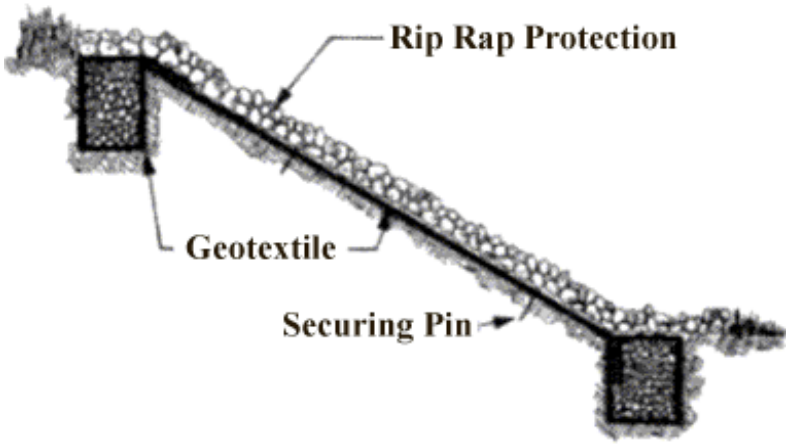


Plate 3.5.6.5 Proposed erosion control structure is sloppy areas

### 3.5.7 Pavement Design Evaluation and Review

As per traffic and CBR values along the project road, pavement has been designed corresponding to T3 traffic (3x106 – 10x106 ESA) and S4 subgrade CBR (10% - 18%). From the Road Design Manual (RDM) Part-III, standard pavement structure "Type-3" has been proposed. The proposed pavement composition for mainline are as follows:

| | | |
|---|---|---|
| AC | - | 50 mm |
| Improved Base | - | 150 mm |
| Improved Sub Base | - | 175 mm |
| Subgrade | - | 300 mm |

However, due to less loading, a weaker pavement has been proposed for service roads as mentioned below:

| | | |
|---|---|---|
| AC | - | 25 mm |
| Improved Base | - | 150 mm |
| Improved Sub Base | - | 150 mm |
| Subgrade | - | 300 mm |

The road shall be provided with sealed shoulder of 1.5 m in width on both sides of the carriageway. The shoulders shall contain surfaced, base and subbase materials in order to prevent erosion of the road.

### 3.5.8 Road Furniture and Facilities

The consultant has proposed road facilities based detail analysis of the project corridor guided by site reconnaissance and engineering judgments. The various facilities proposed are discussed in the paragraphs below.

#### 3.5.8.1 Road Crossings

Grade intersections have been proposed with acceleration, deceleration lanes and channelized islands as required. Three major junctions have been proposed at the locations listed below:

At Ng'inyang (km 0+000)
At Tullow Ngamia (km 168+646) At Lokichar (km 192+650)

#### 3.5.8.2 Service Roads

Service roads have been proposed at the locations listed in table 3.5.8.2 below mainly to segregate local traffic from high speed vehicles, and ingress/egress to mainline at designated places only.

Table 3.5.8.2: Location of proposed service roads

| Sl No. | Design Chainage (km) | | Length (m) | Side | Remarks |
|---|---|---|---|---|---|
| | From | To | | | |
| 1 | 124+300 | 124+800 | 500 | Left | Lokori |

| | | | | | |
|---|---|---|---|---|---|
| 2 | 124+300 | 124+800 | 500 | Right | Village |
| 3 | 191+000 | 192+500 | 1500 | Left | Lokichar Village |
| 4 | 191+100 | 192+575 | 1475 | Right | |

### 3.5.8.3 Bus Bays

Generally, the bus bays shall provide safe entry and exit of buses from project highway and safe boarding and alighting of passengers. The bus bay area shall be provided with an effective drainage system. The typical layout of bus bay has been provided in drawing volume. The list of proposed bus bays is given in Table 3.5.8.3 below.

Table 3.5.8.3: List of Proposed Bus Bays

| Sl No. | Design Chainage | Side | Village/Town |
|---|---|---|---|
| 1 | 0+300 | Left Side | Ng'inyang Village |
| 2 | 0+400 | Right Side | |
| 3 | 26+741 | Left Side | Kapedo Village |
| 4 | 29+817 | Right Side | |
| 5 | 90+929 | Left Side | Napietom Village |
| 6 | 91+000 | Right Side | |
| 7 | 125+000 | Right Side | Lokori Village |
| 8 | 125+158 | Left Side | |
| 9 | 192+225 | Left Side | Lokichar Village |
| 10 | 192+300 | Right Side | |

3.5.8.4 Truck Laybys

2 nos. truck lay byes have been considered at Tullow Ngamia near oil exploration location. Location of proposed truck laybys are given in Table 3.5.8.4 below. A typical layout of truck lay bye has been presented in the drawing volume.

Table 3.5.8.4: Locations of Proposed Truck Laybys

| S. No. | Design Chainage | Side | Village/ Town |
|---|---|---|---|
| 1 | 168+358 | Left | Tullow Ngamia Village |
| 2 | 168+950 | Right | |

3.5.8.5 Wayside Amenities

Wayside amenities to accommodate flooding facilities, fuel station, telephone booth, repair shop etc. have been proposed at an interval of one per every 50km. However, considering the alignment geometry, terrain etc. the locations are finally decided as mentioned below in Table 3.5.8.5. Only landfill quantities have been considered in BOQ at this stage.

Table 3.5.8.5: Locations of Proposed Wayside Amenities

| S. No. | Design Chainage | Side |
|---|---|---|
| 1 | 28+260 | Left |
| 2 | 74+167 | Right |
| 3 | 125+977 | Left |
| 4 | 173+400 | Right |

**3.5.8.6 PIU (Project Implementation Unit) Office**

Provision for PIU office has been considered at one of the wayside amenity location mentioned above. Km 74+167 (right side) has been selected for this purpose at this stage.

**3.5.9 Miscellaneous Provisions for Traffic Guidance and Safety**

A high-speed facility is basically aimed at providing safe efficient and economic movement to motorised through traffic with comfort and pleasing environment during the journey. To achieve these objectives in practice, it is essential to make certain miscellaneous provisions for traffic guidance and safety. The safety measures and devices as proposed by the Consultants along the highway are described below:

3.5.9.1 Roadside Furniture

For notification of road features and also for safety and guidance of the road users, the project road will be provided with all the necessary traffic control and safety devices. These include:

- Traffic Signs and Pavement Markings - Traffic signs and pavement markings shall

include roadside signs, overhead signs; curve mounted signs and road marking along the project highway.

- Road Delineators Pedestrian
  Guard Railing Metal Beam
  Crash Barrier
- Traffic safety Devices wherever required
- Boundary Stones
- Hectometer/Kilometer Stones
- Traffic Blinker Signal (L.E.D) at intersections

#### 3.5.9.2 Street Lighting

The lighting proposed includes**:**

(i) Double arm lighting arrangement (posts @ 30m c/c) has been considered along proposed separator at service road and truck lay bye locations.

(ii) Single arm lighting arrangement (posts @ 30m c/c) has been considered at proposed bus bay and wayside amenity locations.

(iii) High Mast lighting has been considered where the alignment will pass through potentially hazardous locations like junctions and PIU office area.

#### 3.5.9.3 Landscaping and Tree plantation

Landscaping of the highway tree plantation shall be done at quarry sites, steep slopes, at bridge, culverts among others. The cost implication site rehabilitation and landscaping has been provided as earthworks in the engineering design BOQ.

### 3.5.10 Construction Materials

The main construction materials for road development include sand, gravel, hard stones (aggregates), reinforcement iron bars, water and bitumen. Most of the materials shall be obtained locally (within Kenya) except bitumen which shall be imported. Material investigations have been made with the aim of identifying sources for suitable construction materials including borrow pits, sand pits, construction water sources and quarry sites. The investigations were carried out during the preliminary design phase.

Estimate of the total amount of material required for the widening and reconstruction of the Road to 7.5m with 1.5-2m shoulders on either side are as provided in the table below:

*Table 3.5.10 Total material requirement*

| Material | Quantity |
|---|---|
| Gravel | 345,000m3 |
| Hard stone Chippings | |
| Sand | |

### 3.5.10.1 Borrow Areas

There is plenty of gravel along the areas bordering the proposed road. A total of 21 gravel material sites were identified as listed in table 3.5.10.1 below and samples carried out for testing indicated that most of the material are suitable for use as sub-grade in their natural state and as sub-grade after mixing with cement and lime. The table describes the surrounding of the material sites and the regulatory management measures required to be observed to ensure environmental protection. Detailed description of each of the location of the material sites are provided under annex 6 of this report.

*Table 3.5.10.1: Gravel material site locations*

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 1 | 20000 | 2.0 | 40,000 | Km 197+400,RHS & LHS offset 0.3KM | -Located approximately 2+800km from Lokichar<br>-Site near a natural storm water drain<br>-Has scattered thorny trees<br>-Located 30m from the existing corridor and stretched for over 3km along the project corridor<br>-Remarks:<br>-Since it neighbours a river bed the requirements of the Water Rules 2007 and Water Quality Regulations 2006 needs to be observed<br>-Dust control should be undertaken as is near areas of human movement<br>Revegetation using indigenous species need to be done once exploitation is complete |

| Material Site No. | Area (m2) | Gravel Depth | Volume of | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 2 | 10000 | 2.1 | 21,000 | Km 165+000, RHS& LHS offset 0.3 km | -Located approximately 33km from Lokichar<br>-Site near a natural storm water drain<br>-Has scattered thorny trees<br>- Remarks:<br>-Since it neighbours a river bed the requirements of the Water Rules 2007 and Water Quality Regulations 2006 need to be observed<br>-Revegetation using indigenous species need to be done once exploitation is complete. |
| MS 3 | 10000 | 1.4 | 14,000 | Km 151+500, RHS offset 0.3 km | -located between the road to Lokichar from Lokwamosing and the road to Kainuk (Turkana national park located 15km from project road) - area is fairly hilly and is at an offset of about 30m from both roads.<br>• Remarks:<br>-Dust control should be undertaken as is near areas of human movement<br>- Revegetation using indigenous species need to be done once exploitation is complete. |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 4 | 25000 | 1.2 | 30,000 | Km 146+000, RHS off set 0.3 km | - Site located close to Lokwamosing settlement a few kilometers from Lokori Town and along the project road at an offset of about 40m from the project corridor. The site is at the foot of a potential site for hard stone material which is on the LHS of the project corridor.<br>- The area is also characterized by scattered bush (thorny) with grass at selected sections. There are a few rock outcrops of rock material which is brittle on the surface.<br>Remarks:<br>-Dust control should be undertaken as is near areas of human movement<br>- Revegetation using indigenous species need to be done once exploitation is complete. |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| | | | | | -Quarrying of hardstone at this site should be avoided as shall not meet the noise and vibration regulations requirements of distance for noise and vibration exposure near settlements |
| MS 5 | 10000 | 1.3 | 13,000 | Km 144+000, LHS offset 0.3 km | - site is close to Lokori than Napeitom on the LHS<br>-The area is hilly and the material site is on the foot of the hill<br>-Area characterized by a few thorny bushes and scattered grass.<br>Remarks<br>-Dust control should be undertaken as is near areas of human movement<br>- Revegetation using indigenous species need to be done once exploitation is complete. |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 6 | 10000 | 1.2 | 12,000 | Km 128+000, LHS offset 0.3 km | -site is close to Napeitom village<br>-Area characterized by a few thorny bushes and brownish grass.<br>- Remarks<br>-Dust control should be undertaken as is near areas of human settlement<br>- Revegetation using indigenous species need to be done once exploitation is complete. |
| MS 7 | 10000 | 1.6 | 16,000 | Km 123+300, RHS offset 0.3 km | - site is close to famous Napeitom Laga and is on a raised ground 1km from Napeitom on your way to Lokori.<br>-area characterized with a few thorny bushes and brownish grass<br>-Remarks:<br>-Since it neighbours a river bed the requirements of the Water Rules 2007 and Water Quality Regulations 2006 need to be observed |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| | | | | | --Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement |
| MS 8 | 10000 | 1.0 | 10,000 | Km 116+400, RHS offset 0.3 km | -site is close to Napeitom<br>–Area characterized by a hilly terrain on the northern part and a valley on extreme left.<br>Remarks<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement<br>-Soil Erosion control and management |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 9 | 10000 | 1.5 | 15,000 | Km 106+500, LHS offset 0.3Km | - site located between Lokori and Napeitom,<br>- characterized by a hilly terrain with a valley escarpment on the extreme Right of the material site.<br>Remarks<br>-Protect hill as required by EMCA 1999 |
| MS 10 | 10000 | 1.9 | 19,000 | Km 93+000, LHS offset 0.3Km | - The site is located between Kapedo and Napeitom on the RHS of existing corridor at 40m offset. |
| MS 11 | 22500 | 1.2 | 27,000 | Km 80+000, RHS offset 0.3Km | - Site is on a fairly flat surface with a few scattered thorny bushes. It is easily accessible at an offset of approximately 40m from the existing corridor.<br>-Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete. |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 12 | 20000 | - | 20,000 | Km 77+300,RHS & LHS offset 0.3Km | This site is on an area which is considered to be no man's land between the Pokots and the Turkanas and anyone found there by either Turkanas or the Pokots, he is executed. It's a no Stopping zone.<br>Remarks;<br>Provide tight security measures when working in the section |
| MS 13 | 10000 | 2.0 | 20,000 | Km-3+000, RHS offset 0.3Km | - site borders the road from Ng'inyang and road from Loruk via the collapsed bridge (Ng'inyang) a few meters from the 4-way junction at KM 0+000 of the project road.<br>-site is gentle sloping in open area with scattered thorny bushes. - site is characterized by a few anthills and its bordering a homestead.<br>Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 14 | 10000 | 1.0 | 10,000 | Km 64+500, RHS offset 0.3Km | - site is close to Lokori than Napeitom on the RHS of the project corridor.<br>-The area is hilly and the material site is on a plane characterized by a few thorny bushes and scattered grass.<br>-Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement /settlement<br>-Protect hill as required by EMCA 1999 |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gra | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 15 | 30000 | 0.9 | 27,000 | Km 55+600, LHS& RHS offset 0.3Km | - site is along the project road between Kapedo and Napeitom Settlements.<br>- site is in a gentle sloping open area with scattered thorny bushes.<br>Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement |
| MS 16 | 20000 | 0.6 | 12,000 | Km 52+400, LHS& RHS offset 0.3Km | - site is close to Lokori than Napeitom on the RHS of the project corridor. The area is hilly and the material site is on the foot of a hill characterized by a few thorny bushes and scattered grass.<br>Remarks: |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| | | | | | -Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement<br>-Protect hill as required by EMCA 1999 |
| MS 17 | 10000 | 0.8 | 8,000 | Km 46+800, RHS offset 0.3Km | - site is along the project road between Kapedo and Napeitom Settlements, but closer to Kapedo than Napeitom. The site is in a gentle sloping open area with scattered thorny bushes.<br>Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement |
| MS 18 | 10000 | 0.8 | 8,000 | Km 36+000, RHS offset | - site is close to Kapedo than Napeitom on the RHS of the project corridor |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| | | | | 0.3Km | .-area is hilly and the material site is on the foot of a hill characterized by a few thorny bushes and scattered grass.<br>Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement<br>-Protect hill as required by EMCA 1999 |
| MS 19 | 10000 | 0.6 | 6,000 | Km 34+000, RHS offset 0.3Km | The site is close to Kapedo than Napeitom on the RHS of the project corridor.<br>-area is hilly and the material site is on the foot of a hill characterized by dense thorny bushes and scattered grass. The site is located a few meters from the junction to Kapau |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| | | | | | . Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement<br>-Protect hill as required by EMCA 1999 |
| MS 20 | 10000 | 0.6 | 6,000 | Km 24+000, RHS offset 0.3Km | - site is close to Kapedo on the RHS of the project corridor. The material site is on a plane characterized by a few scattered grasses.<br>Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement |

| Material Site No. | Area (m2) | Gravel Depth (m) | Volume of Gravel (m3) | Location | Environmental Consideration Remarks |
|---|---|---|---|---|---|
| MS 21 | 10000 | 0.5 | 5,000 | Km 10+500, RHS offset 0.3Km | The site is located between Ng'inyang and Kapedo on the RHS of the project corridor. The area is fairly flat and the material site is characterized by a few thorny bushes and scattered grass.<br>Remarks:<br>-Revegetation using indigenous species need to be done once exploitation is complete.<br>-Dust control should be undertaken as is near areas of human movement |
| TOTAL VOLUME | | | 345,000m3 | | |

### 3.5.10.2 Quarry Site

Hardstone will be required for use in the manufacture chippings for Asphalt concrete and surface dressing. Substantial volumes will also be required for the production of aggregate for structures. Investigation for quality stone from existing quarry in Ng'inyang for Loruk-Barpelo road and from new sources was carried out. The suitable new quarry was identified around Lokori.

### 3.4.10.3 Natural River Sand

Vast sand deposits are available at Ng'inyang, Lokori, Lagas and Lokichar, from where 5 samples of sand were taken. A sample of sand was also taken from River Kerio bed at Lokori. The samples were subjected to tests at the Material Branch Laboratory of the Ministry of Roads, Nairobi for Particle Size Distribution; Silt content; Sulphate content; Chloride content; Organic content and Specific Gravity. The results obtained indicated that the sand from Lokori complied with the specifications for sand for use in concrete manufacture thus recommended for the project. Sand from Kerio river bed has high silt content and cannot be directly used in the manufacture of concrete.

Plate: 3.5.10.3 (a): View of a sandy river bed

Plate: 3.5.9.3 (b): Flooded sections of the road used as animal watering point

### 3.5.10.4 Construction Water Sources

There are two perennial rivers crossing within the project area and a number of seasonal rivers from which required water for construction can be sourced. Three boreholes were also seen in the project area located at Public owned (National Water Conservation) borehole at Lokichar with good yield; Kapedo at chainage 31+100, 5m from the centreline;

Napeitom chainage 97+100, 15m from the centreline; and KPLC owned borehole at 128+500 positioned 15m from the centreline.

The local communities also depend on the same water sources for domestic use and irrigation agriculture. The contractor will be required to make appropriate arrangements with the local communities and WRMA before abstracting water from the sources.

The water quality was compared with the Permissible quality of drinking from the Practice Manual for Water Supply Services in Kenya, dated October 2005 and the EMC(Water Quality) Regulations, 2006. All the samples met the required standard for drinking water, except the water from Kangitit Girls which seemed to be very hard. Hence the above tested water can also be used in the preparation of concrete for the bridge. Other qualities such biological content and bacteriology (E.coli, faecal) of the water needs to be undertaken to ensure water is holistically clean or guide on the treatment method before consumption. as presence of E.coli, faecal matter needs to be undertaken to ensure the water is holistically clean .

Table 3.5.10.4 (a) The water sources proposed for the project

| No. | Location | Description | Status |
|---|---|---|---|
| 1 | -Km+2+600 | River Ng'inyang' | Perennial |
| 2 | Km 24+257 | River Kapedo | Seasonal |
| 3 | Km 27+405 | River Loandapa | Seasonal |
| 4 | Km 44+250 | River Lere Ngiro | Seasonal |
| 5 | Km 49+105 | River Lomelo | Seasonal |
| 6 | Km 73+792 | River Ngaloikipe | Seasonal |
| 7 | Km 82+287 | River Nameieni | Seasonal |
| 8 | Km 91+800 | River Napeitom | Seasonal |
| 9 | Km 119+400 | River Kerio | Perennial |

Table 3.5.10.4 (a) Water Quality for sampled water sources

| Description | Water Source | | | Permissible quality – KS150* | Remarks | Water Quality Regulation 2006 Standards | Remarks |
|---|---|---|---|---|---|---|---|
| | Direct from Kerio River | Kangitit Girls High School Borehole (Lokori) | Lokichar Borehole | | | | |
| | A | B | C | | | | |
| pH | 7.74 | 8.12 | 7.88 | 6.5 – 9.2 | OK | 6-8.5 | Exceeds |
| Total dissolved solids, | 144.2 | 997.2 | 322.0 | 1500 | OK | 1200 | OK |
| Total Hardness as CaCO3, ppm | 105.0 | 874.5 | 480.0 | 500 | OK (for A & C) | | |
| Sodium as Na, ppm | - | - | - | 200 | OK | | |
| Chlorides as Cl, ppm | 35.7 | 237.9 | 16.0 | 250 | OK | | |
| Sulphates as SO3, ppm | 14.5 | 91.4 | 22.6 | 400 | OK | | |

#### 3.5.10.5 Cement

Cement is recommended for the project based on the materials report is Bamburi Cement. This available in major towns packed in 50kg bags and can also be sourced from the factories in Nairobi.

#### 3.5.10.6 Reinforcement Steel

Reinforcing steel for structural works is also available in the mainland from various factories in Mombasa and Nairobi, or abroad. Strength and other properties of reinforcing steel to be confirmed by testing of samples in approved testing laboratories.

#### 3.5.10.7 Bitumen

Bitumen for road works is generally readily available from either the port of Mombasa or external suppliers. Bitumen properties need to be checked by testing representative samples in approved laboratories.

#### 3.5.10.8 Lime

Industrial hydrated Lime properties need to be checked by testing representative samples in approved laboratories.

### 3.5.11 Construction Equipments

The list of equipment's to be used during the project construction phase is provided in the table below. It is important that the performance of the equipments meets the environmental and safety standards before they are engaged in the project. The standards to be evaluated to ensure they meet the required standards include combustion efficiency to reduce emissions, incorporated noise and vibration abatement gadgets, enclose systems for mixers and material ferrying trucks to reduce fugitive emissions, ability to use clean fuels and nonhazardous substance in their operating systems.

*Table 3.5.11 Construction equipments to be used*

| Name of Equipment | Supplier |
|---|---|
| Dozer | Contractor |
| Grader | Contractor |
| Pay Loader | Contractor |
| Excavator | Contractor |
| Vibro Roller | Contractor |
| Tandem Roller | Contractor |
| Macadam Roller | Contractor |
| Tire Roller | Contractor |
| Dump Truck | Contractor |
| Mixer Truck | Contractor |
| Water Truck | Contractor |
| Tractor w/Trailer | Contractor |
| Tire crane | Contractor |
| Cargo Crane Truck | Contractor |
| Cargo Truck | Contractor |
| Crusher Plant | Contractor |
| Screen Unit | Contractor |
| Concrete Batch Plant | Contractor |
| Asphalt Plant | Contractor |
| Asphalt Finisher | Contractor |
| Asphalt Distributor | Contractor |
| Air Compressor | Contractor |
| Generator | Contractor |
| Fuel Truck | Contractor |

| | |
|---|---|
| Light Vehicle | Contractor |
| Water Boozers | Contractor |
| Vibrators | Contractor |

## 3.6 Project Activities

The project shall have four major activities namely pre-construction, construction, operation and decommissioning.

### 3.6.1 Mobilization or Pre-Construction Phase

This phase entails mobilization of labour force, equipment and construction of offices/camps as well as acquisition of various permits as required by the law. The implementation of the project's design and construction phase will start with thorough investigation of the site biological and physical resources in order to develop a baseline data bank that shall guide in impact monitoring. Practise has shown that the period between the initial ESIA and actual project implementation takes time thus the need of reviewing the established baseline information. The activities to be involved in the pre-construction phase include:

- Identification of proposed alignment or route selection;
- Environmental and Social Impact Assessment to evaluate the changes since last study including baseline surveys;
- Land survey to align the road;
- Geo-technical investigation;
- Materials analysis including soil, stones and water tests;
- Design of the proposed road based on recommended standards and site conditions;
- Identification of suitable quarry and labour camp sites and source of water;
- Clearance of area for labour camp site construction;
- Construction of camps (labour camps, operation camps (offices, store and workshop) and material site camp;
- Mobilisation of the labour and equipment's to the camps;
- Land acquisition; and

- Material storage and material preparation.

#### 3.6.1.1 Campsite Location and Development

The project is expected to have three categories of camp sites, namely workers camps, operation camp (offices, stores and workshops) and material site camps (materials preparation sites). The selection of the location of the contractor's campsite has been based on the availability of adequate land for establishing the camp sites, including parking areas for machinery, stores and workshops, access to communication and local markets, and an appropriate distance from environmental sensitive areas.

#### 3.6.1.2 Transportation

Materials (fine and course aggregates) from quarries will be transported by trucks to the construction site. Water will be moved by water boozers. Other materials like cement, timber and reinforcement bars will be transported by trucks to the construction site. List of transportation vehicles required for the project is provided under section 3 of the report.

#### 3.6.1.3 Storage

Some of the materials from borrow pits will be used directly after delivery and as such no piling up is expected. Other materials like aggregates and sand will be stored at the operation camp site ready for use. Cement and reinforcement bars will be stored in special storage rooms. Timber will directly be used at the required areas and consequently there will be no stockpiling of timber at the camp sites. Fuel will be stored in drums at bund areas.

#### 3.6.1.4 Wastes Generation and Management

Types of waste to be generated at this phase of the project and their management methods are provided in the table 3.6.1.4 below.

*Table 3.6.1.4: Types, amounts and treatment/disposal of wastes during the pre-construction phase*

| Waste | Types | Amount | Treatment/ Disposal |
|---|---|---|---|
| Solid Waste (Degradable) | Vegetations (Trees, Thickets and Grasses) and remnants of timber. | To be determined | Source of energy for cooking at the camp site or nearby villages. |
| | Food remains, cardboards and papers | To be determined | Collected in a large skip bucket at the campsite then disposed at the authorized dumpsite or decomposed for use in adding nutrients to |
| | | | landscaped areas and planted trees or manure sold to farmers |
| Solid Waste (Non-Degradable) | Topsoils | To be determined | Backfilling material in the borrow pits, fill the diversions. |
| | Scrap metals | To be determined | Sold to Recyclers |
| | Tins, glasses and plastics | To be determined | Sold to Recyclers and those that cannot be sold due to quality of material should be collected in a large skip bucket at the campsite then disposed at the authorized dumpsite within the project area when full |
| Liquid waste | Sewage | To be determined | Septic tank and waste water recycling system at the camp sites. Recycled water to be used for non-domestic use. Mobile toilets to be provided at off camp construction sites |
| | Oils and greases | Non (car maintenance shall be done at contractors garages ) unless in cases of emergency | Sold to recyclers |

### 3.6.2 Construction Phase Activities

The overall objective of the road construction works is to improving the structural capacity, drainage and ride ability of the existing road with some improvement and realignment of the road geometry.

The construction phase which shall be undertaken by contractors shall commence after the ESIA has been approved and the affected people resettled. The project implementation activities undertaken by the contractor shall be supervised by a contracted resident engineer and monitored by an ESIA expert, KENHA and NEMA's Sub county Environment Committee as per their monitoring schedule.

The road will be developed to a bitumen surface finish having proper and adequate drainage structures to ensure passage of traffic throughout the whole year. The road section is categorised as class B road which is required to have a road reserve of 40m this is 20m from the either side of the road's centreline but due to minor encroachments some areas of the road reserve have only the carriage left though the reserve can be freed as vast open land is available to relocate those on the reserve. It is envisage the proposed road will follow the existing road profile in most of its sections apart from a few sections which shall be realigned to increase visibility and steepness for enhanced road safety as discussed under sections 3.5.4 and 3.5.5 of this report.

The main activities to be undertaken during the construction phase will include the following:

- Filling and shaping of the road section;
- Cutting of earth section to facilitate widening of the road;
- Rehabilitating and construction of longitudinal and cross drainage structures; and
- Provision of sub-base, base course and double surface dressing ending with finishing course of bitumen surface standard.

The actual works that shall be undertaken during this phase includes:

- Route and Topographical survey
- Earth works including cutting of the earth sections to facilitate widening of the roads; clearing of areas to pave way for the construction works; excavation of the existing roads and the construction of fill embankments, filling and reshaping of the road section to sub-grade level

- Construction of drainage structures culverts and bridges
- Provision of sub-base, base course and double surface dressing ending with finishing course of bitumen surface standard.
- Provision of temporary crossings and traffic diversions;
- Quarrying of gravel from borrow pits for sub-base and base;
- Extraction of sand;
- Extraction of stones and crushing them to form aggregates;
- Transportation of building materials like cement, reinforcement bars and asphalt to site;
- Preparation of form works for handling of concrete;
- Mixing of aggregate;
- Extraction of water from surface/underground sources and transportation to construction site;
- Transportation of construction materials including bitumen and stone chippings;
- Laying a bitumen prime coat and bituminous surface treatment;
- Excavation for the construction of the concrete bridges and incidental works;
- Installation of road signs/sign boards; and
- Operation of the camp sites.

The road construction activities mentioned above shall be associated with activities discussed below. Relevance of each activity to the project is discussed and its anticipated impact identified.

#### 3.6.2.1 Detour and Labour Force

Detour will be required in order to maintain a usable road during the construction period with exceptions. Other alternatives to enable opening up of detour will be use of a single lane by motorist while the other lane is under construction and vice versa. The construction and maintenance of the detour should be of expected standard that ensures road safety. Detours outside the road reserve should be done after consultation with land owners and any losses incurred should be compensated. Once the construction is completed this detours on private firms should be rehabilitated by covering with top soil so as to reinstate to its original state or a manner that shall prevent soil erosion.

Road construction is a labour intensive activity and requires skilled and unskilled manpower consisting of management and technical personnel and labourers who can be sourced locally. Sourcing of local labour is considered to be a major mitigation measure for social impacts on the local community and this is supported by the locals who requested to be given first priority when it comes to employment.

#### 3.6.2.2 Drainage

The drainage systems along the project road are either not existing at all or where they do exist, they are poorly maintained. There is need to install pipe culverts at sections where drainage was noticeably poor and in areas requiring drains as discussed under section of drainage structures.

#### 3.6.2.3 Road Furniture

The project shall also involve development of road furniture and supporting facilities like bus stops, bus parks, signage, and speed control devices. The installation should be done in areas beneficial to the locals in order for them to serve their purpose. There will be need to consult the community members in some instances on the right location to develop these facilities.

#### 3.6.2.4 Sourcing and Transportation of Building Materials

Road building materials will be transported to the project site from their extraction, manufacture, or storage sites using transport trucks. Materials (fine and course aggregates) from quarries will be transported by trucks to the construction site. Water will be moved by water boozers. Other materials like asphalt, cement, timber and reinforcement bars will be transported by trucks to the construction site.

The building materials to be used in construction of the project will be sourced from within the project area with manufactured materials being sourced from major towns such as Kitale, Nakuru and Nairobi. Greater emphasis will be laid on procurement of building materials from sites located closer to the construction site being worked on; this will make both economic and environmental sense as it will reduce negative impacts of transportation of the materials to the project site through reduced distance of travel by the transportation vehicles. Excavated base and sub-base materials from

the existing road can be reprocessed to form new cement improved sub-base and reused as construction material for the same or other projects.

#### 3.6.2.5 Storage of Materials

Building materials will be stored on site though some of the materials from borrow pits will be used directly after delivery and as such no piling up is expected. Bulky materials such as aggregates, stones, ballast, sand and steel shall be stored at the material mixing camp/contractor's yard and protected from elements of weather in order to avoid wastage due to weather conditions such as wind and rain. Cement and reinforcement bars will be stored in special storage rooms. Timber will directly be used at the required areas and consequently there will be no stockpiling of timber at the camp sites. Chemicals material such as emulsifiers, stabilizers, petroleum products and solvents shall also be stored at site in tanks/drums in banded areas to control contamination of natural resources in case of spillage.

#### 3.6.2.6 Excavation and Masonry Work

The project activities will involve undertaking excavation and, masonry work and other related activities including: stone crushing, asphalt mixing by use of both manual and mechanical means. These activities are known to be labor intensive and a source of air pollutants as activities such as quarrying are associated with explosives thus lead to vibration, noise and fugitive emissions. The emissions are also known to have impact on human health causing hearing impairment, pneumonocossis among other health effects.

#### 3.6.2.7 Landscaping

To improve the aesthetic value or visual quality of the site once construction ceases, the proponent will be required to carry out landscaping this will include establishment of roadside tree planting, backfilling and vegetating of disused quarry sites. Some sections of the road will have to be landscaped as construction proceeds to reduce erosion especially the steep sections.

#### 3.6.2.8 Wastes Generation and Management

The proposed project shall generate a substantial amount of waste both at the labour

camp and at the road construction site. Contractor/proponent should provide facilities for handling solid waste generated. These will include dust bins/skips for temporarily holding waste within the camp before final disposal at the designated dumping site. Bulky excavated material should be stock piled at designated collection point before disposal or reused. The appropriate strategy will be to cut and fill so as to reduce stock piling and impacts associated with excavated grounds that are not rehabilitated.

Sewage generated from the camp should be discharged into the sewerage system of the facility to be recycled, while storm water from the project area shall be channelled into the storm water drainage system or directed to natural water courses with consideration of downstream effects. Mobile sanitary facilities should be provided at road side construction sites, the material sites and other projects areas without sanitary facilities this can be in form of mobile toilets. Types of waste to be generated during this phase are provided in table 3.6.2.8 below.

The occupants of the camp units will be responsible for regular washing and cleaning of their units and other common/communal areas. Cleaning operations will involve the use of substantial amounts of water, disinfectants and detergents

*Table 3.6.2.8: Types, amounts and treatment/disposal of wastes during the construction phase*

| Waste | Types | Amount | Treatment/ Disposal |
|---|---|---|---|
| Solid Waste (Degradable) | Vegetations (Trees, Thickets and Grasses) and | To be determined | Source of energy for cooking at the camp site or villages nearby. |
| | Food remains, cardboards and papers | To be determined | Collected in a large skip bucket at the campsite then disposed at the authorized dumpsite or decomposed for use is adding nutrients to |
| Solid Waste (Non-Degradable) | Top soils | To be determined | Backfilling material in the borrow pits, fill the |
| | Scrap metals | To be determined | Sold to Recyclers |
| | Tins, glasses and plastics | To be determined | Sold to Recyclers and those cannot be sold due to quality of material should be collected in a large skip bucket at the campsite then |
| Liquid waste | Sewage | To be determined | Septic tank and waste water recycling system at the campsite. |
| | Oils and greases | Non (car maintenance shall be done at | Sold to recyclers |

### 3.6.2.9 General Repairs and Maintenance

The labour camp's machinery and equipment's will require repairs and maintenance during the construction phase of the project. Such activities will include repairs and

maintenance of construction plants and equipments, electrical gadgets and. equipment, repairs of refrigeration equipment, repairs of leaking water pipes, painting, maintenance and replacement of worn out parts in vehicles, machines and equipments including oil changes among others.

### 3.6.3 Demobilization Phase

Upon completion of the Contracted Work, the contractor shall remove all of its tools, materials and other articles from the construction area. The Contractor shall also clean areas where he worked, remove foreign materials and debris resulting from the contracted work and shall maintain the site in a clean, orderly and safe condition.

Materials and equipment shall be removed from the site as soon as they are no longer necessary to minimize the demobilization work after completion of the project. Before the final inspection, the site shall be cleared of equipment, unused materials and rubbish so as to leave the area aesthetical clean.

All the campsites will be built as temporary structures and these will also include the use of movable structures such as movable containers. All the temporary structures will be demolished after accomplishing the contracted jobs. If in agreement the structures can be handed over to the community or administration to be used for other purpose.

### 3.6.4 Operation Phase

The actual usage of the roads is expected to commence after the construction works. The project road is under class C therefore will be directly managed by KENHA. During this time, KENHA will carry out routine maintenance by attending to cracks, pot holes, clearance of vegetation within the ROW (road reserve area) and monitoring. Other activities to be undertaken includes installation of road signs, thermo-plastic road marking, reinforcement and replacement of road furniture, control of litter accumulation on road sides, awareness rising on proper road use and road management to the communities, monitoring and evaluation, management to reduce pollutant concentrations in runoff, disposal of wastes from road maintenance activities, storage and management of maintenance materials and equipment.

The duration of this phase will be twenty (20) years for roads and fifty (50) years for the bridge.

#### 3.6.4.1 Transportation

Materials (fine and course aggregates) from quarries will be transported by trucks to the construction site. Water will be moved by water bowers. Other materials like bitumen, cement, timber and reinforcement bars will be transported by Lorries to the construction site.

#### 3.6.4.2 Storage

Some of the materials from borrow pits will be used directly after delivery and as such no piling up is expected. Other materials like aggregates and sand will be stored at the materials camp site ready for use. Cement and reinforcement bars will be stored in special storage rooms. Timber will directly be used at the required areas and consequently there will be no stockpiling of timber at the camp sites. The bitumen will be stored in their respective containers which will be kept in the storage rooms.

#### 3.6.4.3 Types, Amounts and Treatment/Disposal of Wastes

Types, amounts and treatment/disposal of wastes during the operation phase shall be similar as those described under the pre-construction and construction phases though their quantities shall be smaller. Treatment methods of waste at this phase shall be similar as described in the sections mentioned.

### 3.6.5 Description of the Project's Decommissioning Activities

The decommissioning phase of the project shall occur at various phases one is as demobilization of contractors assets as discussed above and two is at the end of the project road life span in about 20-25 years. The construction decommissioning phase shall involve the following:

- Removal of temporary structures, installations and equipment's from the workshop, quarry sites and camp sites;
- Rehabilitation of the stoke pile yard, quarry site, workshop and camp site to

at least its original state or acceptable land use that shall not promote land and social degradation;

- Clearance of all sorts of waste including used oil, sewage and solid waste and depositing them at authorised dumping sites; and
- Landscaping the area with suitable vegetation that can adapt in the area preferably indigenous plant species.

The demobilization of the temporary structures will result mainly into solid wastes such as timber, iron sheets and rubbles from demolitions. Timber and iron sheets will be sold to people in the nearby communities for reuse while the rubbles will be used in backfilling the borrow pits.

#### 3.6.5.1 Demolition Works

It is anticipated that the proposed project will have a lifespan of two decades. Upon decommissioning, the project components including the road pavements, drainage systems, parking areas and camp sites will be demolished. This will yield substantial amount of solid waste, which is advisable be reused for other construction works or if not reusable, disposed of appropriately by a licensed waste disposal company.

#### 3.6.5.2 Dismantling of Equipment and Fixtures

All equipment including road surface, electrical installations, quarrying equipments, crushers, furniture partitions, pipe-work and sinks among others will be dismantled and removed from the site on decommissioning of the camp site, the road and other project components. Priority will be given to reuse of these equipment in other projects. This will be achieved through resale of the equipment to other contractors or donation of this equipment to schools, churches and charitable institutions, rehabilitation of feeder roads etc.

#### 3.6.5.3 Site Restoration

Once all the waste resulting from demolition and dismantling works is removed from the site, the site should be restored through replenishment of the topsoil and re-vegetation using indigenous plant species or developed according to the development trend of the time.

#### 3.6.5.4 Construction Materials and Energy Used

The main sources of energy that will be required for decommissioning of the project will include electricity and fossil fuels (especially diesel). Electricity will be used for welding, metal cutting/grinding and provision of light. Diesel will run material transport vehicles and construction equipment/machinery such as bulldozers and concrete mixers.

#### 3.6.5.5 Types, Amounts and treatment/disposal of Wastes

Types, amounts and treatment/disposal of wastes during the decommissioning phase shall be similar as those described under the pre-construction and construction phases though their quantities shall be smaller. Treatment methods of waste at this phase shall be similar as described in the sections mentioned.

# 4. BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

## 4.1 Project Boundaries

### 4.1.1 Spatial Boundaries of the Project

The spatial dimension encompasses the geographical spread of the impacts regardless of whether they are short term or long term. The spatial scale considers the environmental receptor component and can be local or broader. Two zones of impacts namely core impact zone and influence impact zone are considered.

The core impact zone includes the area immediately bordering the project (local). In the case of this project, local impacts will include the site of the construction (borrow areas, quarries and the actual road construction site) and the immediate surrounding areas. The influence impact zone includes the area beyond 500m – 2000m from the road alignment. Based on the environment surrounding the road the influence impact zone includes areas such as the settlements, Indian Ocean and the forests along the project road.

### 4.1.2 Temporal Boundaries

Temporal boundaries refer to the lifespan and reversibility of impacts, the temporal impacts can be either short term or long term. The short-term impacts are considered to be those which will be apparent only for a short period and as such will include mainly construction related impacts. The long-term impacts are considered to be those which will be apparent after construction has been completed (but may include also impacts which may become apparent during the construction phase). Short-term impacts include noise, dust and vehicle movements. Long-term impacts include impact to the ecosystem, revenue to the government, employment and benefit to the local communities in terms of accessibility to markets, industrial goods, transport, health services etc.

### 4.1.3 Institutional Boundaries

Institutionally, KENHA is a government agency under the Ministry of Roads established by the Kenya Roads Act, 2007 with mandates to develop, manage, rehabilitate and maintain international trunk roads linking centres of international importance and crossing

international boundaries or terminating at international ports(Class A road), national trunk roads linking internationally important centres (Class B roads), and primarily roads linking provincially important centres to each other or two higher-class roads (Class C roads).

## 4.2 Administrative Areas of Proposed Project

Based on the Kenyan Constitution 2010, the administrative area of the country was changed from provinces to Counties thus the County of the proposed project are Turkana and Baringo Counties. The project traverses Turkana South, East and, Central and East Post which are located in Turkana and Baringo County respectively. Despite the changes in boundaries and jurisdictions most of the background information on the areas are still presented with the previous larger administrative boundaries namely larger sub counties and to some extent provinces since information on the counties have not been fully updated. The baseline information presented in this report shall focus on the sub counties as presented in the Kenya National Bureau of Statistics -2009 Kenya Population and Housing census volume II and the Sub county Development Plans of 2008-2012 for the case of information that have not been updated or changed much over the years.

### 4.2.1 Geographical Location and Size

#### 4.2.1.1 East Pokot Sub county

East Pokot Sub county became fully fledged Sub county in 2006 with its headquarters at Chemolingot town. It one of the sub counties that make up Baringo county it borders Baringo North, Baringo Central and Marigat to the south, Samburu to the East, Laikipia to the South East, Central Pokot and Turkana Central Sub counties to the North and Marakwet to the West. The Sub county has an area of 4,524.8km2 and the population projection for 2009 is approximately 133,189. The Sub county has
5 operational administrative divisions, 20 locations and 52 Sub-locations as shown in table 1. The sub county links the project road to the Loruk-Barpelo road currently under construction and hence links the project area to the sub county headquarters, Marigat and Nakuru.

#### 4.2.1.1 Turkana Sub county

Turkana is situated on the North-western part of Kenya. It has been the largest sub county in the country covering an area of 77,000 sq. Km, which is about 42.4% of the total area of Rift Valley Province. In 2007, Turkana was split into three (3) sub counties, namely: Turkana North, Turkana Central and South sub countys. During the 2008/2009 financial year, three more sub counties were carved out of the aforementioned sub counties these are Turkana West (made up of Kakuma, Oropoi, Lokichoggio and Nanam divisions); the Loima (composed of Turkwell and Loima divisions) and Turkana East (comprising of Lokori and Lomelo divisions). Currently Turkana North sub county is composed of Lokitaung, Kaaleng, Lapur, Kaikor, Kataboi and Kibish divisions. Turkana Central is composed of Kalokol, Kerio and Central divisions while Turkana South is made up of Lokichar, Katilu, Kainuk and Loreng'elup divisions.

The sub counties in the County traversed by the road are Turkana Central, East and South which politically falls under Turkana South and Central constituency. Turkana County which borders Marsabit County to the east, Samburu County to the south east, and Baringo and West Pokot County to the south, to the South-west. The County has an area of 68,680.3 Km 2. The road connects the Southern Part of the county to the North through road A1 at Lokichar

#### 4.2.1.2. Climatic Conditions, Topography and Geology

#### 4.2.1.2.1 East Pokot and Turkana Sub county

The Climatic condition of the project area is generally arid. The temperatures range between 24°C to and 38°C with a mean of 30°C. The road traverses an arid area characterised by low rainfall. There are two rainfall seasons. The long rains normally occur between March and July and the short rains between October and November. The rainfall ranges between 120mm and
500mm annually; the western parts and areas of higher elevation in the region receive more rainfall. The rainfall pattern and its distribution has been unreliable and erratic over the years as is evidenced from the annual figures derived from Lodwar meteorological station which range from 19 mm to 380 mm. Rain is usually

accompanied by thunderstorms in the late afternoons and at night. The dryer the area, the more unreliable the rains are.

Topographically, Ng'inyang – Lokichar region is gentle undulating with occasional rock outcrops, hills, valleys and floodplains. Most of the region consists of low-lying plains, with isolated mountainous and hilly ranges. The highest point (around Tiati Hills) is about 2500 m above sea whereas the expansive part of the area ranges between 800 and 600 m above sea level.

Geologically the area is dominated by red sandy soils of volcanic origin. Some of the areas within the region have been earmarked for oil prospecting after a nearby site yielded promising results. Similarly, some nearby sites have hot geysers meaning the geology of the area has hot tectonic plates. Consultations with the Mines and Geology department confirmed that the road does not lie on any potential mineral site.

The topography of the area requires that the road is provided with adequate drainage structures as the area is prone to flash floods brought to the area from the hilly sections from as far as Uganda. The geological characteristic requires that geotechnical surveys be done on the alignment to ensure the road is not built on fault lines which can lead to damages in case of earth movements.

#### 4.2.1.3 Population size and Distribution

The settlement patterns in the sub county are determined by various factors such as climate, soil fertility and infrastructure. The only notable migration pattern is rural to rural movement in the form of nomadism. This intra-sub county and inter-sub county migration is temporary but frequent due to dry spells. Land ownership is still communal under trust land. There has been a noticeable increase in the number of people entering the sub county, particularly to Chemolingot town since the inception of the East Pokot Sub county.

The Sub counties are generally sparsely populated with the main economic activity being Pastoralism. The inhabitants of East Pokot are majorly Pokot at 99.9% who generally practice nomadic Pastoralism. 0.1% of the inhabitants are other tribes who work in East Pokot sub county while those in Turkana sub counties are majorly Turkana.

Settlement patterns correspond with natural resource endowment. This is exhibited by sparse population density in the areas receiving low rainfall and high population in towns and market centers, where economic opportunities prevail. There is no clear pattern of poverty distribution in the sub county as the poor and the rich live side by side, especially in the rural areas.

The government efforts and development partners through NALEP, Njaa Marufuku, and Arid Lands Management Project II have started yielding fruits. Settlement patterns may experience gradual change in future. The main livelihood zones in the Sub county include agro-pastoral, integrated cropping, mixed farming and pastoral.

The population of the project sub counties based on the 2009, Population Census Report is provided in table 4.2.1.3.1 below.

*Table 4.2.1.3 Population Data for East Pokot and Turkana sub counties*

| POPULATION CENSUS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Area | Admin. | Male | Female | Total | Household | Area(Km | Densit |
| East Pokot | Sub county | 69889 | 63300 | 133189 | 21291 | 4516.8 | 29 |
| Turkana Central | Sub county | 126,539 | 128,606 | 254,606 | 41,120 | 14,591 | 17 |
| Turkana South | Sub county | 121,022 | 105,357 | 226,379 | 28,437 | 18,671 | 12 |

The population distribution by age indicates that the age group between 1-10 have the largest numbers in the sub county followed by the age group between 11-19 years while the productive age of between 20-50 years forms 32% of the population while the numbers of elderly decreases significantly as the age group increases to a range within the hundreds as opposed to thousands for the productive age.

### 4.2.1.4 Economic Activities, Agriculture and Rural Development

The poverty levels of the project area is rated at 96.1% and them main economic activity is pastoralism though irrigation agriculture is being practised along the Kerio River in Lokori and other irrigation projects are on the pipeline as the

government aims to reduce incidences of famine in the area. Based on the socio-economic survey undertaken by the project team in November 2011, the unemployment rate was found to be at 43% with majority of the population stating that their most valued possession was a radio. Majority of those interviewed stated they earn less than Kshs. 1,000 per month with only one respondent out of 54 stating he earns Ksh.40,000. The locals indicated all their earning goes to purchasing basic commodities. Transport costs in the area were very high and no programmed public transport plied the route thus locals depends on lifts from visitors to the area or from vehicles supplying relief foods and other services.

There is a total area of 136 Ha of arable land in the sub county suitable for food crops. The arable land is mostly concentrated in the high potential areas of Kollowa and Tangulbei. Food crops like beans and maize are grown around these areas although in small scale. A proportion of about 0.1% of the total population is currently engaged in agro-pastoralism activities. This low proportion is attributed to pastoral nomadic lifestyle of the locals and unpredictable climate. Livestock industry is the mainstay of the local population.

Currently, more than 80% of the sub county population is engaged in this activity. Livestock is seen as an asset and held for prestige and also serves as a medium of exchange during cultural events. The forest in the sub county has not been demarcated. Pressure on grazing land has immensely contributed to land degradation.

The sub county has available markets for livestock at KMC. There are also Development partners supporting livestock activities e.g. WVO, Action Aid and ALRMP II. There is availability of local breeds which are tolerant to local conditions. The main livestock enterprises include; Camels, indigenous Zebu cattle, poultry, Sheep, Goats, Pigs, Bee-keeping and Donkeys. Number of livestock found in the area based on the 2009 census report are presented in table 4.2.1.4 below.

The livestock data forms baseline data to check impact of road and other factors such as education on livestock population in the area.

Table 4.2.1.4 Livestock Population by Type and Sub county

| Sub county | Cattle | Sheep | Goats | Camels | Donkeys | Pigs | Chicken | Chicken | Bee - Hi |
|---|---|---|---|---|---|---|---|---|---|
| TURKANA | 196,492 | 560,671 | 1,273,445 | 150,700 | 90,067 | 220 | 27,405 | 3,773 | 1,985 |
| TURKANA | 652,288 | 1,274,062 | 1,874,668 | 269,185 | 194,434 | 132 | 23,876 | 3,441 | 307 |
| TURKANA | 685,832 | 1,682,418 | 2,846,748 | 412,577 | 273,686 | 218 | 114,068 | 8,230 | 30,289 |
| EAST POKOT | 787,209 | 380,125 | 1,474,617 | 67,036 | 51,763 | 37 | 53,977 | 2,883 | 80,089 |

#### 4.2.1.5 Existing Infrastructure Facilities

The distribution of physical infrastructure can be regarded as an indication of the development of the area. The sub county is changing and growing very rapidly, and this has a negative impact on the ability of the existing infrastructure to cope with current demand.

##### 4.2.1.5.1 Roads

The Sub county has all surface types of roads namely; bitumen covering 0.5 Km, gravel and earth within classes A to E including RAR and G classes. Most roads need maintenance and establishment. Most of these roads were made passable to improve transport and communication for the community. Roads, Energy, Transport, Housing, Public Works and Kenya Wildlife Services (Roads, Airstrips and other Infrastructure) form the sub sectors of the physical infrastructure sector.

##### 4.2.1.5.2 Environment and Sanitation

Environmentally, the project area is faced with severe environmental degradation due to charcoal burning, soil erosion, poor waste disposal management and general sanitation amongst the urban and rural settlements.

The main water sources in the sub county are ground water which are unevenly distributed. Boreholes, shallow wells and water pans where found are at the grazing plain ranges, human settlement areas and at commercial centers. The average distance to the nearest watering point is 15 km which is still considered high. In the last few years the water sub sector has managed to put up fully motorized water point for both Boreholes and Shallow wells equipped with pumps. There is at least one water harvesting structure in each division.

Therefore since the sub county is classified as water scarce, with water service coverage of less than 30%,which is much below the national coverage of 52%, there is need to continue investing in water resources development to enhance reliable water sources at strategic areas for both human and livestock. The last five years has witnessed radical changes in the sector resulting in increased budgetary allocations that enhanced water supply rehabilitation, boreholes drilling and rainwater harvesting activities. During this period continuous improvement and expansion of piped water schemes has been undertaken in line with the strategic objectives of Rift Valley Water

Service Board.

Table 4.2.1.5.2 shows the various sources of water in the sub county and the size of the population dependent on them. Studies showed availability of water for construction is challenge thus underground water and ponding of rain water will have to be undertaken.

As part of project enhancement it will be important that the environmental mitigation measures are implemented to ensure the road operates for the intended period. The main project activities to be undertaken to ensure environmental and social sustainability includes:

- Work with line ministry in re-afforestation programmes to help reduce road side erosion and impact of climate change on the road infrastructure such as the storm water drains. This shall also act as a way of mitigating against the carbon and other emission generated by the road usage through sinkage on the trees.

- Incorporate solid and liquid waste management during all phases of the project as the area has no facilities to manage project generated waste. This management could be inform of recycling generated waste, composting organic waste, buying material with minimum packaging materials and engage registered waste management companies to manage generated waste such as incinerators for hazardous waste, among others. Sanitary waste should be managed by providing waste water handling facilities such as septic tanks with soak away pits or water recycling facilities especially when taking into consideration that area is known to be water scarce. In addition sanitary waste from road side workers should be collected and disposed in areas with sewage handling facilities this can be achieved by availing mobile toilets at road side project sites and quarry sites.

- Ground water and water pounding during the rainy season would be the main source of water as the area has limited supply of surface water. Water should be shared with the local community and the livestock to avoid emergence of water conflicts. Since a large population of the residents use indiscriminate

methods when responding to nature calls its important that domestic water from all sources be treated before use.

Sanitation is a challenge in the sub county as the number of households with pit latrines is the highest as shown in the table below. Those accessing sewer lines are just found within the trading centre while a majority of the population still depend on the bushes for nature calls. Generally there are no proper systems of managing liquid and solid wastes even in areas with sewer the capacity has been outstripped with the demand. Most of the sub county's areas have poor or no drainage structures and become flooded during the rainy. It is important that the contractor provides sustainable sanitation facilities both at the labour camps, material sites and at roadside construction site.

*Table 4.2.1.5.2 (a) The various sources of water in East Pokot and Turkana sub counties and the population dependent on them.*

| EXISTING INFRASTRUCTURE(WATER SUPPLY) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area | Pond/Dam | Lake | Stream | Well/ Sprin | Piped Into Dwelling | Piped | Harvested/Rain | Water Vendor | Other | Total |
| East Pokot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Turkana Central | 79 | 4 | 1107 | 2451 | 1154 | 4606 | 3 | 439 | 132 | 9975 |
| Turkana South | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 4.2.1.5.2 (b) The various forms of effluent management in East Pokot and Turkana sub counties and the population dependent on them.*

| EXISTING' INFRASTRUCTURE(Human Waste Disposal) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AREA | Main Sewer | Septic Tank | Cess Pool | Vip Pit Latrine | Pit Latrine (Covered / Uncovered) | Bucket | Bush | Other | Total |
| East Pokot | | | | | | | | | |
| Turkana | 30 | 119 | 97 | 554 | 9984 | 31 | 42695 | 124 | 53634 |

4.2.1.5.3 Education

Provision of quality education and school attendance, has remained a challenge in development of the project regions. The Government identified that economic, the locals lifestyle and social problems affects the provision of education infrastructure in the area. The level of the local population engagement in education is presented in the table 4.2.1.5.3 below.

The education baseline data obtained from the 2009 census indicates that majority of the local population are educated to primary level with a good number not having attended school.

Women in the project area are less educated that men and most get married off at an early age. Women stay at home while men go to herd cows but in the Agricultural areas like around the Kerio River women manage the farms and harvest crops as men herd the cattle's.

*Table 4.2.1.5.3 (b) Sub county Educated population from age 3 and above by sex and highest level of education reached*

| Sub county /Gender | Never Attended | Pre-Primary | Primary | Secondary | Tertiary | University | Youth Polytechnic | Total |
|---|---|---|---|---|---|---|---|---|
| TURKANA CENTRAL URBAN POPULATION CURRENTLY ATTENDING EDUCATION | | | | | | | | |
| MALE | | 1,840 | 6,989 | 1,489 | 227 | 107 | | 10,652 |
| FEMALE | | 1,717 | 6,739 | 943 | 196 | 37 | | 9,632 |
| TOTAL | | 3,557 | 13,728 | 2,432 | 423 | 144 | | 20,284 |
| TURKANA CENTRAL URBAN POPULATION LEVEL OF EDUCATION REACHED | | | | | | | | |
| MALE | 5,544 | 1,902 | 9,533 | 2,693 | 761 | 397 | | 20,830 |
| FEMALE | 8,681 | 1,792 | 9,542 | 1,933 | 649 | 117 | | 22 |
| TOTAL | 14,225 | 3,694 | 19,075 | 4,626 | 1,410 | 514 | | 43,544 |
| TURKANA CENTRAL RURAL POPULATION CURRENTLY ATTENDING EDUCATION | | | | | | | | |
| MALE | | 3,001 | 7.720 | 634 | 55 | 34 | 5 | 4,501 |
| FEMALE | | 2,970 | 6.297 | 286 | 21 | 6 | 0 | 6,907 |
| TOTAL | | 3,298 | 6,297 | 920 | 76 | 40 | 5 | 11,408 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TURKANA CENTRAL RURAL POPULATION LEVEL OF EDUCATION REACHED | | | | | | | | |
| MALE | 78,509 | 3,116 | 10,124 | 1,134 | 266 | 90 | | 93,239 |
| FEMALE | 82,438 | 3,108 | 8,201 | 506 | 86 | 16 | | 94,355 |
| TOTAL | 160,947 | 6,224 | 18,325 | 1,640 | 352 | 106 | | 187,594 |
| TURKANA SOUTH URBAN POPULATION CURRENTLY ATTENDING EDUCATION | | | | | | | | |
| MALE | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| FEMALE | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| TOTAL | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| TURKANA SOUTH URBAN POPULATION LEVEL OF EDUCATION REACHED | | | | | | | | |
| MALE | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| FEMALE | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| TOTAL | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| TURKANA SOUTH RURAL POPULATION CURRENTLY ATTENDING EDUCATION | | | | | | | | |
| MALE | | 3,381 | 20,152 | 3,519 | 296 | 198 | 24 | 27,570 |
| FEMALE | | 3,112 | 16,722 | 2,070 | 179 | 89 | 14 | 22,186 |
| TOTAL | | 6,493 | 36,874 | 5,589 | 475 | 287 | 38 | 49,756 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TURKANA SOUTH RURAL POPULATION LEVEL OF EDUCATION REACHED | | | | | | | | |
| MALE | 78,230 | 3,470 | 24,094 | 5,397 | 741 | 303 | | 112,235 |
| FEMALE | 70,499 | 3,205 | 20,257 | 3,070 | 381 | 127 | | 97,539 |
| TOTAL | 148,729 | 6,675 | 44,351 | 8,467 | 1,122 | 430 | | 209,774 |
| EAST POKOT URBAN POPULATION CURRENTLY ATTENDING EDUCATION | | | | | | | | |
| MALE | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| FEMALE | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| TOTAL | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| EAST POKOT URBAN POPULATION LEVEL OF EDUCATION REACHED | | | | | | | | |
| MALE | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| FEMALE | 0 | 0 | 0 | 0 | 0 | 0 | | |
| TOTAL | 0 | 0 | 0 | 0 | 0 | 0 | | 0 |
| EAST POKOT RURAL POPULATION CURRENTLY ATTENDING EDUCATION | | | | | | | | |
| MALE | | 2,579 | 8,556 | 958 | 90 | 83 | 11 | 12,277 |
| FEMALE | | 2,279 | 6,388 | 533 | 50 | 32 | 7 | 9,289 |
| TOTAL | | 4,858 | 14,944 | 1,491 | 140 | 115 | 18 | 21,566 |

| EAST POKOT RURAL POPULATION LEVEL OF EDUCATION REACHED | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| MALE | 46,385 | 2,635 | 10,581 | 1,695 | 364 | 185 | | 61,845 |
| FEMALE | 44,864 | 2,326 | 8,071 | 826 | 158 | 53 | | 56,298 |
| TOTAL | 91,249 | 4,961 | 18,652 | 2,521 | 522 | 238 | | 118,143 |

#### 4.2.1.5.4 Health

The project area has few medical facilities the doctor to patient ration is almost 1: 57,000. Along the road in East Pokot sub county there is one health centre at Kapedo but a sub county hospital is found at Chemolingot more than 50km away. The Turkana Sub counties found along the road have no hospitals but have health centres and a mission health centre.

The health indicators in the project area a lower than for most parts of the country. Infant mortality is rated at 60 for every 1,000 births while under five years mortality is at 12 for every 1,000. The prevalent diseases are related to malnutrition, malaria, tuberculosis rated at 9 patients for every 10,000 as per 2009/10 data. Other major cause of mortality is feuds between the Pokot and Turkana which is associated with cattle rustling and use of fire arms Based on the January 2012 County profile by USAID HIV in Turkana County was rated at 8.9% which is above the national average of 5.9 which ranks the area at number 42 in the County ranking. The high prevalence of HIV/AIDS is attributed to low literacy levels, cultural practices such as polygamy and, wife inheritance, not practising male circumcision, pastoralism which makes them stay away from home for long periods thus meet new partners'. The main challenge in disseminating information on HIV/AIDS in the that the area lacks basic primary needs thus discussing HIV/AIDS with hungry people who lack water and basic medical services is a challenge. The priority problems for the people in the area are food insecurity, water, education and poverty.

The road A1 is known to contribute to the spread of HIV in the area as transporters using the route to Southern Sudan engage with local girls who practise prostitution due to poverty and lack of other skills to enable use other means to alleviate poverty. Use of condom is rates low in the area especially by women as they have no bargaining power and also cultural reasons hinders their use for both men and men. Despite that availability of condoms in the area is also low though even if locals are offered condoms they refuse to use as men consider them to be small and generally they refuse to use as they really do not understand its concept.

Studies shows that building HIV awareness in Turkana is difficult – there is no access to radio or print media and illiteracy is high. "The area is so huge that many of the pastoralists have yet to be reached and majority still believe that HIV is something that does not happen in their area.

In regards to testing mobile VCT centres were introduced in the area more women are being tested. At clinics run by the ministry of health more men than women report for testing. "The women have to seek permission from their husbands to be tested and they

have many tasks to complete, and so don't often have the time to travel to the clinic.

The mobile clinics tests about 600 people per month, while the health ministry tests 500 people per month at their centres. Antiretrovirals are available in major hospital like in Lodwar, but the supply is not constant and it is still difficult to obtain the drugs which means supply is difficult to access for people within the project area.

The project should therefore incorporate HIV/AIDS awareness, prevention and training programmes throughout its life span and this should include care programmes that ensure continuous supply of medication and nutritional food supplies to workers living with the virus.

4.2.1.6 Gender and Labour Force

Although both men and women play important roles in the pastoral economies, women's roles were found to be more taxing and crucial since women were responsible for cultural reproduction in addition to domestic chores and livestock production activities. It was found that drought affected the performance of gender roles due to the scarcity of basic resources for both humans and animals. The greatest challenge faced by men was the reduction in their authority as household heads and breadwinners since women were in charge of the famine relief food. The challenges women faced constituted lack of time and energy to perform their gender roles under the strenuous drought conditions.

The main role of women in the project area is home management. As with most societies in Kenya, women's roles among the Turkana continue to be centred on the house. It is the general responsibility of Turkana women to provide food and comfort for the household. The specific roles they undertake include Fetching water for domestic use and for watering animals; preparing food and gathering wild fruits for domestic consumption; fetching firewood; and Cleaning the house and compound, which involves the construction of the animal kraals (anɔk), residence structures including the main house (akai), resting shelter (ekɔl) and sleeping/cooking area (atabɔ). Each structure is constructed independently to form a homestead. The women gets more engaged with this activites during the draught seasons as they have to walk long distance to search for water, prepare for migration to new locations, milk the cows, herd the small stocks (goats) while men are out in the fileds with the cattle, care for waek animals that are left in the homestead, exploring new grazing grounds.

Turkana women play the initial and crucial role of bringing forth children and nurturing them as they grow. They feed, cloth and educate both the male and female children. They

socialize the children into the Turkana way of life. As the children grow older, women concentrate on guiding and counselling girls into responsible adults who can function effectively in the Turkana society.

Turkana men view themselves and are viewed by the general society as the head of their households. Their specific roles they undertake include: Husband and father: They play the roles of husband to their wives and that of father to their children and in the process are the decision makers, supervisors (delegate duties to women and children), disciplinarians in the home by advising and counselling family members (wives and children); and providers (it is the responsibility of men to provide food, clothing and school fees).

Availability of labour force in the project area shall be constrained with the cultural practices especially pastoralism during the drought season. Despite that the local would like to be employed in labour where they can earn money to enable them take care of their daily needs.

## 4.3 Flora and Fauna in Project Area

The assessment of flora and fauna of the area involved identifying the ecosystems found along the road corridor; identifying of common plant species, their uses, local names and (IUCN) conservation status; preparation of conservation and mitigation measures aimed at preserving/rehabilitation of the impacted components of the vegetation.

The floristic assessment findings indicated that due to limited and unreliable rainfall of the project area, a good part of the ground, usually covererd with short-lived annual herbs was bare of vegetation. During the visit to the project area, it was established the road will cross rivers Ng'inyang (seasonal), Kerio (permanent) and traverse the following vegetation/landscape types:

- Wooded and open grasslands scattered with Acacia species
- Bushed grasslands on flat ground with coarse sand
- Dense woodland and shrubs growing along the river beds and luggas and on flood plains
- Swamp vegetation (next to Lokwamosing village)

Critical habitats on the road corridor include floodplains, luggas, river courses, and seasonal swamps. These areas are wet (humid) for longer periods of the year and

therefore act as refugia, providing micro-climatic conditions favorable for survival of relatively diverse flora and fauna during extended droughts that are rampant in the area.

A quick appraisal of the vegetation revealed a total of over eighty five (85), mostly perennial shrub and tree species common in the area as listed under annex 14 of this report. Typical of this kind of ecological zone, most species present here have xerophytic attributes that enable them survive extended drought. Several species of leguminous species are represented, indicating likelihood of high nitrogen levels fixed by the plants. The succulent plants adaptation in this area is of enormous importance in view of climate change and global warming.

As indicated in the table found under annex 14 (a), the vegetation in this region is extremely important to the survival of humans and their livestock. Most species of plants have multiple uses from livestock forage, medicinal, fibres source, food (fruits) and for building houses. Acacia tortilis plants are particularly revered by the Pokot and Turkana communities as a livestock feed. The trees provide pods that are a major forage source for livestock during the dry season. The Acacia tortilis plants (especially those along the dry river beds and luggas) are customarily 'privately owned' among the Turkana people and therefore their utilization is regulated by the 'owners'.

The trees therefore 'confer' ownership of space to individual in a region that is typically communally owned and never been subdivided by the government officially. Annex 14 (b) provides a pictorial presentation of some of the most common and useful species of plants occurring in the project area.

## Species of conservation Concern

Having compared the inventory of species provided under annex 14 (a) with those listed by the IUCN, we can confirm that none of the plants in the project area has been assessed for probability of extinction in the wild. However, the Floristic significance of the area is accentuated by the existence of fifteen or so species endemic to Kenya. As stipulated by the Convention on Biological diversity, conservation of endemic species is the sole responsibility of the range state, in this case Kenya. On this basis it will be important to look further into the best ways of ensuring persistence of endemic species, whose safety may be impacted by among other factors; alteration and loss of habits as well as spread of invasive plants such as the mathenge (Prosopis juliflora)and cactus (Opuntia stricta) already present in the area.

The existence of a conservation area (South Turkana National Reserve) within 50km of the project area provides hope for conservation and an opportunity for continuity of species that get depleted in unprotected communal lands within the road corridor. In the likely event that economic development will lead to the hitherto nomadic communities opting for a more sendentary livelihood, it will be useful for them to conserve some of the species in home gardens to ensure continued supply of resources.

The project corridor had no conserved wildlife reserves or animals corridors but sections between Lokori and Kapedo is dispersal area for small wildlife like the dik dik who use the lagas and springs as watering points especially around Lokuagipi laga where large herds were seen.

## 4.4 Rivers

All the rivers along the road alignment flow to the South Easterly direction. The catchments lie within the Rift Valley Basin. There are a number of perennial and ephemeral rivers on the alignment. The Kerio and Nginynang Rivers are the perennial rivers in the area that drains into Lake Turkana. The area also has several springs located along the road reserve but only the one at Lokwamusing is protected and used as a watering point by the community members. Sources of fresh water in the area are scares and ground water in the area is salty thus community living far from fresh water sources get their water from the Sandy river beds found in the area. The road traverses several vast flood plain this was evident during the rainy season as masses of water could be seen while during the dry season this was indicated with the existence of sand and, rock deposits in the plains and the road and several water ways that cuts across the road. The sections seen to have large plains were between Lokichar -Lokiro and towards Ng'inyang . Marshy land at chainage 37+000 and is located along a vast storm water way.

## 4.5 Archaeological and cultural sites

The two important sites along the project road are:

- The Ekang'wata Chiror, a cultural site belonging to the Turkana ethnic community which is found between the Lomelo and Napeitom/Enapeitom (meaning an elephant with one eye) after crossing the Nasalkeni and Anakuto laga on the right hand from Napeitom village. The site is a small hill located

about 10m off the road corridor it is a remembrance point where a single Maasai elderly woman died alone. Locals go there to retreat and pay tributes but due to insecurity the site is not used as the traditions require so locals go to the site when they feel the situation is calm and there will be no confrontation with the pokots who might have come to raid them. There will be need to realign the road at this section so to preserve the site during construction and operation phase of the project.

- The stone art works found in Lokori; and
- Several grave sides found along the road used bury those deceased through clashes.

The road section neighboring the cultural sites should be realigned to avoid interfering with the sites.

## 4.6 Avian sites

Several birds nestling points were seen along the road and would need to be preserved or the birds' nests moved to other locations that they can adopt too. All birds nestling points found along the road should be relocated before the vegetation is cleared.

Plate 4.7 (a) Tree used as nestling site by birds on the road side

Plate 4.7 (b) Tree used as nestling site by birds on the road side

# 5. IDENTIFICATION AND ANALYSIS OF IMPACTS

The development of highways roads and other transportation systems are good for socio- economic development of a community but are normally associated with a wide range of environmental and social impacts on a number of receptors on which the development depends on. The ESIA aims to identify these impacts for the purposes of mitigating the adverse ones while enhancing the benefits of the project. Impact identification is a process designed to ensure that all potentially significant impacts are identified and taken into account in the ESIA process. A number of 'tools' are available to assist in impact identification. The simplest, and most frequently used, are checklists of impacts, although matrices, network diagrams and map overlays are also commonly used. In these EIA simple checklists, matrices and expert's knowledge were used to evaluate project impacts. The project impacts were identified then further categorized into the project phase that they shall occur in namely pre-construction, construction and operational phase. The main receptors of project road includes physical resources (surface water, soils and air); ecological resources (wildlife and their associated eco-system); material assets, public health and safety, aesthetics and landscape.

## 5.1 Impact Zones

The study has considered two critical impacts zones, namely;

- The core impact zones – include the area immediately bordering the project sites.
- The zone of influence – which includes the area beyond 500m –2000m from the road alignment thus translating to the wider geographical areas within the project sub counties.

## 5.2 Environmental and Social Impact Identification and Evaluation Methodology

As already mentioned in the methodology section the identification, assessment and analysis of impacts requires three steps. The first step involves identification of impacts based on Environmental Impacts Identification Checklist (EIIC). The EII

Checklist considers various aspects of the natural and human environments that are likely to be affected by the project during construction and operations phases. These include:

- Local resource uses and socio-economic environment
- Biophysical and landscape environment
- Air and water quality environment
- Occupational health and safety, natural hazards and construction related hazards.

Based on the check list the proposed project was seen to have an overall of broad fourteen positive impacts and seventeen negative impacts as shown on the list provided under annex.8 of the report.

## 5.3 Assessment of Impacts

The second step is assessment of impacts by using the Rapid Impact Assessment (RIAM) Matrix (See Annex 9) and Impact Categorization (IC) Matrix (See annex 10). The RIA Matrix is used to assess the effect of potential impacts on biophysical and socio-economic components. The assessment of impacts focuses on their magnitude, significance, permanence, and whether the impact is cumulative and reversible or irreversible. The IC Matrix is used to categorize impacts into negative and positive impacts based on project activities. The impacts are also grouped according to environmental components (biophysical and socio-economic) likely to be affected. The result of assessment by using the RIA and IC matrices is shown below in Figure 5.3 (a) and 5.3 (b) respectively.

The result by using RIA Matrix indicates that the project is expected to have more negative impacts on biophysical components (BC) than on socio-economic components (SC) shown in annex 9 of this report and Figure 5.3 (a) below . The assessment indicates that the project is expected to be more beneficial socio-economically and cumulatively it has a net of twenty two (22) positive points in the social component and negative 19 (-19) points in the BC. These findings indicate the project will have both positive and negative impacts. Thus, there shall be a need to enhance the identified positive impacts and minimize or mitigate the negative impacts. This is to ensure that the project is environmentally sustainable and socio-economically beneficial. The findings also indicate that the results from RIA Matrix and IC Matrix are consistent.

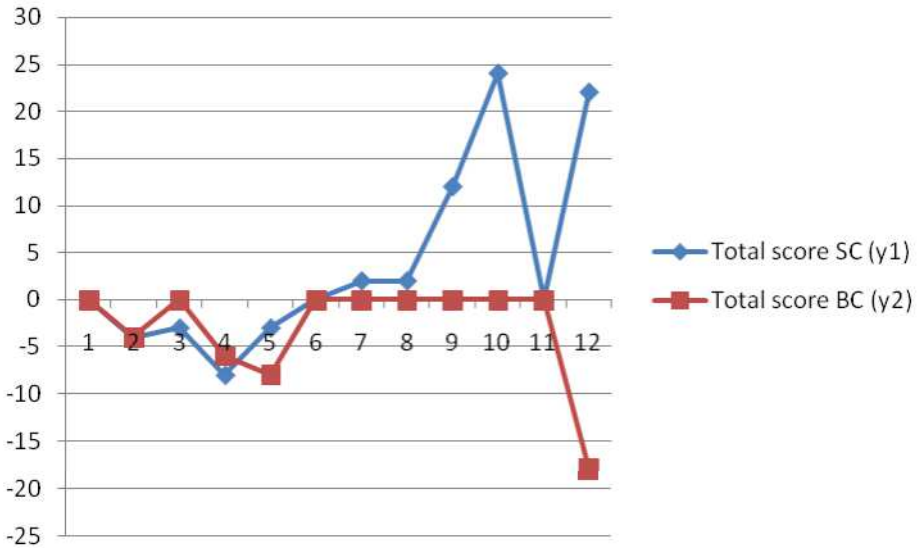


Figure 5.3(a): Findings of assessment of impacts based on RIA Matrix

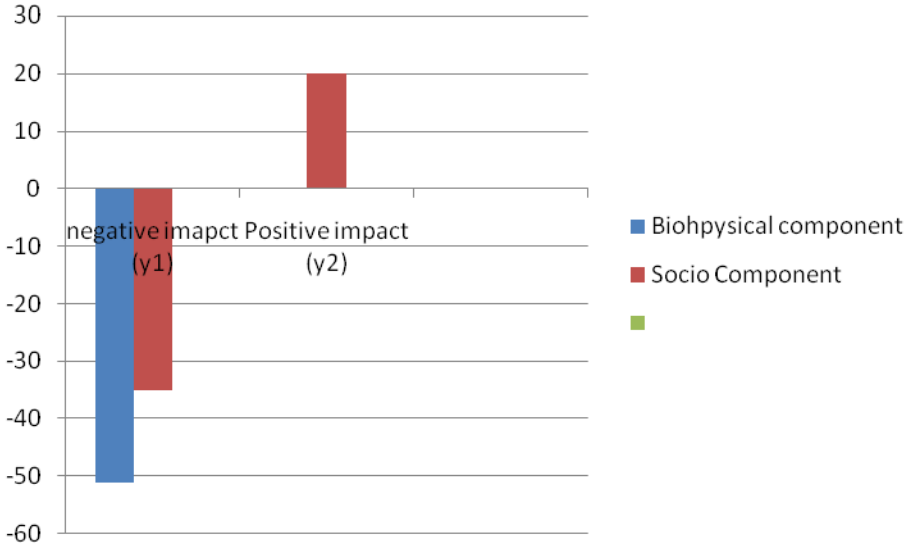


Figure 5.3 (b): Findings of assessment of impacts based on IC Matrix

## 5.4 Analysis of Impacts

The third step is analysis of impacts is by using Impact Evaluation (IE) Matrix, which is complemented by grid method for determination of significance of impacts as shown in annex 11 of this report. The technique considers the characteristics of impacts based on the following factors:

- Type of impact – whether positive or negative

- Its effects – whether direct, indirect or cumulative
- Intensity – whether low, intermediate or high
- Magnitude – whether site specific, local or regional
- Duration – whether permanent, or temporary; short term or long term;
- Reversibility- reversible of irreversible
- Significance- whether low, intermediate or high.

In order to determine the significance of impacts the IE Matrix is complemented by Grid method, which considers intensity, magnitude and duration of impacts.

The frequency of occurrence of each factor for a given impact has been used to obtain the characteristics of impacts as shown under annex 11 of this report which shows that majority of impacts are rated to be of low significance.

The important output in this analysis is the significance of impacts, which is determined by considering intensity, magnitude and duration. For example, if the impact has a low intensity, site specific and temporary; then its significance is low. The results of the analysis indicate that most of the impacts are:

- Negative;
- Indirect;
- Have low intensity;
- Site specific;
- Temporary (Short term);
- Reversible and have low significance.

### 5.5 Potential Positive Impacts to be enhanced during Project Implementation

Construction of a road in a project area is among the strategies for rural and urban poverty alleviation. The improved road will open more opportunities for self-employment income generating activities for the local communities and at the same time attract investor to the area.

A family with sufficient and regular income is more likely to afford paying the costs of education and health services for its members apart from getting enough food to eat.

The main benefits of the proposed project to the locals shall be employment of casual

labourers and skilled workforce from within the project Sub counties. In addition, the local people can benefit by engaging in small scale businesses that provide goods and services needed by the project labour force this shall be in form of selling merchandise, food substances and even provision of domestic services. Qualified personnel not found within the project sub county shall be employed to work for the project thus there will be diffusion of knowhow from the qualified personnel towards the local personnel.

The road project in known to be associated with several positive impacts which if not well undertaken can turn to be negative or have adverse implications to the community and county at large. The major positive impact associated with the project is the increase of economic activities as discussed below thus should be enhanced.

- The project is anticipated to create both direct and indirect employment for both the skilled and unskilled workers who shall be locals and incoming labourers.
- The project is anticipated to create markets for goods and services required for the construction work and for personal use by the workers and locals. This shall also create business opportunities to local traders.
- It is anticipated that women will get opportunities to work in the project thus empower them and help improve their skills.

To ensure the positive impacts are achieved and maintained at acceptable norms it is important that;

- The locals are given employment priority in regards to both skilled and non-skilled labour. Labour should be brought in from other areas only in the event that locally available skills are not sufficient or at par to the requirements to the project. The recruitment process should also meet the legal requirements on equal opportunities for all as prescribed in Constitution and the National Cohesion and Integration Act.
- Locals should be encouraged to tap into the business opportunities associated with the project by calling them to tender for businesses within their capacity or advertising opportunities at the administrative offices frequented by locals.
- Women should be given equal job opportunities as men
- As part of Community Corporate Social Responsibility (CCSR), the proponent

in collaboration with the contractor should initiate social programmes such as football matches, capacity building on money and resources management, rehabilitation or building of classroom at identified schools among others. This will not only enhance relationship between the community and the locals but also reduce number of vices that are associated with free time such as alcoholism, drug abuse and poor money management skills.

- Programmes should be developed to assist or guide locals on financial management to enable them use acquired funds from the project positively to ensure socio-economic sustainability.
- The contractor should adhere to the policy, legal and regulatory framework governing the project as this shall act as an umbrella factor for enhancing the project's positive impacts.

## 5.6 Details of Identified Negative Impacts during the construction Phase

### 5.6.1 Land Acquisition and Resettlements

In Kenya the road reserve is measured from the existing road centreline. The method of measurement implies that any deviation from the existing centreline will move the ROW. According to the study land acquisition shall be required for development of the realignment section at Lokichar Shopping Centre but the other section follow the existing alignment. Land acquisition will also be required for development of material sites, project office and labour camps. At least twenty (20) traders found in Kapedo, Lokori and Lokichar and a village at Napeitom located at the centre of the reserve shall be affected by the development. There will be about 3 km realignment at Lokichar Shopping centre joining A1 road because of safety related issues. This will ensure that the through traffic don't pass through the Centre. The existing road through the centre will be upgraded for local traffic.

### 5.6.2 Increased Water and Soil Pollution

The road development will require the creation of drainage channels in order to drain concentrated run-off from the road. Whichever construction method is used, small-scale and short-term water pollution may result especially during development of water body crossing structures such as bridge on the perennial rivers may stir riverbed

deposits into suspension.

Though the large particles may settle quickly, the finer ones will increase the turbidity of surface water sources. The turbidity impacts may be short-term since the stream construction takes place within a few weeks.

Construction of off-road drainage structures shall also be a source of pollution. Other sources of impacts can be accidental spillage of fuels and construction materials, which may pollute both water and soil. Water or soil pollution by accidental spillage of fuel or other materials and chemicals occurring with road construction is undesirable. At this stage it is not possible to predict the location or type of spillage, but it is considered that any form of spillage to soil will be local in nature if remediation is undertaken immediately it occurs. Spillage to watercourse is a high potentially impacts as it can result to adverse health impacts on humans, fishes, riverine vegetation and wild animals and have a regional impact as the rivers drain into lake Turkana. Spillage of chemicals especially hydrocarbons can have residual and cumulative effect in soil and water for years leading to total destruction of ecosystems.

### 5.6.3 Soil Erosion and Instability of Slopes

Soil erosion is the area is generally thigh along the road due to the terrain and run-off flow patterns of the area and lack of dense vegetation cover. The construction of the proposed project shall lead to soil erosion and contamination at the following areas: borrow pits, road cuttings, embankments, construction camps, workshop areas, equipment washing yards, asphalt plants, batching plants, fuel and chemical storage areas, etc especially during the rainy season. Intense erosion is particularly anticipated in areas with unconsolidated sandy soils that happen to be common on the project site such as at Lokori, Ng'inyang River and most of the hill slopes in the project area. In addition, increased disturbance of the vegetation will result in general degradation of the environment.

Soil erosion and contamination may affect the road stability, and increase flood risk due to rapid and higher flowing volumes of runoff, silting up of water bodies, landscape value and in worst cases may reduce the economic productivity of land and biodiversity in the project Area. The impacts of soil erosion and contamination would

be temporary and moderate negative if stripped soils are stored and reused properly.

### 5.6.4 Air Pollution

Various forms of air pollution is anticipated to occur during the development and operation of this project. The main sources of pollution during development will be:

- Excavation and quarrying activities which will pollute the air by generating dust particles, projectile objects e. g flying stones and noise. Air pollutant from these sources shall be accentuated with operation of crusher and asphalt plants, and general earth works at the site which shall also generate exhaust fumes from fuel used or materials being processed such as bitumen and other chemicals to be used.
- Machines, equipments and vehicles which will generate noise, vibration and exhaust fumes
- Stock piled materials which will generate fugitive emissions in form of fine to large dust particles,

Dust and fumes will have major direct but short-term impacts during the project construction phase. The areas to be affected are settlement and areas with leafy vegetation like the near the laga and springs found along the road that have river palm trees and other indigenous trees. Dust will be a temporary nuisance to the people within the core impact area especially during construction in the dry season.

The pollution levels in several areas adjacent to the project roads shall be diluted fast due to the following reasons:

- Watering of the road surface during construction;
- The project area is relatively open, without impediment to air movement; and
- Leafy vegetation is areas along the road shall filter out a considerable content of low level air borne pollutants.

Noise will be produced by construction vehicles, plant and machinery during delivery of materials, processing of materials, and actual construction work. Due to an increase in activities and number of operational vehicles, the impacts of noise will

cause disturbance to humans and animals as well as birds. As such, noise impacts will have short range – near the construction site apart from settled areas with villages like in Lokwamusign and Napeitom.

Vibration from the proposed project shall be generated by a number of construction activities such as piling, blasting and rock removal during earthworks. Vibration can cause physical damage to those near the construction site and sources such as blasting at quarry sites can cause far reaching effects to moving objects and settlements. The parameter normally used to assess the ground vibration is the peak particle velocity (ppv) expressed in millimetres per second (mm/s) which is considered to be the best descriptor for assessing human comfort and the potential damage response of structures. Vibration can cause varying degrees of damage to buildings and affect vibration-sensitive machinery or equipment. Its effect on people may be to cause disturbance or annoyance or, at higher levels, to affect a person's ability to work. Human response to blast induced ground vibration is a relatively complex phenomenon and is dependent upon a range of factors of which the actual vibration magnitude .The human body is very sensitive to the onset of vibration albeit very poor at distinguishing relative magnitudes. Although sensitivity to vibration varies significantly between individuals, a person will generally become aware of blast induced vibration at levels of around 0.5 mms-1 peak particle velocity, however individuals are very poor at distinguishing between vibrations of differing magnitudes. This threshold of perception of vibration is very much lower than the onset of even cosmetic damage (plaster cracking at typically least <12mm/s). Typical levels measured vibration sources during construction activities are shown in table 5.6.4 below.

*Table 5.6.4 typical levels measured vibration sources during construction activities*

| Construction Activity | Typical Ground Vibration Level |
|---|---|
| Vibratory roller | Up to 1.5mms @ 25m |
| Hydraulic rock breakers | 4.5 mm/s @ 5m, 0.4 @ 20m, 0.1 @ 50m |
| Compactor | 20mm/s @ 5m, <0.3mm/s @30m |
| Pile driving | 1-3mm/s @ 50m depending on soil conditions and piling technique |
| Bulldozer | 1-2mm/s @ 5m, 0.1 @ 50m |
| Truck traffic (smooth surface)<br><br>Truck traffic (rough surface) | <0.2mm/s @ 20m<br><br><2mm/s @ 20m |

### 5.6.5 Increased Spread of HIV/AIDS and Substance Abuse

The main health risk associated with road projects is the spread of HIV/AIDS epidemic. Considering the socio-economic as well as geographical characteristics of the project area, there exist a number of parameters that either may influence a high infection rate, or deter efforts to combat the epidemic. The main parameter is the polygamous nature of families in the area, lack of good road network to spread information on awareness and prevention, lack of medication outlets such as hospitals, health centres and counselling centres. Empowerment of the locals at times might turn negative as they might use the gained resources to indulge in alcoholism and substance abuse which are also associated with increase in HIV/AIDS and other STIs thus mitigation measures to curb such vices should be implemented and mentorship programmes developed to guide project personnel on resource management.

### 5.6.6 Safety and Health Risks

Roads construction activities normally expose the labourers and the general public to several health and safety issues and this includes

- Bronchial and other respiratory tract diseases if measures such as water palliation and use of safety gears are not practised during the construction

period. Respiratory diseases can result to loss of lives or injuries during construction.

- Increase incidence rate of water borne diseases such as cholera and diarrhoea which arises when appropriate sanitation practices at the camps and along the roadside are not observed.
- Increased exposure to water borne disease vectors due to increased breeding sites at unrehabilitated borrow pits and, quarry site and water pools at construction sites due to poor or lack of drainage structures. The stagnant waters could stimulate growth of Culex mosquitoes, which transmit filarial worms (Wuchereria bancrofti). Disease that increased arises due to such situations are malaria, elephantiasis, river blindness among others. The impact has a long-term significant effect to the health of local communities. Exposure to animal attacks in area inhabited by wildlife such as around the Grassland Savannah in Ng'inyang known to be home to the big five animals.
- Other safety risks includes exposure to accidents, fire, hearing impairment among others

### 5.6.7 Increased Road Accidents

Increased traffic during construction and poor road safety measures like absence of diversion (where necessary), signage during construction and road safety awareness campaigns will result into unnecessary road accidents involving vehicles, non-motirised vehicles and humans.

### 5.6.8 Interference with Local Hydrology and Increased Water Abstraction

Construction of the road shall entail significant water abstraction from the river such as Kerio to be used for domestic and construction purposes which shall include dust mitigation in the local areas. It is assumed that the project shall require 60,000-100,000 litres for every 100m this shall translate to 12,000,000 to 20,000,000 litres of water for the entire road for the construction period. This increased abstraction of water will have negative impacts to the people dependent on the rivers and the local groundwater. Availability of fresh water in the project area is scare thus there will be need to drill boreholes so as to source water for the project. The contractor should

share the water with the local communities and their livestock so as to enahcne co-existence with the locals.

Interference with the local hydrology can be a direct long term time impact if not eliminated during construction and to ensure the impacts are minimised, the roads interface should be constructed with the natural surface and groundwater flow regimes. Good design features should be adopted to ensure that the changes of the hydrological regimes are minimized and that any impacts are insignificant. The design should also provide controlled and effective storm water dispersion systems by indicating areas of installation of the appropriate drainage structures. The discharges points should be well designed to avoid accelerate erosion downstream.

### 5.6.9 Loss of Definite Materials and Land Degradation

Construction of the road will have direct impacts associated with excavation, quarrying and deposition of spoil material which shall be undertaken during gravel and rock sourcing, cutting and filling among other activities. Since the road is being constructed a fresh significant use of definite materials is expected.

Quarrying involves clearing the vegetation at the sites, excavation and transportation of the material. Thus, borrowing and quarrying activities will cause habitat change, land degradation (due to removal of fertile top soil), landscape impairment (visual intrusion) and soil erosion- which lead to siltation of waterways. Quarrying, excavation and the disposal of spoil material can destroy the economic and aesthetic value of public and/or private property including the land itself. Some species may be affected during construction, but not to the level of extinction. However, establishment of detour routes during construction may damage more plant species.

Scenic quality deterioration will occur due to stock piling of construction materials and discoloration of plant leaves in the vicinity of the roads due to windblown dust. Excavation work as well as presence of construction vehicles, plant and equipment will also add to scenic quality deterioration. Scenic quality deterioration will also occur off-site, at the sources of construction materials, the quarries and sand mines. If they are not rehabilitated they may become an eyesore.. Scenic quality degradation

effects will be significant, short term and direct.

They will, in spite of everything, be manageable given proper site operation and prior warning as well as issuance of site operation guidelines.

### 5.6.10 Climate Change

Factors likely to lead to climate change due to project implementation are;

- Emissions from vehicles, machines and equipments due to inefficient combustion systems and use of unclean fuels. Emissions to be emitted shall include NOx (oxides of Nitrogen), SOx (oxides of sulphur), Ozone (O3), carbon monoxide and the notorious Green House Gas Carbon dioxide. These pollutants have different impacts on the stratosphere leading to climate change, acid rain and impacts on human health.
- Lack of appropriate time transport management plan for project activities such as ferrying workers, materials, equipments and other supplies. If not well planned the emissions levels from the gadgets shall be high thus contribute to climate change.
- Ozone depleting substances (ODS) due to the use of halogenated compounds chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), methyl bromide, carbon tetrachloride, and methyl chloroform found in cooling system in the vehicles and, refrigerators, fire extinguishers and other machines and equipments. The release of ODS normally result to formation of dioxins and other uncontrolled substances which affects the climate by depleting the ozone layer. Impacts of dioxins are known to be long term as they can exist in the atmosphere for years moving slowly to the stratosphere. Depletion of the ozone layer causes increased amounts of UV radiation to reach the earth which can lead to more cases of skin cancer, cataracts, and impaired immune systems. Over exposure to UV is believed to be contributing to the increase in melanoma, the most fatal of all skin cancers.
- Clearance of vegetation: Vegetation plays a natural role in cleansing the air of pollutants thus its clearance shall have an impact on the areas micro-climate.
- The magnitude of climate change related to emissions are anticipated to be low at this phase of the project and can be eradicated by implementing cleaner production mechanism as mentioned in the mitigation measures section in the

### 5.6.11 Loss of Vegetation

The construction of the road and its support structures such as bridges and culverts will involve clearance of terrestrial vegetation, river riparian vegetation and soil excavations. The degree of perturbation is expected to be high when heavy moving equipment / machinery are used at the natural embarkments. The degradation of riparian vegetation jeopardizes water sources quality and aquatic ecosystem as it allows direct flow of contaminated water into the natural water source. The main causes and impacts on areas vegetation due to the project shall be:

- Habitat modification, surface excavation and soil compacting: Modification of habitat within the confines of the road corridor will be inevitable given the influx of machinery, construction material and personnel. In addition, road construction entails undertaking surface excavation, establishment of camping sites etc. This will cause alteration of ground cover, due to trampling, off-road drives etc. In the ultimate these activities will interrupt and fragment habitats and most likely lead to introduction and spread of invasive species such as Parthenium hysetrophorus, Prosopis juliflora and Lantana camara. Disturbance and establishment of invasive species will in turn make the habitats unsuitable for endemic species, many of which are often habitat specialists. So far Prosopis juliflora is only found between Marigat –Ng'inyang and the Congress weed (Parthenium hysterophorus) is found around Lake Bogoria. As witnessed elsewhere in the country, earth moving machinery will provide easy avenues for spread of seeds and other reproductive structures of plants from place to place. Throughout the construction and operation period, an upsurge of invasive species is anticipated due to increased movement as well as increased disturbance along the road corridor. It is possible that such species will find their way into pristine habitats in the interior, most preferably the watering points.
- Clearing of vegetation: The road is expected to be at least five meters wide. Vegetation will in addition be cleared alongside the main road where diversion will be constructed for temporary passage of traffic. It is estimated that at least 1000 km2 ha of indigenous vegetation will be lost to the road itself; this translates to significant loss of forage for livestock, herbal cures, food and other

essential goods such as fiber and construction posts.

- Risk of fire: Influx of road constructors and other personnel in this area necessitates establishment of campsites to cater for basic needs. High temperatures, presence of dry and inflammable material increase risks of spread of fire from cooking facilities as well as cigarette remains.
- Loss of grazing land: Grazing land will be lost in three profound ways; firstly the road and associated corridor will take estimated 4000 square kilometer of land. Secondly, grazing resource in form of browse from trees will be lost from clearing to give way for the road as well as road embankments and waterways. Lastly, the spread of invasive plants that most often than not are unpalatable and harmful to livestock will compromise the grazing value of the region.
- Loss of vegetation has also lead to loss of birds nestling areas.

### 5.6.12 Poaching

The section between Lokori and Kapedo along the project road is home to small animals like the dik dik which are known to be delicacy to locals and visitors. Opening up of the area shall expose the wildlife to poaching for game meat for domestic and commercial purposes.

### 5.6.13 Interference with archaeological and cultural sites

Two sites of historical importance were identified along the road as discussed under section 4.6. It important that project activities likely to interfere with the areas such as quarrying, acquisition of lateritic materials are not undertaken within their vicinity. It was noted that a potential source of stone material was seen near the art works site in Lokori it will be important not to exploit this area as vibration effects might damage the archaeological site and surrounding settlements.

### 5.6.14 Lack of initiative to implement the Mitigation Measures

Implementation of project mitigation measures is normally considered as voluntary as one uses self conscious to abide by the regulatory framework making most contractors and project engineers to over look them. This misconception normally arises due to lack of stringent compliance monitoring on the implementation schedule of the

mitigation measures or weakness in enforcement of environmental and overall project's legal and regulatory framework. This impact is usual observed at all phases of project implementation.

### 5.6.15 Insecurity of project area

The project area in general is insecure due to historical feuds between the Pokot and cattle rustling. This has created tension in the area especially at the boundary of the two communities at km 77+300 that a no man's land has been created anyone seen in this area is considered an enemy and can be executed. This can affect the workers safety and the progress of the project.

## 5.7 Positive Project Impacts during the Operational Phase

The operation phase of the project is associated with several positive and associated multiplier effects which are the main objective of rehabilitating the project road. The identified positive project impacts are discussed below.

### 5.7.1 Job Creation and Increased Income to Local Communities

Road operation and maintenance shall generate both direct and indirect employment opportunities. Direct employment will be to those working on the road during maintenance and shall be engaged in skilled and non-skilled labour such as engineers, surveyors, labourers among others. Activities to be undertaken at this stage shall include grass cutting, cleaning drainage culverts, etc; as well as some clerical / low level supervision jobs. Such employment would contribute to poverty reduction, especially for women. The operation of the road shall create jobs by attracting other socio-economic infrastructure or businesses to the area.

### 5.7.2 Improved Transport and Economy of the People

The road will facilitate easy transportation within the project sub countys as well as increasing communication among the communities along the project road. The improved road would be particularly beneficial to passengers and cargoes as transportation time will be shortened.

Presently vehicle it takes up to two weeks if not months for any vehicle to ply through the project route and the situation gets worse during the rainy season. Traffic is

encountered at each end of the road at Lokichar and Nginy'ang due to their proximity to major towns like Kitale and Marigat respectively. But in between the few vehicles that use the route are trucks ferrying relief food and pickups owned by the NGO's working in the area which the locals use to hike lifts to move around the area. The locals currently pay very high fares to move around the area or they walk. Operation vehicles costs are very high such as high fuel consumption and frequent need to replace parts due to the condition of the road. It is anticipated with the improved status of the road transport costs shall be lowered.

### 5.7.3 Enhanced Socio-Cultural Interaction

The implementation of the project will bring several people from different cultural backgrounds together. Such interactions may bring about social changes in the communities along the road. Interaction with technocrats will stimulate adoption of the new technologies. Also, local people will acquire skills from the road workers during constructions and after implementation. The skills and acquired knowledge shall be implemented locally thus lead to the development of the project area.

### 5.7.4 Opening of more grazing sites

Enhancement of security which shall be a benefit accrued from the road will enable the locals access grazing sites that they currently cant access due to insecurity.

## 5.8 Negative Impacts during the Operational Phase

### 5.8.1 Increased Noise, Vibration, and Air Pollution at Operation Phase

Increased air pollution will be evident during the operation phase of the road due to fuels and other chemicals emissions from vehicular traffic and, maintenance works machinery and equipment. The emissions to be released include particulate matter, NOx , SOx , ODS and carbon monoxide and the notorious Green House Gas Carbon dioxide. The chemical emission is likely to be washed by rainfall to water sources and adjacent soils.

Noise is one of the most obvious negative impacts of daily road use. The discomfort caused by noise includes auditory fatigue and temporary lessening of hearing ability. For this project road, the noise and vibration impacts are to be felt most as the locals are not used to such scenarios and thus are classified as introduced to traffic induced

noise.

The effect on air quality due to the increased traffic flow is considered to be significant if no maintenance program is instituted. Under good maintenance schedule, traffic exhaust emissions, will be intermittent and atmospheric dispersal of exhaust emissions will not affect the air quality. However, concerted effort to check engine performance is needed so as to deter not road-worth vehicles from using the road.

The rough estimate of greenhouse gas emission from increased vehicular use can be estimated using the formula below:

$$C = A \times B \times 365 \text{ (tonnes of } CO_2 \text{ per year)}$$

Where:

*A is the Average emission from one vehicle per Km (tonnes of $CO_2$/Km) x Total distance of road; (*this may depend on the average age of vehicles in using the road.)

- B is the Envisaged increase in number of Vehicles using the road per day
- C is the Increase in GHG emission per year

The formula can be used to calculate several pollutants namely Hydrocarbon HC, Carbon monoxide CO, Nitrous oxide NOx, Sulphur dioxide $SO_2$, Carbon dioxide $CO_2$, Particulates Matter and Lead Pb which are normally emitted from vehicles due to the combustion of fuels. Traffic increase was not only considered as projections of vehicles traffic on the project road but also the traffic that shall be attracted from other roads. It is anticipated that the calculation might not reflect the future reality as vehicles produce less emissions if riding conditions are improved and also the use of fuels refiners and bio fuels might be in mass use thus cleaner fuels might be available. Currently lead containing fuels are not being sold in Kenya and most fuels sold in the region at the pump stations have lower sulphur content. As research and campaign on bio-fuels continues maybe in the next few years the emissions from vehicles will only be Carbon-dioxide and water.

The effects of the identified vehicles pollutants varies as discussed below

- HC through oxidation can release carbon dioxide
- Lead (Pb) has no documented impact on climate change but has impact on human and plant growth

- PM is known to cause respiratory ailments to human beings and affect plant growth
- $CO_2$ has a direct impact on climate change as its presence in the atmosphere increase global temperature as it is known to absorb heat
- $SO_2$ is known to cause acid rain which affects crops and roofs. It also combines with fog and dust to form smog a major killer and serious contributor to respiratory problems.
- Nox is also known to contribute to acid rain and also it can be converted into ground ozone which affects human health.
- CO is also known to have health effect and it can be oxidized to $CO_2$ thus exacerbate global warming.

The quantification of the impact of the various gases on global warming is measured using the Global Warming Potential (GWP) of the gas in question over different time periods or time horizons usually 20 years, 100 years and 500 years. This value is used to compare the abilities of different greenhouse gases to trap heat in the atmosphere. Since each of the greenhouse gases affects the atmosphere in different degree, and survives for a different length of time' GWPs are based on the heat-absorbing ability of each gas relative to that of carbon dioxide ($CO_2$), as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years). The GWP of most greenhouse gases decrease as the time horizon increases. This is because the greenhouse gas is gradually removed from the atmosphere through natural removal mechanisms, and its influence on the greenhouse effect declines. Some of the CFCs however, have long atmospheric lifetimes, and the 100-year GWP may be greater than their 20 year GWP. To make the effects of different gases comparable, the GWP expresses the factor by which the gas in question is more (or less) damaging than the same mass of $CO_2$ over a given period of time, according to the UNEP Guidelines the GWP of $CO_2$ is always 1 and is used as a benchmark to describe the amount of $CO_2$ that would cause the same amount of warming over a specified timespan as would be caused by one of the other GHGs. Gases which cause much more warming than $CO_2$ may in turn decay faster than it does, so they may pose a considerable problem for a few years but a smaller one later. Equally, others may decay slower and pose a greater problem over a long period of time. The GWP for

methane over 100 years is 25 and for nitrous oxide 298 (UNFCCC). This means that emissions of one metric tonne of methane or of nitrous oxide are equivalent to emissions of 25 and 298 metric tonnes of carbon dioxide respectively. Based on rough estimates of the current traffic provided in table 5.8.1 below. The impact of air emissions within the 20 year life span of the project will be insignificant as the projected traffic is rated at between 3-8% and considering the vast open lands the gerated pollutions will be duluted. Though the dymanics of the area are likely to change due to the development of the county and expansion of the minining sector which will require periodic monitoring of the vehicles traffic to enable quantify the volumes of emissions, their associated Global Warming Potential to guide in developing mitigation measures.

*Table 5.8.1 (a) Current trip purpose for Lokichar*

| Vehicle Type | Home | Work | Visiting | P.S.V | Freight |
|---|---|---|---|---|---|
| M/Cy | 2 | 1 | 0 | 2 | 0 |
| Car | 3 | 3 | 1 | 2 | 0 |
| Pick up/Jeeps | 4 | 71 | 4 | 0 | 2 |
| Minibus | 0 | 0 | 0 | 4 | 0 |
| Light truck | 0 | 0 | 0 | 0 | 8 |
| Medium truck | 0 | 2 | 0 | 0 | 22 |
| Heavy truck | 0 | 2 | 0 | 0 | 51 |
| Drawback | 0 | 0 | 0 | 0 | 1 |
| Bus | 0 | 0 | 0 | 0 | 0 |
| Total | 9 | 79 | 5 | 8 | 84 |

The calculated GWP shall guide in calculating the number of trees that need to be planted to mitigate against the generated heat absorbing gasses so as to maintain or improve the areas micro-climate. A tree can be planted for each metric tonne of carbon dioxide generated which translates to 1 GWP therefore as part of climate change impact mitigation the project will be required to grow at least 16,583 trees during its life cycle to act as carbon sinks.

### 5.8.2 Increased Road Accidents

Road deaths, injuries and damage to property are most tangible negative impacts on the community during the road operation phase and may be reduced or increased depending on several safety factors. The project roads transverse several settlement areas and business centres which are also known to be black spots of the road due to the number of accidents recorded at the sections.

Increased traffic and speed driving will result into unnecessary road accidents. The main causes for accidents are poor road conditions due to lack of maintenance, lack of road signs, reckless driving, defective vehicles, drunkenness, poor road facilities for the pedestrian and cyclists and unqualified drivers.

### 5.8.3 Settlements on the Road Reserves

Areas with efficient roads normally attract large numbers of people some of who decides to settle or conduct business on the road reserve. This is normally done with a conscious mind on the assumption that it is no one's land and/or that the road authority shall not develop the road in the near foreseeable future and also since most traders believe their clients are found near the roads thus they equally believe that their business have to be adjacent to the road . Such people normally expose themselves to several road hazards including accidents and pollution. Such settlements if not controlled can grow so rapidly that it affects any plan of further road development in terms of compensating those to be relocated and it consumes lots of the road development planning time. Such settlements in most cases are normally unplanned with no basic services such as water sewer and solid waste management, which lead to the use of the road, drains and neighboring area as dumping grounds which affects the performance of the road.

# 6. STAKEHOLDERS AND PUBLIC INVOLVEMENT

## 6.1 Legal Requirement

Section 17 of the Environmental (Impact Assessment and Audit) Regulations of 2003, requires that all E&SIA Studies incorporate Public Consultation (PC) as part of the assignment. The aim of the PC is to ensure that all stakeholders interested in a proposed project (including project beneficiaries and the general public in the vicinity of the proposed project) are identified and their opinion considered during project planning, design, construction, operation and decommission phase.

## 6.2 Objectives of Public Consultations

The main objective of the PC was to:

- Inform the local administration (Sub county Commissioners, Sub county Officers, Chiefs, Assistant Chiefs, Councillors and Village Elders) and the departmental heads in the project sub county about the proposed project and at the same time collect their views.
- Provide an opportunity for all the stakeholders and communities in the proposed project area to raise issues and concerns pertaining to the project. and
- Conduct socio-economic survey and collect primary baseline information on the project area.

## 6.3 Methodology and Data Collection

The field reconnaissance study and detailed surveys for project road was conducted in phases from October to December 2011 with the aim of:

- Collecting baseline data and evaluating the state of the environment.
- Studying the administrative structure of the two sub counties traversed by the road project in order to formulate a data collection methodology.
- Conduct introductory meetings at the Sub county levels in preparation for the public participation.
- Gather literature material from the Sub county offices on the Development Plans and Socio-economic profile of the project area.
- Assessment of the available social, cultural and economic infrastructure.

The initial field survey was followed with verbal communication with the Sub county

Commissioners in the project area. This approach was used due to need of hastening the process because of insecurity in the area and due to lack of business centres in the area. The aim of the discussion was to introduce the scope of the project at the same time request for permission to conduct public participation with the Sub county Environment Committee and the local populace. The sub county administrative heads granted the consultant's permission to conduct the study and a detailed site visit which incorporated public meetings was undertaken from December 2011 to January 2012.

The list of consulted key stakeholders included:

- The Sub county Commissioners Office in West Pokot Sub county
- Chief's Office Kositei Location
- Assistant Chief's Office Kositei sub-location Sub county
- Youth Office East Pokot Sub county Chief's Office Kapedo Turkana South
- Chief 's Napeitom Turkana Central
- Administration Police Chief Inspector's Office Turkana East
- Senior Chief Office Lokori Turkana East
- Mowlem/Lokubae Irrigation Scheme, Lokori

A list indicating the number of meetings held during the site visit including their dates, time and venue of meetings is given in the table 6.3 (a) while details showing the number of participants in each meeting are shown in table 6.3(b).

*Table 6.3 (a): A List Indicating the Schedule of Meetings held during the Site Visit*

| NO./S | DATE | TIME | SUB COUNTY | POINT OF MEETING |
|---|---|---|---|---|
| 1 | 27/10/2011 | 11 a.m | West Pokot | Cheptunoyo Bridge |
| 2 | 28/ 10/2011 | 4 p.m. | Turkana South | Kapedo Baraza Park |
| 3. | 30/10/2011 | 9.30 | Turkana East | Chief's |

The minutes of these meetings and the attendant list are presented in annex 1 of this report. The public participation revealed that the socio-economic impacts (positive and negative) of the road project on the communities living along it or the population dependent on it were similar throughout the road's stretch. All the communities living along the road were optimistic on the benefits of the proposed road improvement project though some negative issues were also raised. The general contributions made by the public on the proposed project are outlined in section below.

Table 6.3 (b): Summary of public consultations meetings

| Activity | No. Of PC | Venue | No. Of female participants | No. Of male participants | Total Number of participants |
|---|---|---|---|---|---|
| Public meeting | 3 | Cheptunoyo Bridge | | | 68 |
| | | Lokori's Chief's Office | | | 106 |
| | | Kapedo Baraza Park | | | 81 |
| Individual meetings | 11 | DC's office, Chief's Offices and Departmental Heads Offices | | 11 | 11 |

### 6.4. Consultants comments to the collected data

Based on the public consultation views and response provided by the consultant it was noted that generally the residents of the project area would like the road to be developed while maintaining negative project impacts at minimum levels.

### 6.5 Overall Anticipated Impacts

The major positive impact perceived by the community members was enhancement of transport thus attraction of business activities in the respective sub counties. Other positive impacts included increased accessibility to the social and economic facilities such as markets, schools, hospitals among others.

The major positive impact mentioned by the community members was the benefits they shall achieve due to enhancement of transport sector which included:

- Increase in irrigation farming in Lokori due to direct links to the markets
- Diversification of economic activities which will reduce over independence in livestock keeping, pastrolism and help develop the trading industry
- Improve security due to good road that shall allow frequent patrols and development of police posts
- Improve the status of the trading centres as they are on a busy corridor but due to the poor road they do not flourish.
- Development of the mining and tourism sector. It is anticipated that the oil exploration going on in Turkana North will yield good quantities for economic exploration thus the road will play a big role during development and management of the oil rigs. The road traverses a Savannah Grassland inhabited by the Big Five animals around chainage 43
- Reduction in travel time and, transportation costs and introduction of comfortable/various modes of public transport vehicles
- Attraction of other socio-economic infrastructure in the area such as schools, hospitals, financial institutions among others and will also facilitate the activities of the Non-Governmental Organisations
- Improve accessibility to the area with workers and extension officers from various fields such as education, agriculture, fisheries, youth enterprise development among others.

- Road will enhance reconciliation between the Pokot and Turkana communities as they shall trade together and work together during road construction

The negative impacts raised were substantial but could be mitigated if an appropriate management, monitoring and implementation plan is drawn. The consideration raised by the community members to help reduce negative impacts included:

- Provision of employment to the locals
- Development of construction camps in areas easily accessible by the locals or provision of transport to work
- Giving the community abandoned materials sites and burrow pits to be used as water storage structures
- Observation or respecting of local cultural norms.

Minutes of the public participation and findings of each of the areas consulted is found under annex 1 of this report.

### 6.6 Deduction on information gathered during public participation

The public participation was comprehensively conducted with a wide section of the community members being consulted including the administration, business community, farmers and the general public. According to the comments raised by the community members, the need of rehabilitating the road and, improvement of its associated support infrastructure is apparent. The road in its current state hinders the optimal exploitation of potentials areas in terms of business and agricultural productivity and poses a great hazard to the community members due to lack of drainage facilities, safety facilities among others.

The community members would like to have a safe road thus designed road safety features should be developed simultaneously with the road especially at the junctions, black spots, steep areas, near institutions such as schools.

All resources to be sourced or shared with community such as water should be done or shared in a humanly manner or under the guidance of appropriate regulations. It is advised consultations among the proponent/contractor, community administration and community members should be conducted if any major works that might lead to adverse impacts. Livelihood restoration programmes of those affected should be undertaken as required to ensure harmonious co- existence.

# 7. ANALYSIS OF ALTERNATIVES

## 7.1 Overview

The aim of the EIA process is to come up with the most sustainable project considerations, which shall ensure optimal benefits, are obtained from the project. Therefore it was important to evaluate the proposed road based on its anticipated impacts thereafter come up with alternatives which include a consideration of without the project alternative.

A range of systematic methods were used for comparing and evaluating various alternatives. These include simple checklists, overlay maps, complex matrices, mathematical models descriptions of the main impacts and the reasons for their rejection. The consultations with stakeholders and project site visits provided basis for identifying project alternatives. The alternatives considered for the project are elaborately discussed in the sections below.

## 7.2 No Project Alternative

This section analyses the project alternatives in terms of site, technology scale and waste management options. This option is the most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing environmental conditions. This option will however, involve several losses both to the local community and the nation as a whole. The community will continue to face the constraints they are currently experiencing due to inefficient transport network and system and the anticipated economic development aimed at fulfilling the Vision 2030 will remain unattainable. The No Project Option is the least preferred from the socio-economic and partly environmental perspective due to the following factors:

- The economic status of the Kenyans, the local people and the neighboring country would remain unchanged;
- The local skills would remain underutilized as no employment opportunities will be created for thousands of Kenyans who would have otherwise worked at the project area;
- Enhanced economic retardation in the area leading increased strain in socio-

economic infrastructure and thus deter penetration of businesses, health facility etc which shall affect the locals health and economic status;

- Reduced interaction both at local, national and international levels due to lack of transport and communication facilities;
- Increased poverty levels and literacy and subsequent increase in crime and environmental destruction;
- Under utilization of the LAPSSET project connecting Kenya to Southern Sudan and Ethiopia
- Increased food in security and effects of malnutrition
- Continued insecurity in the area due to inability of security personnel and services penetration among other impacts

From the analysis above, it becomes apparent that the No Project alternative is no alternative to the local people, Kenyans, the government of Kenya and Eastern African region as a whole.

## 7.3 Analysis of Alternative Routes

According to the field survey and stakeholders consultations it was noted that alternative consideration needs to be evaluated at some sections of the project roads. The key areas that needed alternative consideration were:

- The section occupied by the Napeitom village.
- The section neighboring the Ekang'wata Chiror cultural site as it is only 10m from the current alignment
- Sections laying on swampy sections

## 7.4 Cost - Benefit Evaluation of each of the road alternative

The project economic analysis shall be evaluated based on its NPV and IRR at the detailed design stage. ..

## 7.6 Analysis of Alternative Construction Materials and Technology

The road will be constructed using modern, locally and internationally accepted materials to achieve public health, safety, security and environmental aesthetic requirements. Equipment and systems that save resources such as use of alternative energy sources such as use of solar systems and wind power; water conservation

systems among others should be used in the project so as to reduce environmental impacts. Use of wood for melting bitumen should be done and alternatives such as bitumen melting furnaces incorporated with environmental management systems such as filters to capture emissions, desulphurization units to neutralize sulphur and silencers to abate machine generated noise. The machines should also have heat recovery and conservation mechanisms to ensure sustainable use of the available energy source.

Rainwater should be harvested and be used in construction activities and supply to labour camps for flushing toilets and other non-domestic activities. Community members should also be encouraged to harvest rain water not only as a means to supplement the water supplied but also to help reduce pressure on the drainage structures. Heavy use of timber and wood during construction should be discouraged to minimize destruction of natural resources. The exotic tree species should be preferred to indigenous species in the construction of the project components where need will arise as they can be replanted with ease.

Asphalt mixers, crushers and other construction equipments and machineries should be incorporated with pollution control devices like dust arrestors/precipitators, emission control, noise abatement devices and desulfurization devices. The equipments and vehicles should have highest levels of combustion efficiency, capability to use cleaner fuels like biofuels and should have enhanced safety features.

There are several options from an engineering point of view for developing road pavements and the most suitable pavement is both environmental and economic viable. . Use of concrete (AC) was seen to be the most viable option both environmentally and economically as it is durable and requires less maintenance. Use of AC is advised especially in steep areas as it can with stand oil spillage though from the economic analysis it is normally not viable due to costs. Heavy duty trucks are known to move slowly on steep sections of the road where oil spillage is known to occur thus the need to protect the road in these sections from deterioration.

## 7.7 Solid Waste Management Alternatives

Substantial amount of solid wastes will be generated due to the proposed Project. An

integrated solid waste management system is recommended. First, the proponent should give priority to reducing waste at source. This option will demand a solid waste management awareness program for the management, workers and the residents. Secondly, recycling, reuse and composting of the waste will be the second alternative in priority. This will call for a source separation program to be put in place. The recyclable waste should be sold to waste buyers within the project area or be collected by a private waste management company. The third priority in the hierarchy of options is combustion of the waste that is not recyclable though environmental regulations prohibit open burning of waste thus such wastes should be contracted to incineration service providers. Finally, sanitary land filling will be the last option for the proponent in areas provided with the facilities. Burying of hydrocarbons should be avoided at all costs and such waste should be recycled, reused or incinerated.

## 7.8 Minimization of Resettlement and impact on historical sites

The road reserve of the road is known and despite the fact that the carriage alignment will not change much there will be need to free the road reserve from encroachers so as to reduce congestion on the roads, create room for roadside construction activities and, save the proponent time and, money for relocation and compensation during future works. The consultant has identified that encroachments had occurred at Lokichar, Lokori, Napeitom and Kapedo trading centres. The road is encroached with shops, charcoal traders and the Napeitom village. At the detailed design state the consultant shall identify the project affected people and develop a livelihood restoration programme to ensure their income lines are not affected due to the project.

The road was also seen to be a few meters from a cultural site near Napeitom it is important that the road is realigned at this section to avoid intruding with cultural activities undertaken by the community members at the site.

A potential quarry site near Lokori centre shall not be suitable for exploitation despite the site being near the road thus will make economic sense to the contractor. As the site is located near homesteads and the law requires one to observe a minimum distance off 2km and vibration exposure of 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source. These limits will be hard to obtain when the site is exploited and even if the settlements shall be relocated as the site is next to a road.

# 8. IMPACT MITIGATION MEASURES

## 8.1 General Considerations

This section is devoted to describing measures or actions that shall be implemented so as to minimize any of the potential impacts identified earlier. Many of the mitigation measures put forward are nothing more than good engineering practice that should be adhered to during the design, construction and operation and maintenance period.

## 8.2 Mitigation Measures for Pre-construction phase

### 8.2.1 Land Expropriation, Loss of Property and Resettlement

The study team has identified areas likely to be affected by the project and made an estimation of the number of people and properties to be affected. Minimal land acquisition will be required for this project at Lokichar Shopping Centre. A land acquisition plan will guide the compensation of affected structures. Based on preliminary studies the reserve is encroached by about 20 shops and a village at Napeitom who have erected permanent and temporary structures for their businesses. The contractor may also require land during for the materials camp and other uses thus all land acquired for materials or temporary activities should be compensated for and reinstated.

In practice most expropriation disputes in similar projects are due to disagreements on the compensation value of the affected estate and its improvements. The compulsory resettlement of business premises must ensure that compensation considerations are given to both the owners of the structures and occupants/tenants of the structures. In summary the compensation should cover the following:

- The replacement value of the un-exhausted improvements.
- Transport allowance
- Disturbance and loss of income
- Cost of acquiring or getting replacement land/permanent crops or properties/planted vegetations/farmlands

- Any other capital expenditure or immediate cost incurred to redevelop the same activities in the new location.

If the structure to be destroyed is rented, the authorities should make sure that the rights of the person who uses the building are compensated. The total values of properties to be affected will be determined after the comprehensive valuation study.

### 8.2.2 Green Development and Climate Change Abatement

As part of mitigating against factors contributing to climate change the project should involve incorporation of "green/clean development mechanism" in its components this shall include use of locally available resources such as solar and wind to generate electricity, development of water recycling systems in the camps and construction yards, use energy saving bulbs, provide enclosures with adequate natural light, re-plant harvested trees with indigenous species among others. The camps should not be developed near natural resources such as wetlands especially when taking into consideration the area has no sewerage infrastructure. .

To mitigate against climate change in addition to green development, the contractor should possess project equipments and machinery that are designed to abate pollution and its impact on climate change and this should be included as one of the selection criteria of contractors assets. The key environmental management systems that should be considered when evaluating the contractor's equipments and machinery are;

- Age of vehicles, equipment's and machinery;
- Components and type of fluids used in the gadgets cooling systems;
- Combustion efficiency of the engines;
- Emission and noise abatements gadgets in the plants such as existence of water precipitator in the mixers and their efficiency, enclosed conveyor systems, enclosed transportation systems, installed silencers among other pollution abatement technologies
- Ability of machines to use or adjust to use clean flues such as bio-fuels, low sulphur fuels , unleaded fuels among others
- The above information should be supported with manufactures manuals devices,

log books, inspections reports/certificates, calibration reports/certificates. Recommendation from previous clients among others.

Such mitigation measures shall play a great role in reduction of GHG as discussed under section 5.6.1 and 5.8.1 of this report.

### 8.2.3 Protection against insecurity in the area

There is need to provide the project team adequate security as the area is prone to attacks from the two feuding communities and cattle rustling. To mitigate against rivalry among the locals employment consideration should be distributed equally to all the communities. This shall promote peaceful co-existence and reduce incidences of cattle rustling and other causes of feuds.

## 8.3 Mitigation Measures for Construction Phase Impacts

### 8.3.1 Increased water and soil pollution

- Spillage of fuels and chemicals is a risk, but spillages are likely to be local and remediation should include bunding of their storage areas, use of automated dispenser machines for fuels instead of pumps and pipes, avoid washing project vehicles and equipments in water bodies, develop garage for repair of project vehicles and collect waste oil/lubricants and their packages in containers for reuse or proper disposal, provide sealed washing basins and collect wastewater in sedimentation/retention pond with oil/water separators and maintain vehicles in proper conditions to avoid spillage .
- Spillage to watercourse is harmful to all living beings. In case of accidental spillage, the contractor shall exercise every effort in order to minimize the associated risks. For instance refueling of plant or transfer of materials should not be carried out near watercourses, and any local spillage to the soil should immediately be remedied.
- Good housekeeping should be practiced within material storage compounds or vehicle maintenance yards where the possibility of spillage is great.
- Undertake continued maintenance of piping system to ensure their integrity and avoid accidental spillage.
- The proponent will ensure that the construction work is confined within the RoW

and water bodies are protected from pollution during construction especially when taken into consideration most of the rivers feed into Lake Turkana;

- Regular water quality monitoring should be undertaken according to determined sampling schedule provided in the monitoring plan;
- The contractor should ensure that construction debris do not find their way into the rivers and drainage channels which may get clogged and lead to several other impacts such as flooding, poisoning of aquatic flora and fauna;
- Avoid undertaking construction works in the water bodies during the rainy seasons as most materials and waste shall be washed into the river and seasonal river beds awaiting transportation during the rainy season.
- To maintain the surface water flow/drainage, proper mitigation measures should be taken along the road, like provision of appropriate drainage structures especially near settled areas;
- All wastes generated by the project should be collected, stored recycled/resold and/or taken to approved disposal sites. Treated waste water discharged into the environment should meet recommended standards and sanitation facilities should be provided to workers both at the labour camp and at working sites including road sides, quarry sites among others.

### 8.3.2 Soil Erosion and Instability of Slopes

- Ground clearance should be restricted to areas earmarked for the development and re-alignments of project to sensitive areas should be avoided.
- Lined drainage channels at sensitive terrains should be provided to control speed and volumes of storm-water. The discharge points must be carefully chosen to avoid erosion of arable land and creation of gullies. Bio-engineering geotextile shall be laid underneath the stone protection (rip rap) on very erodible side slopes before top soiling and grassing as shown below. The geotextile provide a long-term confinement of the cut slope or fill materials. Being constructed of soft and pliable needle-punched polyester, a quality geotextile will remain stable and functional for many years, in spite of potential exposure to the sun's ultraviolet rays and/or concentrated hydrocarbons, such as gasoline, diesel fuel, oil, or

hydraulic fluid.

- Rehabilitate burrow pits and quarries immediately after finishing with them.
- Remove excavated materials and soils from site to avoid impacts of wind and water which will blow/wash them away thus impacting on the human health, vegetation, water bodies and even the road works
- The denuded ground cover should be re-vegetated as soon as possible following fill placement to facilitate regeneration of a stabilizing ground cover;
- The road embankments and road cuttings should be vegetated with a fast growing crop of indigenous nature immediately after fill placement to prevent scour and to encourage stabilization. Use of stone pitching or riprap shall be made at appropriate places especially around overpasses, bridges, culverts;
- Discharge zones from drainage structures shall be furnished with rip-rap to reduce erosion;
- Down drains/chutes shall be lined with rip-rap/masonry or concrete to prevent erosion;
- Side slopes shall be adjusted to a gradient necessary to reduce erosion potential or, if steeper, stabilized, covered with riprap or other material to prevent soil erosion;
- Construction shall be restricted to dry season to avoid soil erosion;
- Soil erosion checking measures such as the formation of sediment basins etc, shall be taken;
- Soil contamination caused by bitumen, fuel and chemical storages facilities should be minimized by siting them on an impervious base within an embanked area and secured by fencing. The base and walls of the embankment shall be impermeable and of sufficient capacity to contain 110 per cent of the total volume of stored fuels and chemicals;
- The disposal of waste asphalt shall be made in approved locations such as borrow pits or natural depressions and shall not be within the RoW. Unless located in areas with impervious soils, encapsulation with pre-laid impervious liners including walls and capping is required with the objective to prevent water percolating through the waste materials and

leaching toxic chemicals into the surrounding soils. On completion of disposal at the site, the area shall be capped with a compacted thickness of at least 0.5 meters of impermeable soil covered with at least 200 mm of top soil and shall be finally landscaped with indigenous plant species.

### 8.3.3 Noise, Vibration and Air Pollution

- The nuisance of noise, vibration and dust will be transient and good work practice can minimize them.
- The impacts of noise and dust emissions will further be minimized by proper choice of plant and machinery (i.e. fitted with noise silences and dust arrestors) and locating quarry areas away from human settlements (at least 2km away) and 30m from moving objects.
- Dust at work places within or close to human habitation should be critically minimized by periodic water sprinkling on working sections. The contractor shall advise or notify local households on dust, noise, vibration and other dangers.
- Watering should be practiced regularly at all active work sections along the road and at all quarries and borrow sites for the protection of workers. In addition, sections of road heavily traversed by construction vehicles should also be regularly watered.
- Avoid undertaking noisy activities in the night near settlements, hospitality area and animal habitats

To ensure noise levels from the road are minimized during the construction and operation phases;

- The design of the facilities shall take into account measures to reduce noise and air pollution. For example; steep grades at critical locations shall be avoided so as to reduce noise from acceleration, braking and gear changes.
- Design components on noise reductions should be incorporate in bridges and Road such as noise absorbers
- Observe the noise regimes as prescribed under the Environmental Management Coordination (Noise and Excessive Vibration Pollution Control) Regulations,

2009.

To control ground and airborne vibration within acceptable limits, blast activities should be design and planned by taking into consideration number of blast holes, weight of explosive, amount of stemming and delay timing. The blasting plan should be communicated by keeping neighbors informed of the nature of the work and progress by use of warning signs within project foot print and warning alarms not only as a mitigation measure but a measure to collect views for monitoring too. Ground and airborne vibration should be controlled and their impacts monitored during construction activities especially during blasting and while working in sensitive areas. Ground vibration is recorded in terms of peak particle velocity in millimeters per second in 3 mutually perpendicular directions (T, V & L) while airborne vibration should be measured in terms of decibels (dB).

Monitoring should takes place at the closest vibration sensitive building/structures to the current operations and findings measured against known standards. The Vibration Standards states that there should typically be no damage to structures if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above. These guidelines relate to relatively modern buildings and are normally be reduced to 50% or less for more critical buildings such as historic buildings that may be in poor repair, including residential properties. The Kenyan law requires vibration not to exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source and that mines and quarries using explosives and machinery is located in designated areas and not less than two kilometres away from human settlements.

### 8.3.4 Archaeological and Cultural sites

The project shall avoid interfering with sites of cultural significance by re-aligning the road at such as sites and avoid undertaking activities likely to affect accessibility and existence of the sites.

### 8.3.5 Increased Road Accidents

Traffic management plan incorporated in the designs should be implemented by the contractor and this should include detailed use of signs, markings, intersection layouts,

access restrictions, bus stops, crossings, footpaths etc. The traffic management plans shall be presented both in English and Swahili/Local Languages.

As part of the plan, the contractor should ensure that the traffic flow is not interfered with during the whole construction period. No total closure of the road should be allowed. The contractor should provide diversions and deploy a person responsible for traffic safety.

### 8.3.6 Increased Spread of HIV/AIDS

- Since construction camps will attract job seekers and traders from various areas, the contractor is required to enforce code of conduct at the camp to encourage respect for the local community and, to maintain cleanliness and order at the camp at all the time. It is important that the camp is located far from the villages, trading centres and markets so as to reduce chances of engaging in vices such as alcoholism, drugs use which are known to play a role in accentuation of HIV/AIDS infections.
- The contractor should deploy locally available labour to reduce risk of spreading communicable diseases (especially STD) and other social vices such as alcoholism which accentuate the spread of the virus.
- Environment, health and safety induction course should be conducted to all workers, putting more emphasis on HIV/AIDS, which has become a national disaster.
- In order to create awareness on prevention of HIV/AIDS infection, information education and communication component (IEC) should be undertaken during the implementation phase in collaboration with line sectoral departments as required by the Kenya National HIV/AIDS Strategic Plan 2009/10-2012/13. This shall include involving the local NGOs and government agencies already active in the project area in awareness creation and educating the local communities on HIV/AIDS and STIs prevention.

### 8.3.7 Safety and Health Risks

- Appropriate working gear (such as nose masks, ear pads and clothing) and good camp management should be provided. During construction the contractors should ensure that the campsites are fenced and hygienically kept

with adequate provision of sanitary facilities such as waste disposal receptacles, sewage handling structures, firefighting equipments and, clean and safe water supply. The contractor may be required to drill a borehole for obtaining water for construction as the project area has limited fresh water resources.

- A well-stocked first aid kit (administered by medical personnel) shall be maintained at each camp. The medical personnel shall also be responsible for primary treatment of ailments and other minor medical cases as well as providing some health education to the workforce.
- Observe hygiene and sanitation standards at the labour camps and construction site by proving adequate clean water for drinking and domestic use, provide sanitation facilities even at the road side to avoid workers from using open spaces
- Avoid creating breeding sites for disease vectors by draining and restoring quarry sites and burrow pits;
- Work with the wildlife warden at KWS when undertaking activities near animal habitats so that they can provide guidelines on co-existence with animals and advice on their timelines or movements as monkeys the Grassland Savannah found around km 43 is home to lions and other big five animals;
- Regulations on work environment should be adhered to as required by the Acts discussed under section 2 of this report.
- A safety plan for the project has been documents and a copy is provided under annex 12 of this report.

### 8.3.8 Increased Water Abstraction

- The contractor is required by law to apply for water abstraction permit from the Water Resource Management Authority (WRMA) before abstraction water from any natural water sources.
- The amount of water given to the contractor should consider the needs of the local Communities around the project road and other downstream users. During the dry seasons consultations on water abstraction should be held with the community members to ensure they are not affected with the project activities

and the contractor should ensure environmental flows recommended by the water office are allocated to the water bodies and downstream users.

- Watering should be done at places with significant dust levels and near the settlement in order to minimize water wastage.

### 8.3.9 Loss of Definite Materials and Land Degradation

- Where construction materials such as gravel and stones are to be obtained from individual lands, the material shall be purchased and this should be officially negotiated with the owners in order to avoid conflicts. The contractor may be compelled to pay a fee to the land owners.
- Borrow pits and quarry sites should be rehabilitated immediately the sites resource has been extracted and pits shall not be left with steep or vertical sides. The pits should be reinstated using stock piled excavated top soils.
- Shallow slopes will encourage rapid re-vegetation thus preventing erosion as well as providing safety to animals.
- Obtaining sand from riversides must be well investigated to avoid accelerated land degradation and pollution of water sources and/or interfere with agricultural activities in farmlands especially the Morlem Irrigation Scheme in Lokori.

### 8.3.11 Vegetation clearance

- Project sites, camps and vehicles movement should be concentrated in sites with minimal stand of vegetation;
- Rehabilitate, landscape/levelling, and tree planting and re-vegetation once the construction or excavation activities are complete. Some critical sites may need fencing to promote faster regeneration of lost cover and avoid erosion.
- Avoid clearing vegetation along riverine, luggas and wetlands
- Preserve indigenous plants as much as possible and those uprooted should be replaced with appropriate tree species adapted to the area and those that protect soil and conserve water near watering points.

- Develop appropriate methods of handling uprooted plants to avoid spreading of invasive species. Undertake species specific control measures e.g. manual control by uprooting and burning before flowering. Depending on seriousness of invasion, Integrated control measures are recommended (physical, chemical and cultural practices)
- Planting and tending of vegetation especially those with medicinal value this can be done in collaboration with the Kenya Forest Service and the local community
- Avian nestling sites found along the road should be relocated before trees are cleared for the road construction;

### 8.3.11 Provision of security

Due to the high insecurity levels in the project area security services should be provided round the clock to the workers. There is need to provide the project team adequate security as the area is prone to attacks from the two feuding communities and cattle rustling. To mitigate against rivalry among the locals employment consideration should be distributed equally to all the communities. This shall promote peaceful co-existence and reduce incidences of cattle rustling and other causes of feuds.

### 8.3.12 Climate Change Mitigation

To ensure that factors leading to climate change are kept at minimum the pre-construction evaluation factors discussed under section 8.2.2 should be adhered to and monitored on a period basis.

The contractor should incorporate green technology in the project's daily operation and this shall include fleet management which incorporates time based traffic planning, use of clean fuels, periodic maintenance of vehicles, machines and equipments.

The Government of Kenya has taken several measures in addressing issues of climate change such as development of policy that take into consideration sustainable development and by ratifying several multilateral environmental agreements (MEAs) and protocols that address various aspects of the environment as discussed under chapter 2 of this report. Kenya is the process of incorporating the MEA's within existing national policies, strategies, and development goals. So

far climate change has not been adequately mainstreamed or integrated in sector specific plans and strategies. But efforts have been initiated in some areas such as in the energy sector in regards to use of solar, bio-fuels, gas to replace wood among others there are still remaining implementation gaps of the identified strategies/processes.

Based on the GWP of the project to be determined by the level of traffic based emissions, the proponent will be required to grow trees equivalent to the generated emissions during the entire projects life cycle to act as carbon sinks. This can be done in collaboration with the Kenya Forest Service who in collaboration with local communities undertakes forest management, afforestation and reforestation programmes to ensure the mitigation measures are effective. Such activities are currently on-going in the project area.

#### 8.3.13 Monitoring Compliance and Enforcement of Contractor's Guidelines

To ensure that environmental and social mitigation measures are implemented during project development. It is important that project output and, certificates of payment and actual payment are tied to implementation of the EMP. This can be effectively achieved by including the environmental mitigation and monitoring plans to the contractor's guidelines and contract.

## 8.4 Mitigation Measures for Operational Phase Impacts

### 8.4.1 Increased Road Accidents

It is anticipated that the levels of accidents on the project road shall increase once its operation commences. Measures to curb road accidents should include

- Installation of proper road signs and regular inspections for their presence.
- Installation of speed control devices like humps.
- Increased road safety awareness programmes which should include refresher courses or public campaigns aimed at drivers and pedestrians.
- Provision of pedestrian lanes/paths, bridges, zebra crossing at areas of high human presence such as markets, trading centre, settlement, schools among other gathering areas.

- Capacity building and monitoring of traffic law enforcers
- Provide clearly displayed name boards for each village at entrance and exits.

### 8.4.2 Increased Noise, Vibration, and Air Pollution during the Operation Phase

Exposure of the public to noise and air pollution during operation can be controlled by

- The road Authority participating in the planning activities of the area and guide the planners on need of having settlements and towns built at appropriate distance from the road reserves.
- Road signs such as speed limit signs should be installed, and also exhaust emissions controls should be enforced.
- Machines and equipments to be used during operation should be those that release the lowest possible noise and emissions at recommended levels.
- Avoid undertaking noisy and vibration generating activities in the night near settlements and animal habitats

### 8.4.3 Safety of Road users during the Operation Phase

- The road design should take account of safety concerns especially at human habitation crossings e.g. installation of bus stops along the road stretch at settlement centres.
- Awareness seminars shall be conducted during the construction and operation phases of the roads Safety of road users should include awareness creation for community members and school children.
- The traffic management plans shall be presented both in English and Swahili/Local dialects.

## 8.5 Contractors Guidelines to Implementation of Impact Mitigation Measures

Contractor shall be responsible for the following measures to protect the environment in addition to the above outlined mitigation measures:

- Compliance with national and local statutes and regulations relating to protection of the environment. The Contractor will be responsible for

familiarizing himself with all existing national and local legislation in this regard.

- All construction activities shall be carried out using the best possible means to reduce environmental pollution such as noise, dust and smoke. All vehicles and plant procured for the project should be installed with environmental management systems aimed at abating pollution. The machines and equipments should be regularly serviced in accordance with the manufacturer's recommendations to ensure that they operate efficiently and without excessive noxious emissions. The Resident Engineer will have the authority to instruct the Contractor to temporarily cease operations and/or remove from the site vehicles or plant which do not comply with this requirement, until such time that he is satisfied that best practices to reduce environmental pollution to a minimum are being used.
- The Contractor shall at all times maintain all sites under his control in a clean and tidy condition and shall provide appropriate and adequate facilities for the temporary storage of all waste prior to disposal.
- The Contractor shall be responsible for the safe transportation and disposal of all waste generated as a result of his activities in such a manner as will not give rise to environmental pollution in any form, or hazard to human or animal health. In the event of any third party being employed to dispose of waste, the Contractor shall be considered to have discharged his responsibilities under this clause from the time at which waste leaves sites under his control, providing that he has satisfied himself that the proposed transportation and disposal companies is registered with the relevant Authorities and are in possession of all the required legal documents including the waste tracking documents which should be duly signed by both parties.
- The Contractor shall be responsible for the provision of adequate sanitary facilities for his workforce, and that of his sub-contractors, at all construction and ancillary sites. The Contractor shall not allow the discharge of any untreated sanitary waste to soil, groundwater or any surface watercourse.

- Prior to the mobilization of the workforce the Contractor shall provide details of proposed sanitary arrangements to the Engineer for approval, such as will allow him to assess whether or not the proposed facilities are adequate and are unlikely to pollute water resources, and also that the facilities will be properly operated and maintained.
- All concrete and asphalt plants shall be operated and maintained in accordance with the original manufacturer's specifications and manuals, and in such a manner as to minimize emissions of hydrocarbons and particulates. If, in the opinion of the Resident Engineer (RE), the operation of such plant is causing, or is likely to cause nuisance or health problems to site staff or the general public, the Contractor shall carry out such work as is necessary to reduce emissions to an acceptable level within a time-scale agreed with the Engineer.
- The Contractor shall regularly dowse water to all exposed dirt surfaces to reduce dust levels.
- The Contractor shall take all reasonable measures, at all sites under his control, to prevent spillage and leakage of materials likely to cause pollution of water resources. Such measures shall include, but not be limited to the provision of bunds around fuel, oil and bitumen storage facilities, and provision of oil and grease traps for servicing and fuelling areas. Prior to construction of such facilities, the Contractor shall submit details of pollution prevention measures to the RE for his approval.
- The Contractor shall be responsible for ensuring that exposed surfaces are re-vegetated as construction progresses, all to the satisfaction of the Engineer.
- The removal of trees shall be kept to the minimum necessary to accommodate the Permanent Works and where removal is required, trees should be replaced using indigenous plant species that can easily adapt to the area.
- Prior to the removal of any trees the Contractor shall inform the RE of the intended operation and obtain the permission of the RE for the removal of the trees. If any tree is removed without permission the Contractor shall replace it with an approved tree at no additional cost to the Employer
- The Contractor shall ensure that fires, except for controlled fires for burning rubbish, do not start within the Site or in the environs thereto as a result of the

works or from the actions of his employees. The burning of waste, such as vehicle tyres causing noxious emissions is prohibited. The Contractor shall have available at all times trained fire- fighting personnel provided with adequate fire-fighting equipment to deal with all fires. The Contractor shall additionally at all times provide sufficient fire protection and fighting equipment local to parts of the Works which constitute particular fire hazards

- The contractor in conjunction with line ministries and, organizations such as Ministry of Health, NGOs and Community Based Organization (CBO) be involved in creating awareness on HIV/AIDS and other STDs in order to play a role in the control of the spread of the infectious diseases.
- The contractor is required to be conversant with chance find procedures in case the road works excavations unearth materials that are considered to be of historic in nature. Chance find procedures requires that once excavated materials are considered to be of historic importance the site is sealed off , left undisturbed until a qualified archaeologist verifies if the material is of historical importance or not. If material is found to be of historic importance an emergency evacuation is done to collect the material for further investigation or safe keep by the Museums.
- The contractor shall ensure that the safety of the workers and the community in the project area is safeguarded as required by the Occupation Health and Safety Act and the development partner's guidelines on Environment, Health and Safety. This shall include ensuring that the design components and operation procedures minimize exposure of workers and, the general public to risks and, hazards and, ensuring all environmental and social safeguards on air quality, water quality, energy conservation, water conservation, hazardous material management, waste management, and noise and land contamination are maintained within the recommended standards.

- As part of the foregoing, the contractor should ensure that all asphalt batching plants set up follows the environmental standards for air and water pollution control and disposal of construction waste. Occupational health and safety guidelines should be adhered to, with appropriate safety gear provided to all

workers. It is advised that the Contractors follows the recommended environmental and safety measures and maintain proper working conditions at construction camps, as per the EMP, to avoid penalties as stipulated in the countries environmental laws, and such others penalties as that shall be defined by the contract.

- This contractor's guideline in addition to the EMMP shall form part of the contractor's working contract and payments certificates and actual payments shall be also pegged on the implementation of the environmental mitigation measures.

# 9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

## 9.1 Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) presents the implementation schedule of the proposed mitigation measures for the project's identified impacts. The ESMP also includes the associated costs needed to implement the recommended mitigation measures. The implementation will involve the contractor, the Resident Engineer, Environmentalist, Sociologist, Health and Safety Expert, Local Councils, infrastructure users and the local communities at large.

## 9.2 Institution Arrangements

Mitigation measures proposed for the project on environmental, social and engineering aspects should be attached to the project contract documents. The contractor should take stock of the contents of the Environmental and Social Impact Assessment Report and implement the mitigation measures as much as possible and improve them based on their practical implementation.

An environmental expert should be appointed to assist the Resident Engineer, in order to make sure that the measures recommended in this report are effectively complied with and timely adjusted whenever necessary. The expert should be familiar with the scientific measurement of environmental and socio-economic impacts and remedies. He/she will liaise with the relevant public agencies and carry out the training scheme associated to his assignment.

## 9.3 Financing Agency

The GOK is the financing agency for this project and funds shall be disbursed through the KENHA who shall implement the project.

## 9.4 Implementing Agency

The Project Proponent (owner) of this project is the GOK who is represented by KENHA who holds final responsibility for the environmental performance of the project. Thus, KENHA shall be considered to be the Implementing agency for this

project on behalf of GOK.

## 9.5 Supervision Consultant

The Supervision Consultant is appointed by the implementing agency and is responsible for monitoring and supervision of the construction works including implementation of EMP. The Consultant shall appoint Engineers Representative (ER) to oversee the construction works and monitor the works undertaken by the Contractor and implementation of EMP to ensure compliance with contract specification and contractual requirements.

However, for supervision and monitoring the implementation of EMP throughout the construction phase the implementing agency should engage an Independent Environmental Consultant (IEC), who can be persons or a firm of expert consisting of an environmental expert, sociologist and health and safety expert. The IEC shall be responsible for checking, verifying and validating the overall environmental performance of the project through regular audits, inspection and review of project submissions.

## 9.6 Contractor

The Contractor shall be responsible for implementation of construction works and ensure compliance with environmental requirements. The Contractor shall establish and Environmental Engineers Team (EET). The EET shall be responsible for implementation of and management of the EMP programme and the required environmental monitoring works.

## 9.7 Local Government Authorities and Local NGOs / CBOs

The involvement of local authorities is crucial for successful implementation of EMP because some of the mitigation measures are better undertaken by local communities with the support of the local government authorities and NGOs. It is therefore important that the various Sub county Committees such as the Sub county Environment Committee (DEC) which consists of the Sub county Public Health, Sub county Environment Officer, Physical Planner among other are involved in the implementation of EMP.

## 9.8 Local Communities

In general, the local communities do support the project because they know it is going to benefit them. However, the project can obtain maximum benefit if it involves the local communities such as by providing employment and undertaking Corporate Social Responsibility Programmes that benefit them.

The Implementing agency through the Regional Manger's Office should prepare and distribute a project briefs summarizing the project and advice whom should be contacted before and during construction.

## 9.9 Training Requirements

The effective implementation of EMP requires that all persons working for the project be aware of the importance of environmental requirements of the project; their roles and responsibilities in the implementation of the EMP. They should also be aware of the significant actual or potential environmental impacts of their work activities; the benefits of improved performance and the consequence of not complying with environmental requirements.

### 9.9.1 Whom to be trained

The following entities shall need to be trained:

- All persons working for the project
- Persons whose actions can affect compliance
- Persons with environmental responsibilities
- Construction workers
- Persons involved in emergency procedures
- Senior managers

### 9.9.2 What to be trained

The following shall need to be trained:

- Legislative framework – applicable laws, regulations, standards and technical guidelines to persons whose work will affect environmental compliance. The training should also include policies or procedures of

the implementing agency which is applicable to the project.

- Environmental monitoring – compliance monitoring and surveillance – which is the major tool for implementation of EMP
- Documents of Key Concern – this apart from EMP should include other documents (E.g. ESIA report)
- Records keeping and reporting – to create awareness on the need of records keeping documentation, registration of information and maintenance of the records.
- Communication methods and procedures – understanding lines of communication and type of information to be communicated.
- Dealing with complaints – to maintain good relationship with stakeholders; understanding the needs, traditions and behavior of local communities.

## 9.10 Institutional Arrangements and Reporting Procedures

KENHA, assisted by the supervising consultant, will be responsible for monitoring the implementation of the ESMP and the civil works contracts.

The purpose of environmental and social monitoring is to quantitatively measure the environmental effects of the road project. The environmental monitoring program will operate through the pre-construction, construction, and operation phases. It will consist of a number of activities, each with a specific purpose, key indicators, and significance criteria.

An Environmental and Social Specialist will carry out the monitoring of mitigation measures during design, construction and operation phases of the project. He/she will conduct mitigation monitoring as part of the regular works inspections. The responsibility for mitigation monitoring during the operation phase will lie with the Environmental Section in KENHA.

## 9.11 Environmental Management Plan Budget

The implementation of the Environmental Management Plan (EMP) shall be based on inspection of the ongoing road works by the IEC as discussed under section 9.5 and the main financial implication of the service is outlined in the table below. The calculation is based on the assumption that it shall take three teams of consultants to develop the road in 3 years. Thus the total cost of inspecting compliance to the EMP shall cost Kshs. 32,760,000.

Table 9.11(a) Cost of Road Inspection for EMP compliance by IEC

| Item | Description | Unit | Quantit | Rate | Amount |
|---|---|---|---|---|---|
| Lead Expert | 10 Nights per Trip*01 Officer*04 Trips Per Year*3 years*3 contractors | Man-days | 360 | 30,000 | 10,800,000 |
| 2 No. Associate Experts | 10 Nights per Trip*02 Officers*04 Trips per year*03 years*3 contractors | Man-days | 720 | 15,000 | 10,800,000 |
| Fuel | 3,000km*04 Trips Per Year*3 years*3 contractors | km | 10,800 | 100 per km | 1,080,000 |
| Other Direct Costs Telephone, faxes, stationery etc | 10,000 per trip*04 Trips Per Year*3 years*3 contractors | Lump Sum | | | 360,000 |
| Public and stakeholders consultations | 30,000 per trip*04 Trips Per Year*3 years*3 contractors | Lump Sum | | | 1,080,000 |
| Total | | | | | 32,760,000 |

*Table 9.11 (b): Environmental and Social Management Plan (ESMP)*

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Pre- construction phase | | | | |
| Loss of property possible resettlement | • Development and implementation of the land acquisition plan /compensation framework<br>• Confine clearance to road reserve /construction site boundary. | • KENHA/ Consultant/Affected people, Contractor/Environmental Supervisor (ES)<br>• Contractor/ES | Before and during construction phases | 10,000,000 |
| Inadequate Knowledge of Environmental and Social Management Issues | • Training of contractors staff from various sections of the construction company | • KENHA/ ES<br>• Reputable training institution on Environmental, Health and Safety Issues | One Month Short Course. | 10,000 per trainee approximately 20 to be trained 200,000 |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Contactors selection criteria | • Develop contractor selection criteria that take into consideration ability of contractor to implement environmental conservation<br>• Contractor's vehicles, machinery and equipments should be installed with EMS<br>• Contractors tender application should be submitted with documents in support of the status of the machines and equipments such as manufacturer's manual, log books, inspection certificates/reports, calibration certificates among others<br>• Recommendation by previous clients on level of works achieved should be sorted in confidentially or contractor should prove successful implementation of other ESMP<br>• Contractors guideline on implementation of the EMMP and the plan itself should form part of the project contract | • KENHA/ES<br>• KENHA/ES<br>• KENHA | -Planning and Tendering Phase and during construction | Covered in tender evaluation fees |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Loss of Vegetation | Project sites, camps and vehicles movement should be concentrated in sites with minimal stand of vegetation;<br>Rehabilitate, landscape/levelling, tree planting and re- vegetation once the construction or excavation activities are complete. Some critical sites may need fencing to remote<br>Faster regeneration of lost covers and avoids erosion. Undertake species specific control measures e.g. manual control by uprooting and burning before flowering. Depending on seriousness of invasion, Integrated control measures are recommended (physical, chemical and cultural practices)<br>Planting and tending of vegetation especially those with medicinal value this can be done in collaboration with the Kenya Forest Service and the local community<br>Avian nestling sites found along the road should be relocated before trees are cleared for the road construction; | • Contractor/ RE/ES | Continuously during site preparation | As per BOQ on earthworks |

| | | | | |
|---|---|---|---|---|
| | Preserve indigenous plants as much as possible and those uprooted should be replaced with appropriate tree species adapted to the area and those that protect soil and conserve water near watering points. | | | |
| Climate change | • Use green technology in developing labour camps by installing solar panels, wind generators and water recycling facilities<br>• Provide adequate day natural lighting and use energy saving bulbs<br>• Ensure machines and equipment's planned for project use are installed with EMS to abate accentuating contributors of climate change | • Contractor / RE/ES<br>• KENHA/RE/ES | During camp and site development | 500,000 per unit |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Health and Sanitation | • Develop a sanitation management plan to include appropriate siting of sanitation facilities/or providing mobile toilet facilities along the road<br>• Develop eco-friendly sanitation facilities with capability to recycle water and reuse of sludge | • Contractor/RE/ES<br>• Contractor/RE/ES | Mobilization , During camp and site development | 10,000 per unit per month |
| Archaeological site | • Plan project area and activities to ensure the sites are preserved<br>• Ensure accessibility to the site is not affected by project activities<br>• Discuss with the local community to enable identify other areas of cultural importance not identified during the study so that they can be preserved. | • Contractor/RE/ES | Mobilization , During camp and site development | Part of planning costs |
| Insecurity and prevention of road accidents | • Provide all workers with security<br>• Observe traffic rules<br>• screen for alcohol among drivers and machine operators<br>• Undertake road safety awareness in school and for the general public | • Contractor | | 3,000 per personnel per day |

| | | | | |
|---|---|---|---|---|
| | Reduce speed while driving around animal crossing area at Lokwamising Km 146+000; Napeitom-km is 91+200; Kapedo bridge km 24+075; GSU km 27+075 and Kariamarow km 34+075 or any area near water points as they are used for sourcing domestic and animal drinking water. | | | |
| Construction phase | | | | |
| oil and water pollution | • Minimize risks of accidental spillage and clear area immediately it occurs<br>• Use silt fences and hay bales to remove suspended solids from surface water runoff<br>• Use silt curtains to minimize sediment suspension and transport while working near water crossings.<br>• Discharged waste water into the environment should meet recommended standards<br>• Avoid use of heavy machines and equipment at river riparian<br>• Provide solid waste / garbage collection containers and sanitation facilities.<br>• Garbage should be segregated, biodegradable composted or | • Contractor/ ES<br>• Contractor/ES<br>• Contractor/ES<br>• Contractor/ES<br>• Contractor/ES | During Construction and operation | 200,000 per month |

| | | | | |
|---|---|---|---|---|
| | • The facilities must be properly maintained and satisfactorily decommissioned after the project.<br>• Solid and liquid waste must be handled as prescribed by law<br>• Solid waste resulting from road construction works should be disposed of as prescribed in the law<br>• Avoid burning of waste and melting bitumen on arable land<br>• All vehicles maintenance should be done at the site garage which should have an oil water separator. The oil/water separator should be periodically cleaned | • Contractor/ES<br>• Contractor/ES<br>• Contractor/ES<br>• Contractor/ES<br>• Contractor/ES | | Kshs. 200,000 annually |
| Flooding and damaging of settlements/farm lands | • In slopes and suitable places along the roadside, grass must be planted, and retaining wall, water intercepting ditches, and masonry rubbles must be built to prevent damage to adjacent properties.<br>• Temporary and permanent drainage systems to be developed to minimize the impact on adjacent properties during construction and operation, respectively.<br>• Adequate number of culverts must be designed and placed in such a way that storm water does not damage adjacent land use below the road bed | • Contractor/ES/RE<br>• Contractor/ES/RE<br>• Contractor/ES/RE | | As per engineering design and bills of quantities and |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| | • Provide appropriate outfall for drainage structures to avoid flooding the area<br>• River simulations should be considered when designing and installing bridges to reduce siltation of water bodies | • Contractor/ES/RE<br>• Contractor/ES/RE | | |
| Soil Erosion and instability of Slopes | • The discharge points must be carefully chosen to avoid erosion of arable land and creation of gullies.<br>• Road run off must be channelled to natural water course through side drains in which baffles and rip rap are placed to check water velocity.<br>• Drains must be included at short intervals to cope with run –off.<br>• Restrict ground clearance to RoW and avoid re-alignments to sensitive areas<br>• ▪ Lined drainage channels at sensitive terrains are provided to control speed and volumes of storm-water.<br>• ▪ Use bio-engineering geo-textile underneath stone protection (rip raps) on very erodible side slopes before top soiling and grassing | • Contractor/ ES/RE<br>• Contractor/ ES/RE | During Design and Construction | As per engineering design and bills of quantities and |

| | | | | |
|---|---|---|---|---|
| Loss of Vegetation | Project sites, camps and vehicles movement should be concentrated in sites with minimal stand of vegetation;<br>Rehabilitate, landscape/levelling, and tree planting and re- vegetation once the construction or excavation activities are complete. Some critical sites may need fencing to promote faster regeneration of lost cover and avoid erosion.<br>Preserve indigenous plants as much as possible and those uprooted should be replaced with appropriate tree species adapted to the area and those that protect soil and conserve water near watering points.<br>Develop appropriate methods of handling uprooted plants to avoid spreading of invasive species. Undertake species specific control measures e.g. manual control by uprooting before flowering and burning<br>Depending on seriousness of invasion, Integrated control measures are recommended (physical, chemical and cultural practices)<br>Planting and tending of vegetation especially those with medicinal value this can be done in collaboration with the Kenya Forest Service and the local community | • Contractor/RE/ES | Continuously during construction | As per BOQ costing on Earthworks |

| | | | | |
|---|---|---|---|---|
| | Avian nestling sites found along the road should be relocated before trees are cleared for the road construction; | | | |
| Loss of definite materials and Land degradation | Purchase construction materials such as gravel and stones from land owners and officially negotiate with land owners in order to avoid conflict. Agreement should include reinstatement plan<br>• Rehabilitate all borrow pits and quarries by landscaping after excavation works are completed<br>• Use stock piled topsoil for reinstating pit opened due to road construction.<br>• Sand mining from riversides should be done in a sustainable manner to avoid accelerated land degradation, pollution of water sources and/or interfere with agricultural activities in farmland | •Contractor/ES/RE Area chief | During Mobilization, Construction and after construction | As per bills of quantities (BOQ) |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Increased Road Accidents | • Traffic management plan (in both English and Swahili/Local Dialect)<br>• Speed limits in villages<br>• Conduct public awareness on road safety for the general public and in schools<br>• Provide sign boards clearly displaying the name for areas located along the road, humans and animal crossing areas, especially around Lokwamising Km 146+000; Napeitom-km is 91+200; Kapedo bridge km | • Design Engineer (DE)/Contractor/RE<br>• DE/Contractor/RE<br>• KENHA/Traffic police/ Local community<br>• ES/Contractor/RE<br>• ES/Contractor/RE | Constructional Phase | As per Engineering design and BOQ |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| | 24+075; GSU km 27+075 and Kariamarow km 34+075 or any area near water points as they are used for sourcing domestic and animal drinking water.<br>• Speed humps should be used near schools and dispensaries and should be clearly marked as pedestrian crossings.<br>• Observe traffic rules<br>• screen for alcohol among drivers and machine operators | | | |
| Increased Spread of HIV/AIDS | • Safety, Health and Environment (SHE) induction course<br>• Support HIV/AIDS campaigns as required by the | • Contractor/ES/ OHSO/RE<br>• KENHA/ | Constructional Phase | 16,250,000 |

| | | | | |
|---|---|---|---|---|
| | Strategic Plan by involving the local NGOs and government agencies already active in the project area in awareness creation and educating the local communities on HIV / AIDS and STIs prevention.<br>• Provision of condoms<br>• Locate the Construction camp site far from human settlements and employ a large number of unskilled labourers from within the local communities to minimize number of new comers.<br>• Monitor substance (alcohol and drugs) abuse at work place<br>• Collaborate with NACADA in | NGOs/CBOs/local communities<br>• KENHA/ NGOs<br>• Contractor/RE/ES<br>• Contractor/RE/ES | | |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| | their campaigns against the vice | Contractor/RE/ES/KENHA | | 200,000 Annually |
| Safety and health risks | • Regular maintenance of construction machinery to minimize accidents and professional hazards during construction period.<br>• Safety, Health and Environment (SHE) induction course<br>• Comply with the Occupation Health and Safety Act (2007) by provision of safety gears, equipments and clothing's.<br>• Adequate signage and availability of First Aid Kit<br>• Ensure hygiene and sanitation is maintained at the labour camps | • Contractor/RE<br>•Contractor/ ES/ OHS/Workers<br>• Contractor/RE/ES<br>• Contractor/RE/OHS<br>• Contractor/RE/ES | Throughout Construction phase | 100,000 per worker per year |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| | • The management and use of blasting materials should be done by Contractor registered by the Mines and Geology department in strict conformity with the safety requirements for public security as stipulated in the legislations.<br>• Drain and restore open pits to reduce incidence of disease vector breeding sites unless local community request to use as water storage structures<br>• Ensure security of team when working in wildlife habitats by training workers, providing appropriate gear and engaging wildlife wardens | • Contractor/RE/ES<br>• Contractor/RE/ES<br>• Contractor/RE/ES | | |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Archaeological site | • Plan project area and activities to ensure the sites are preserved<br>• Ensure accessibility to the site is not affected by project activities<br>• Discuss with the local community to enable identify other areas of cultural importance not identified during the study so that they can be preserved. | •Contractor/RE/ES | Mobilization , During camp and site development | Part of planning costs |
| Insecurity | • Provide all workers with security | • Contractor | | 3,000 per personnel per day |

| | | | | |
|---|---|---|---|---|
| Air pollution | • Water palliation on road section near human settlements and farms<br>• Proper choice of equipment with environmental management systems such as mixing plants with dust precipitators, efficient combustion engines<br>• Use clean fuels and energy<br>• Use enclosed processing and transportation equipments<br>• Avoid open burning of waste and bitumen use designed furnaces for melting bitumen<br>• Undertake continuous maintenance of machines and equipments to reduce pollutants | • Contractor/ RE/ES<br>• Contractor/ RE/ES<br>• Contractor/ RE/ES<br>• Contractor/ RE/ES<br>• Contractor/ RE/ES<br>• Contractor/ RE/ES | Construction | As per BOQ |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Vibration | • Provide advance notice to local communities when activities likely to cause vibration are to be undertaken<br>• Locate vibration sources such as of quarry sites far from settlements (recommended atleast 2km as per the regulations)<br>• Measure vibration levels<br>• Acquire license from the Mines and Geology department for use of explosives | • Contractor/ ES<br>• Contractor/ ES<br>• Contractor/ ES<br>• Contractor/ ES | Construction | 10,000 |
| Noise pollution | • Provide working gear to workers | • Contractor/RE/ ES | Construction | Cost cover in health and safety section |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| | • Proper choice of equipment with environmental management systems<br>• Avoid undertaking noisy activities in the night near settlements and animal habitats | • Contractor/RE/ ES<br>• Contractor/RE/ ES | | |
| Attacks by wild animals | • Provide workers with protective clothing<br>• Map animal migratory routes and advice works on their existence when working in such areas such as the Grassland Savannah in Ng'inyang<br>• Train workers on co-existence behavior with wildlife<br>• Engage game wardens when | • Contractor/ ES/ RE/KWS<br>• Contractor/ ES/ KWS/RE<br>• Contractor/ KWS/ES<br>• Contractor/ KWS/ES | During Construction near wildlife corridor or park boundaries | 2,000 per worker |

| | | | | |
|---|---|---|---|---|
| | working in the vicinity of game reserve or wildlife corridors.<br>• Contractor guidelines and code of conduct should include legal aspect against poaching and its adherence monitored | | | |
| Unsustainable options/Project Alternative | • Select most sustainable option of available development choices<br>• Avoid developing open drains in trading areas cover them to also act as walkways and reduce exposure to accidents<br>• Drains should be provided with sieves to ensure large solid particles do not enter them and cause blockage | • Contractor/ KENHA/E S/RE<br>• Contractor/ KENHA/E S/RE | Construction phase planning | As per BOQ |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| Estimated cost of implementing mitigation measures during construction phase | | | | Guided by the BOQ and cost estimates provided in this |
| Operation phase | | | | |
| Interference with local hydrology | • Good design and engineering practice<br>• Efficient drainage system<br>• Selection of proper outfall point so as to avoid flooding at the discharge point<br>• Avoid pollution of water bodies<br>• Acquire water abstraction permits before taking water from water bodies and consider downstream users | • DE/ Contractor/KENHA<br>• DE/Contractor/RE<br>• DE/RE/ Contractor/WRMA Coast sub-region officers<br>• RE/ Contractor<br>• RE/ | Long-term | As per Engineering design and BOQ |

| | | | | |
|---|---|---|---|---|
| Increased Road accidents | • Capacity building of traffic police officer on traffic management during construction<br>• Enforcement of traffic laws<br>• Installation of proper road signs and regular inspections for their presence<br>• Installation of speed control devices like humps<br>• Installation of pedestrian lanes at human settlement crossings<br>• Observe traffic rules<br>• screen for alcohol among drivers and machine operators<br>• Conduct public awareness on | • Design Engineer /Traffic police/ KENHA<br>• Traffic police/ KENHA<br>• Contractor /RE/ KENHA<br>• Contractor /RE/ KENHA/Community members<br>• Contractor /RE/ KENHA/Community member | Operation phase | As per BOQ |

| | | | | |
|---|---|---|---|---|
| | road safety for the general public and in schools | | | |
| Noise, vibration and air pollution | • Good design practice<br>• Provide noise absorbers<br>• Enforce speed and exhaust limits<br>• Based on traffic flows estimate emissions volumes and plant vegetation to act as carbon sinks to clean the air<br>• Plant a tree for every tonne of GWP estimated | • Design Engineer/ Traffic police/ KENHA | Operation phase | As per BOQ |
| Attacks by wild animals | • Provide workers with protective clothing<br>• Map animal migratory routes and advice workers existence when working in | • Contractor/ Environmental Supervisor/ KWS | During Maintenance while working near wildlife corridor or park | 2,000 per worker |

| | | | | |
|---|---|---|---|---|
| | such areas<br>• Train workers on co-existence behavior with wildlife<br>• Engage game wardens when working in the vicinity of game reserve or wildlife corridors. | | | |
| Total Estimated cost of implementing mitigation measures during construction phase | | | | Guided by the BOQ and cost estimates provided in this |
| Decommissioning Phase | | | | |
| Construction Equipment / Vehicles / Machinery | • All construction equipment / vehicles and machinery should be removed immediately from the site at the end of defects liability period. | • Contractor / RE | Decommissioning phase | As per BOQ |

| | | | | |
|---|---|---|---|---|
| Workers' Campsite, Workshops and other associated facilities. | • The workers' camp site and other facilities should be removed at the end of defect liability period.<br>• The removed materials should be transported and kept in safe place for use by the Contractor in other works.<br>• However, in some cases the Workers' Campsite can be retained for use by the local communities as a school, technical institute/college or dispensary as the case may be.<br>• The area should be cleaned and all domestic wastes, debris / waste metals, grease and oils must be cleaned up | • Contractor /RE.<br>• Contractor /RE/ES<br>• Contractor /RE/ES/KENHA<br>• Contractor /RE/ES | Decommissioning phase | As per BOQ |

| Impact | Mitigation Measure | Responsible Institution | Mitigation Time Frame | Estimated Cost (Kshs) |
|---|---|---|---|---|
| | and disposed of in a manner approved by Resident Engineer. | | | |
| Total Estimated cost of implementing mitigation measures during decommissioning phase | | | | 20-10% 0f project cost |

# 10. ENVIRONMENTAL AND SOCIAL MONITORING PLAN

## 10.1 Introduction

Monitoring of the anticipated impacts in the receiving environments is important as it provides the basis for rational management decision in regards to impact control. Monitoring also helps in determining the project activities that requires enhancing, helps in understanding the cause effect of impacts and their relationships with human activities, and verifies the accuracy of prediction of the social impacts. It ensures compliance with regulatory measures and understanding the degree of implementation of ESPM and its effectiveness.

Monitoring is performed in all stages of project implementation this is construction, commissioning and operation to enable verify impact predicted during the study and at the same time to ensure that adverse impacts are minimized. The information collected during monitoring exercise helps to improve environmental management plans by adapting measures to ensure that the anticipated impacts are mitigated. For example, in case environmental monitoring identifies some environmental concerns during construction or operation phase then construction or operation works has to be modified or stopped to allow abatement/minimization of the impact.

The objectives of environmental monitoring programme are:

- To ensure that mitigation and benefit enhancement measures have been adopted in a timely manner and are effective
- To identify any unforeseen negative impacts during ESIA study stage and propose appropriate mitigation measures
- To provide information on the actual nature and extent of key impacts and effectiveness of mitigation and benefit enhancement measures, which through feedback mechanism can improve the planning and execution of similar projects in the future.

There are two basic forms of monitoring:

- Compliance monitoring which checks whether prescribed actions have been carried out.

- Effects monitoring which records the consequences of activities on one or more environmental components, and usually involves physical measurement of selected parameters or the execution of surveys to establish the nature and extent of induced changes.

For the proposed project, both compliance and effects monitoring can be recommended, the compliance monitoring is important because most impacts control takes the form of incorporating measures in the project designs and contract documents. This monitoring also checks the extent to which recommended mitigation measures prescribed in the ESIA and ESMP are complied with thus play a major part in determining the overall performance of the project.

The environmental monitoring plan is outlined in Table 10.4 below. The plan outlines the particular issues that will be monitored during construction and operation phases. The monitoring plan also includes type of monitoring indicators, frequency of monitoring, methods of monitoring the indicators and project personnel responsibility for each monitoring activity.

## 10.2 Monitoring Parameters

The selection of the parameters to be monitored is based on the impacts likely to occur during project implementation. Monitoring of these parameters will be done in various stages of the project as follows;

Pre-construction stage

Monitoring of the parameters at this stage is meant to establish the baseline information of the target parameters in the project area.

Construction stage

Monitoring at this stage is meant to establish the pollution levels that arise from the construction activities.

Operation stage

Monitoring at this stage is meant to check on the impacts that might arise as the result of normal use of the infrastructure and maintenance activities.

Decommissioning

Decommissioning is likely after 20 years which is the end of the project's life

span. This phase entail rehabilitation of the road or change of use (functional changes) or demolition triggered by change of land use.

## 10.3 Implementation of Monitoring Plan

The environmental monitoring during the construction phase shall comprise of two activities:

- Review of Contractor's plans, methods statement, and temporary works design and arrangements to ensure that environmental protection measures specified in the contract documents are adopted and Contractor's proposals provide acceptable levels of impact control.
- Systematic observation of all site activities and the Contractor's offsite facilities, including borrow pits and quarry sites areas. To ensure that the contract requirements relating to environmental matters are being complied with, and that no impact foreseen and unforeseen are occurring.

The monitoring activities will comprise of visual observation during site inspection and will be carried out at the same time as the engineering monitoring activities. Site inspections will take place with emphasis on early identification of any environmental issues and the initiation of suitable remedial action. Where remedial actions are required on the part of the Contractor, further checks will need to be made to ensure that they have actually been implemented as per the agreed schedule and in the required form. All sites where construction is taking place will be formally inspected using environmental monitoring checklists to ensure all issues are considered, recorded and remedial measures proposed.

However, in addition to visual observation there shall be informal questioning of local communities members and their leaders who live near the project sites since they may be aware of matters which are unsatisfactory but may not be readily recognized during normal site inspection visits.

The monitoring activities will also be integrated with other construction supervision and monitoring activities to be carried out by the contracted Environmental Supervisor (ES) under the RE' office. The ES and RE will decide on the appropriate course of action to be taken in cases where unsatisfactory reports are received from the field

staff regarding environmental matters. In case of relatively minor matters, advice to the Contractor on the need for remedial action may suffice, but in all serious cases, RE should issue a formal instruction to the Contractor to take remedial action, depending on the extent of delegated powers.

## 10.4 Monitoring Responsibilities and Reporting

The project Implementing Agency KENHA shall work with the construction supervision team to ensure that the environmental monitoring plan is implemented. It is recommended that an Environmental Management Unit (EMU) is established at the site office level to work with the engineering supervision team. The EMU at the site office shall be responsible for coordination of environmental management and monitoring activities on day-to-day basis.

The contractor will be responsible for implementing environmental and social mitigation measures under the Supervision of Resident Engineer and Environmental Supervisor from EMU. This is to ensure that technical and environmental clauses are followed and well implemented by the Contractor.

There must be a feedback mechanism during monitoring to ensure that failure to implement an approved measure incurs a penalty to the Contractor. The Resident Engineer's job should include enforcement of mitigation measures. At times approved mitigation measure may not achieve the desired effect or lead to unforeseen adverse impacts such incidences where failure of a measure to mitigate an adverse impact occurs should be communicated to the EMU site Office, which would work in finding out why the situation did not improve while commissioning appropriate further measures, otherwise absence of such mechanism would render the whole mitigation and monitoring process futile.

The Contractor shall assign an Environmental Inspector who shall be responsible for carrying out monitoring on an intermittent basis. The Contractor shall also nominate a Senior Representative to oversee compliance with environmental mitigation measures. The Contractor's representative must submit a monthly report to the RE specifying:

- All previously notified failures to comply with the mitigation measures that have been rectified.

- All newly notified requirements that have been fulfilled and all standard requirements (as specified in the ESIA report) have been put into action.

- The Resident Engineer must countersign the report and make it available to EMU Site Office, which in turn should pass a copy to the KENHA within a reasonable period not exceeding 30 days from receipt.

*Table 10.4: Environmental and Social Monitoring Plan for the development of the Lokichar-Lokori-Ng'inyang Road*

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| Pre-construction stage | | | | | | | | |
| Water Quality | Turbidity | Twice before the construction starts (Once during rainy season and once during dry season) | 100m before and after the location of bridge and culverts construction site | NTU | Turbid meter | 10NTU | Contractor/ ES | 100,000 |
| Air quality | Dust | Once before the construction starts | Near settlements (villages) | µg/m3 | Micro Dust Pro | 0.01 | Contractor/ ES | 325,000 |
| Noise Baseline | Noise level/ mapping | Once before the construction starts | Near settlements (villages) | dBA | calibrated precision integrating sound level | 110 | Contractor/ ES | 120,000 |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| | | | | | meter, open Field Microphone and GPS, Garmin eTrex 12-Channel | | | |
| Biodiversity | Baseline information on biodiversity | Once before the construction work starts | All vegetation along the road | type and number of living organisms | Counting and Observation | - | ES/ Contractor/ Sub county Forests Officer (DFO), KWS | 300,000 |
| Compensation | Rate of compensation n for land and properties | Once before the construction starts | All affected people | Once before construction begins | Resettlement Action Plan (RAP). | - | Sub county Officers/ KENHA/ ES | 300,000 |
| Solid Waste | Presence of | Once before | Entire project | Tonnes | Visual | Clean areas | Local Council | |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| | solid waste | the construction starts | area | | observation | | | |
| Machinery and equipments | Emissions, Soot, Noise, (Sox), (NoX), (CoX), (CO), (Pd), (O3). | As per manufactures manual | All plants, vehicles, equipments and machinery | PM10/PM5, dBA, µg/m3 | calibrated precision integrating sound level meter, open Field Microphone and GPS, Garmin eTrex 12-Channel, cartridge with10mm nylon cyclone with 37mm diameter with polyvinyl- | -110 -PM10 at 24 hr exposure 25 µg/m3 Sox at 24 hr exposure is 125 µg/m3 NoX at 1 hr exposure is 200 µg/m3), (CoX), (CO), measures based on NESC& WHO Air Quality Guidelines, Global Update | Contractor/ ES | 100,000 |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| | | | | | chloride with pores of 5µm or other methods as per KBS | | | |
| Total cost of monitoring at pre-construction stage is Kshs. | | | | | | | | 1,245,000 |
| Construction stage | | | | | | | | |
| Water Quality | Turbidity | Once Per month | 100m before and after the bridge construction site | NTU | Turbid meter | 10NTU | Contractor/ ES | 20,000 Annually 240,000 |
| Air pollution | Dust | Once Per month | Near settlements (villages) | µg/m3 | Micro Dust Pro | 0.01 | Contractor/ ES | 325,000 Annually 3,900,000 |
| Noise pollution | Noise level | Once Per month | Near settlements (villages) | dBA | Measurements | 110 | Contractor/ ES | 100,000 Annually 1,200,000 |

| Parameters<br>Indicator | | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/<br>Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| Soil erosion | Soil erosion along the road | Once in three Months | Project road, Detour routes, Quarry sites. | Level of erosions | Site inspection | _ | ES/<br>Contractor/ RE | 20,000<br>Annually 60,000 |
| Natural habitat | Biomass | Once in three month for construction period | All forests along the road/material sites | - | Inspection | - | ES/<br>Contractor/ DFO, KWS | 10,000<br>Annually 40,000 |
| Biodiversity | Biodiversity | Once year | Vegetated areas along the road/ material sites | type and number of living and organisms | Inspection | - | ES/<br>Contractor/ DFO, KWS | 100,000 |
| Vibration | Vibration levels | Once per Month | Project road, Quarry sites | No per time | Records | -0.5 centimeters per second for stationery property | Contractor/ ES | 100,000 Annually 1,200,000 |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | -30 metres from any moving source | | |
| Frequency of illness of construction workers | Illness of construction workers | Once every three month for the construction period | Project site | Number of cases | Health records | - | Sub county Public Health Officers (DPHO)/ Contractor, HSO, HIV/AIDS consultant | 200,000 Annually 800,000 |
| Employment opportunity | Percentage of local construction labourers | Three times a year | Project site | Number of local people employed in the project | Records, inquiries and observation | - | Sub county Labour Officer (DLO)/ Contractor/ KENHA | - |
| Safety and health risks | Number and type of safety equipment such as mask, helmet gloves | Once in three month | Project site | Number of safety measures provided | Actual injuries, death (human and animals) and illness | - | Contractor/ OSHA | 50,000 per worker annually |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| | Health and sanitation facilities in camps.<br>Number of HIV/AIDs and STI prevention and awareness camps and number of reported infections<br>Number of accidents and death cases | | | | statistics | | | -<br>100,000 quarterly<br>400,000 annually |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| Solid Waste | Presence of solid waste | Once every month | Entire project area | Tonnes | Visual observation<br>Analysis of waste type and their origin | Clean areas | ES | 10,000 |
| Dust Suppression | Water sprinkling | Everyday | Project site | Frequency of water sprinkling | Inquiries and observation | Minimum dust emission | Contractor/ ES | As per BOQ |
| Machinery and equipments | Emissions, Soot, Noise, (Sox), (NoX), (CoX), (CO), (Pd), (O3). | As per manufactures manual | All plants, vehicles, equipments and machinery | PM10/PM5,<br>dBA, µg/m3 | calibrated precision integrating sound level meter, open Field Microphone and GPS, Garmin eTrex 12-Channel, | -110<br>-PM10 at 24 hr exposure 25 µg/m3 Sox at 24 hr exposure is 125 µg/m3 NoX at 1 hr exposure is 200 µg/m3), (Co$_X$), (CO), | Contractor/ ES | 100,000 |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| | | | | | cartridge with10mm nylon cyclone with 37mm diameter with polyvinyl-chloride with pores of 5µm | measures based on WHO Air Quality Guidelines, Global Update | | |
| Insecurity | Attacks | Daily attendance and performance records for each worker | Contractors camps and surrounding areas | Number of invasions<br>Number of those attacked/injured/killed | Supervision by security officer, RE, ES | Safe environment for all | Contractor/ Security Officer/RE/ES | 1,500,000 annually |
| Total cost of annual monitoring at construction stage is Kshs. | | | | | | | | 9,950,000 |
| Operation stage | | | | | | | | |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| Water Quality | Turbidity | Once in three month | 100m before and after the bridge construction site | NTU | Turbid meter | 10NTU | Contractor/ ES | 50,000 Annually 200,000 |
| Air pollution | Dust | Once in three Months | Near settlements (villages) | µg/m3 | Micro Dust Pro | 0.01 | ES | 325,000 Annually 1,300,000 |
| Noise pollution | Noise level | Once in three Months | Near settlements (villages) | dBA | Measurements | 110 | ES | 100,000 Annually 400,000 |
| Increased in natural resources extractions | Condition of the forest | Once in three Months | All forests along the road | Volume of wood extracted | Measurements of volume of trees cut | - | DFO /ES/ KENHA | 100,000 Annually 400,000 |
| Safety of human beings in | Road accidents (both | Three times a year for the project life | Project site | Road signs and number of accidents | Records, inquiries and accident | Zero accident and sufficient no of road | Traffic police/ Sub county council | 100,000 Annually 400,000 |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| villages and towns | involving human & animals)<br>roads signs life span | span<br>A | | | statistics | signs | | |
| Machinery and equipment | Emissions, Soot, Noise, (Sox), (NoX), (CoX), (CO), (Pd), (O3). | As per manufactures manual | All plants, vehicles, equipments and machinery | PM10/PM5, dBA, µg/m3 | calibrated precision integrating sound level meter, open Field Microphone and GPS, Garmin eTrex 12-Channel, cartridge with10mm nylon cyclone with 37mm | -110<br>-PM10 at 24 hr exposure 25 µg/m3 Sox at 24 hr exposure is 125 µg/m3 NoX at 1 hr exposure is 200 µg/m3), (Co$_X$), (CO), measures based on WHO Air Quality Guidelines, | Contractor/ ES | 100,000 per vehicle for 10 |

| Parameters | Indicator | Monitoring frequency | Sampling Area | Measurement Units | Method | Target level/ Standard | Responsibility for monitoring | Costs estimates (Kshs) |
|---|---|---|---|---|---|---|---|---|
| | | | | | diameter with polyvinyl-chloride with pores of 5µm | Global Update | | |
| Insecurity | Attacks | Daily attendance and performance records for each worker | Contractors camps and surrounding areas | Number of invasions<br>Number of those attacked/injured/killed | Supervision by security officer, RE, ES | Safe environment for all | Contractor/ Security Officer/RE/ES | 1,500,000 annually |
| Total cost of monitoring during operation stage is Kshs. | | | | | | | | 3,500,000 |

# 11. RESOURCE EVALUATION AND COST BENEFIT ANALYSIS

## 11.1 Total Project Cost

The project cost for the proposed road and associated bridges consists of construction cost, design engineering cost, construction supervision cost and construction contingencies.

The estimate of construction costs which involves activities such as bush clearing, earthworks, bridge construction works, culverts and other drainage structures, pavement construction, ancillary works and construction contingencies was based on the preliminary engineering designs and costs of other road project being undertaken in the country. Unit rate were developed from an estimate of accommodation of traffic, drainage, earthworks, pavement, bitumen surfacing and auxiliary roadwork. Other costs incorporated in the above area material costs, required construction equipment including mobilization and demobilization cost, staff and labour requirement with mobilization /demobilization and accommodation etc.

Accommodation of Traffic cost has mainly been determined by the cost of the deviations. Drainage costs shall cover the nominal culverts and other concrete work, excluding major box culverts and bridges. The earthworks cost shall cover material required for fill. The asphalt surfacing cost has been obtained by calculating amount required based on the project designs. Auxiliary roadwork costs shall cover activities such as road markings, guardrails, road signs and other road furniture. The costs took into consideration painting of the road markings on completion of the construction and again at the end of the maintenance period. Costs of purchasing and installing road studs (cat eyes) have been catered for as they significantly improve the night time driving conditions.

*Table 11.1(a): Construction cost:*

| Bill no. | Descriptio | Amount (Kshs) |
|---|---|---|
| 1 | Preliminary and general | 644,475,629 |
| 4 | Site clearance and top soil stripping | 152,500,000. |
| 5 | Earthworks | 2,102,675,000 |
| 7 | Excavation and filling for structures | 69,636,172. |
| 8 | Culverts and drainage works | 678,627,875 |
| 9 | Passage of traffic | 83,544,000. |
| 12 | Natural material base and subbase | 753,911,750. |
| 14 | Cement treated material | 1,788,561,115 |
| 15 | Bituminous surface treatments and surface dressing | 851,350,000. |
| 16 | Bituminous mix bases binder courses and wearing courses | 1,919,740,000 |
| 17 | Concrete works | |
| 20 | Road furniture | 103,704,800. |
| 21 | Miscellaneous bridge works | |
| 22 | Day works | 12,063,500. |
| 26 | Hiv/aids awareness and education | 16,250,000. |
| 27. | Environment Management and Monitoring (Annual Estimates during | 22,724,000+32,760,000 (consultancy |
| 28. | Environment Management and Monitoring (Annual Estimates during | 9,940,0 |
| A | Sub total (1) | 9,177,039,841 |
| B | Add 10% of (1) for contingencies to be expended in part or deleted entirely by the engineer in accordance with clause 58 of the | 917,703,984. |
| C | Add 15% of (1) for price adjustment in accordance with clause 70.1 conditions of contract (3) | 1,376,555,976 |
| D | Sub total (4) | 11,471,299,802 |
| E | Add 16% of (4) for value added tax (vat) | 1,835,407,968 |
| F | Grand total carried forward to form of bid | 13,339,897,834 |

## 11.2 Financial and Economic Analysis

### 11.2.1 Traffic Assessments and Forecast

Traffic survey for the project road was undertaken in 2012and the findings of the survey are shown in Table 11.2.1 below.

*Table 11.2.1(a): ADT and AADT calculations Kenya - 2011 study*

*Table 1:Trip purpose for Lokichar*

| Vehicle Type | Home | Work | Visiting | P.S.V | Freight |
|---|---|---|---|---|---|
| M/Cy | 2 | 1 | 0 | 2 | 0 |
| Car | 3 | 3 | 1 | 2 | 0 |
| Pick up/Jeeps | 4 | 71 | 4 | 0 | 2 |
| Minibus | 0 | 0 | 0 | 4 | 0 |
| Light truck | 0 | 0 | 0 | 0 | 8 |
| Medium truck | 0 | 2 | 0 | 0 | 22 |
| Heavy | 0 | Drawback 1 | | | |
| Drawback k | 0 | 0 | 0 | 0 | 1 |
| Bus | 0 | 0 | 0 | 0 | 0 |
| Total | 9 | 79 | 5 | 8 | 84 |

### 11.2.2 Analysis of Macro-Economic Data

A frequently used guideline for the determination of traffic growth from constant GDP for developing countries is to apply an elasticity factor of between 1 and 1.5 to the constant GDP growth to derive the traffic growth rate.

*Table 11.2.2: Kenya Real GDP Growth*

| Indicator | Year | | |
|---|---|---|---|
| | 2009 | 2010 | 2011 |
| Real GDP Growth (%) | 2.6 | 5.6 | 4.3 |

Based on the above, the application of the elasticity factor would translate into a traffic growth rate of between 4.2% and 6.25% if the real or constant GDP average growth rate of 4.2% is applied.

### 11.2.3 Economic Evaluation Framework and Methodology

The economic analysis of a project is aimed at whether that project is consistent with overall national and sectoral objectives and whether the investment proposed represents the best means of achieving the intended objectives.

A project must yield benefits in excess of costs over its life. Here are three methods commonly used in comparing the cost and the benefit streams to arrive at investment decisions.

- Benefit cost Ratio

It compares the present values of benefits and costs discounted at a rate which represents the opportunity cost of capital.

$$\text{Benefits/costs ratio} = \sum \frac{B}{(1\ i)t} \Big/ \frac{n}{} \frac{C}{(1\ i)t}$$

$$\text{Benefits/costs ratio} = \sum \frac{B}{(1\ i)t} \Big/ \frac{n}{} \frac{C}{(1\ i)t}$$

$$t\ o \frac{\quad t \quad}{} \qquad \sum t0 \qquad t$$

Here Bt: aggregated benefits year t

Ct: aggregated costs year t

i: interest rate (discount rate)

t : number of years

In order to have economic viability, the ratio should be larger than 1.

- Net Present Value (NPV)

It expresses the difference between the present values of the streams of costs and benefits of a project discounted at the opportunity cost of capital.

$$NPV = n\Sigma \frac{B}{(1\ i)t} \qquad \sum n(1\ \frac{C}{i)t}$$
$$t\ o \frac{\quad t \quad}{} \qquad t\ 0 \frac{\quad t \quad}{}$$

Here, Bt : aggregated benefits year t

Ct : aggregated costs year t

i : interest rate(discount rate)

t : number of years

If, for an estimated i, NPV is positive, the project is likely to be accepted as economically viable.

- Internal Rate of Return.

It is the rate of discount at which the streams of the costs and benefits over the life of the project are equalized, that is the value of i which makes NPV equal to zero.

$$\text{IRR} = \sum_{t=1}^{n} \frac{B}{(1+i)^t} - \sum_{t=1}^{n} \frac{C}{(1+i)^t}$$

$t\ o\ \frac{}{t}$ $t\ 0\ \frac{}{t}$

Here, Bt : aggregated benefits year t

Ct : aggregated costs year t

i : interest rate(discount rate)

t : number of year

If IRR, the discount rate that will drive NPV to zero, is greater than the estimated opportunity cost of capital or investment rate of interest, the project is generally considered to be economically viable.

### 11.3.4 Result of Economic Analysis

The economic evaluation of a project is assessed by comparing the proposed investment or project with the base-line project alternative or the base case. In order to perform the economic evaluation, the road upgrading alternative was compared with the base case (Alternative 0) of the road.

The relative impact of the upgrading alternative is represented by the net effect of the benefits and costs they induce. The most desirable alternative is usually the one that maximises the net benefits. Reduced Vehicle Operating Costs (VOCs) and reduced travel time costs due to the improved road condition were considered to represent the benefit side of the Cost-Benefit equation.

The following costs were taken into consideration:

- User Cost Inputs;
- Road Upgrading/Improvement Costs;
- Maintenance Costs;

#### 11.3.4.1 User Cost Inputs

Vehicle Characteristics & Economic Unit Costs

It is anticipated that the upgrading of the project road will result in a reduction of vehicle operating costs and travel time.

#### 11.3.4.2 Upgrading and Maintenance Cost Inputs

Apart from taking into consideration traffic scenarios and traffic growth estimates with the development of the model, improvement and/or maintenance options for each of the alternatives, as well as several cost types were also taken into consideration. These included:

- Road upgrading costs (including construction and supervision); and
- Road maintenance costs.

As 2014 being the year of commencement of the economic analysis and year 2017 being the commencement of the lifecycle of the project roads) at a discount rate of 12% per annum.

It was furthermore assumed that the upgrading costs will be spent in a 33%:33%:34% proportion during those three years. It was also assumed that the residual value will be 20% at the end of the analysis period.

The results of the analysis are presented in the tables below, in terms of the following:

- Net Present Value (NPV); and
- Internal Rate of Return (IRR).

The alternatives are all viable if they conform to the following:

- NPV: positive; and
- IRR: higher than the opportunity cost of capital (OCC).

The IRR can be used to priorities independent projects. It should be noted that the calculation of an IRR is not always possible because its calculation is based on an iterative procedure. Therefore, due to the cash flow nature of the net-benefits, it is

sometimes possible to obtain no IRR solution or more than one IRR solution. The NPV is used to determine the most feasible project within a range of mutually exclusive projects.

The results of economic analysis indicate that the overall upgrade of the road is feasible for the pessimistic, realistic and optimistic scenarios.

### 11.2.5 Sensitivity Analysis

The following sensitivity tests were carried out (for construction costs only, as varying traffic growth is already incorporated in the three traffic scenarios):

- 20 % increase in construction costs; and
- 20 % decrease in construction costs.

For the Kenyan sections, only the 20% increase in construction costs is shown for the Pessimistic Scenario, as increasing the construction costs will have a more drastic effect on the results as in the case of the Optimistic and Realistic scenarios.

### 11.3.5 Regional Development Potentials

#### 11.3.5.1 Neighboring roads

Construction of Loruk – Barpelo (B4) is underway and this will link to the project road reducing travel time for vehicles from Nakuru to Lokichar and other Northerly destinations. The Level of Service (LOS) offered by the project road once constructed is also expected to be better than the current condition of the A1 section running parallel to it. These two factors are expected to attract traffic currently using the Nakuru – Kitale – Lodwar route onto the project road.

#### 11.3.5.2 LAPSSET

The Loruk –Lokichar section of the project road has been placed as part of the Lamu Port Transport corridor under the Lamu Port- Southern Sudan-Ethiopia Transport (LAPSSET) Corridor Project. This has an impact on the Traffic Class of the road since the LAPSSET project has indicated that this section will have a traffic class of T3 due

to the volume of traffic that is projected to be using the road.

11.3.5.3 NGAMIA 1 Tullow oil

The recent discovery of oil deposits at Ngamia 1 about 30 km from Lokichar along the project road is expected to increase the flow of heavy goods vehicles. This was also considered in the traffic projections and designation of the traffic class.

It is expected that the upgrading of the project road will impact on economic growth of the area and Kenya as a whole in the following way:

- Improved access to employment opportunities, due to increased mobility and accessibility;
- Increased household income due to increased employment opportunities;
- Increased market access for rural agricultural produce;
- Increased trade link along the project road between Kenya , Southern Sudan and Ethiopia;
- Increased GDP contribution.

# 12. DECOMMISSIONING PLAN

## 12.1 General Requirement

In general during decommissioning phase all work areas including offices, workshops /garages and other temporary installations shall require removal if no other proposed use is identified and, the site cleaned up and restored. These includes removal or re-use of temporary buildings, materials, wood, refuse, surplus materials, embankments or any other material that was not in the area before constriction works.

All natural drainages must be restored and excavated materials must be used to fill excavated areas and spread. The damaged areas must be restored to make it compatible with future use. However, it is recommended that the contract consult the local authority to obtain information about the envisaged use of the area before decommissioning.

Natural drainage must be preserved during rehabilitation and restoration works, ditches must be created to facilitate water run-off by installing drains and derivation ditches perpendicular to the slopes. All superfluous temporary drainage elements must be removed. Permanent installations must be restored / repaired to their initial state.

The compacted soils must be scarified to at least 15 cm deep to loosen it and facilitate vegetation growth. Concrete surfaces, paving stones and flagstones must be removed or broken and covered with 1 m of topsoil.

Damage trees must be chopped / lopped and crosscut after completion of construction works. The site must be cleared of equipment, materials, provisional installations, wastes, debris and overburden resulting from construction works. The adjacent strip of vegetation must be cleaned.

## 12.2 Specific Requirements

### 12.2.1 Restoration of Borrow Pits and Quarry Sites

The restoration of borrow pits should be done by levelling the ground and planting trees, shrubs, grass or tree crops or other crops growing in the area. The holes in the quarry sites could be filled with earth or stones and planted with vegetation. The stockpiled soil around borrow pits and surplus excavated materials must be stabilized.

The area must fit well with the surrounding landscape and should be sufficiently drained. The planted vegetation should be maintained for a period of 1 year after decommissioning period. Thereafter it can be handed over to the DFO or relevant authority.

### 12.2.2 Temporary Access Roads and Culverts

The temporary access roads must be closed to prevent public access. However, it is recommended that the Contractor consults with the local authorities to decide about the possible future use of the roads. The slopes must be stabilized by spreading topsoil spread and planting vegetation at entrances and exits in prominent areas such as in borrow pits or quarry sites.

Temporary culverts must be removed and the natural drainage restored. In streams / river crossings it is important to restore normal flow. The river beds and river banks must be restored as much as possible to their original conditions.

### 12.2.3 Workshops / Garages and Materials Storage Areas

The workshop and other materials storage areas must be cleaned to remove petroleum products like oils and grease. The petroleum products should be handled in accordance with the provisions of the Act.

All asphalts, cements, stockpiled gravels and any other surplus materials must be removed from the Materials storage yard. The useable materials should be taken away and stored in a safe place far from the abandoned site. The spilled materials must be removed and the site must be properly cleaned and restored to its original state. If possible the site be prepared and planted with vegetation.

### 12.2.4 Solid Waste Dump Sites

The solid waste dump site must be cleaned, levelled and returned to a regular form. All wastes in the dump site should be thoroughly covered with a layer of soil. The Contractor must ensure that no wastes are visible and no surface water drains into the site.

The eliminated dry materials should form a stable slope and must be in harmony with the surrounding landscape. The wastes should be covered with 1 m of earth or granular material. The soils should be compacted thoroughly, the slope flattened and spread a layer of additional cover material and cover with topsoil and plant with vegetation.

## 13. CONCLUSION AND RECOMMENDATIONS

The ESIA study results show that the proposed project alignment already exists but to improve its status to an all-weather durable road there is need to upgrade it to bitumen standard. The study indicated that the general project impacts value is rated as low since the project shall not involve significant deviation from the existing alignment. Through stakeholders consultation it was evident that the project is highly anticipated by the area residents as it of high socio- economic benefits to them. It was noted that the project shall enhance trade in the project sub counties and adjoining regions as well.

In order to ensure the project's positive impacts are enhanced, a project environmental and social Management and Monitoring plan has been developed to guide in mitigating the project negative impacts. It was noted that, to a large extent the negative impacts can be minimized through appropriate decision making, good engineering design and construction practices in addition to the mitigation measures proposed in this report. The mitigation measures shall offset some of the inherent adverse impacts especially those linked to land, water and air pollution. Implementing these mitigation measures would increase environmental soundness of the project.

It is, therefore, concluded that, implementation of the proposed project will entail no detrimental impacts provided that the recommended mitigation measures are adequately and timely put in place. The identified adverse impacts should be managed through the proposed mitigation measures and implementation regime laid down in this ESIA. The responsible parties should be committed in implementing all the recommendations given in the report and further carry out environmental auditing and monitoring schedules to gauge the effectiveness of the mitigation measures. The key recommendation of the study therefore includes:

- Integrate suitable mitigation measures as outlined in this report.

- Implement livelihood restoration programme for those to be affected by the project.
- Consult the communities and other stakeholders, particularly property owners on the works plans, especially where property, inhabitations and other aspects of social/cultural interest are concerned,
- Collaborate with the Kenya Wildlife Services in regard to wildlife considerations during all the phases of the road development so as to develop suitable alternatives and ensure safety from wildlife attacks and also for conservation issues among other concerns.
- This will especially be required in Ng'inyang where the Grassland Savannah is found;
- Institute effective communication, education and awareness towards the project beneficiaries for enhanced acceptability and social harmony. This is particularly important for the settled areas near the road where HIV/AIDS and other STI's awareness and prevention programmes should be undertaken.
- Implement the environmental management plan throughout the project implementation period with assistance of appropriate expert.
- Create an environmental management unit to work together with the contractor and RE and they should be guided with the EMP and the environmental monitoring plan outlined in the report.
- During the preparation of this report, it was observed and established that most of the negative impacts on the environment are rated low and short term thus can be abated through the proposed mitigation measures. The positive impacts are highly rated and will benefit all stakeholders and the country at large. The project proponents should aim to prudently implement the Environmental Management and Monitoring Plans.

## 14. REFERENCES


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# APPENDICES

# Appendix 1: Minutes

# Appendix 2: Noise standards

# Appendix 3: Emissions standards for vehicles

# Appendix 4: List of stakeholders

# Appendix 5: Water quality standards

# Appendix 6: Descriptions of materials

# Appendix 7: Site pictures

# Appendix 8: List of potential impacts

# Appendix 9: Road works safety plan

# Appendix 10: List of local plant species