Strategic Environmental Assessment (SEA) for the Formulation of a Master Plan on Logistics in the Northern Economic Corridor, Kenya

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ACRONYMS

ACZ	Agro Climatic Zone
AEZ	Agro-Ecological Zones
ASAL	Arid and Semi-Arid Land
AZE	Alliance for Zero Extinction
BID	Background Information Document
CBD	Central Business District
CR	Critically Endangered
DD	Data Deficient
DEM	Digital Elevation Model
DOSHS	Department of Occupational Safety and Health
DUV	Direct Use Value
E&S	Environmental and Social
EACC	East African Coastal Current
EAM	Eastern Afromontane Biodiversity
EARS	East African Rift System
EBAs	Endemic Bird Areas
ECC	Equatorial Counter Current
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management Coordination Act (1999)
EN	Endangered
ERM	Environmental Resources Management
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Management and Monitoring Plan
EV	Existence Value
EX	Extinct
FAO	Food and Agriculture Organization of the United Nations
FR	Forest Reserve
GCA	Groundwater Conservation Area
GDP	Gross Domestic Product
GHG	Green House Gas
GIIP	Good International Industry Practice
GISD	Global Invasive Species Database
GoK	Government of Kenya
GR	Game Reserve
IBA	Important Bird Area
IFC	International Finance Corporation
ITCZ	Inter Tropical Convergence Zone
IUCN	International Union for Conservation of Nature
IUV	Indirect Use Value
I&APs	Interested & Affected Parties
JICA	Japan International Cooperation Agency
JST	JICA Study Team
KBA	Key Biodiversity Area
KFS	Kenya Forest Service

KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Service
KWTA	Kenya Water Tower Agency
LC	Least Concern
MAB	Man and Biosphere Reserve
MGR	Meter Gauge Railway
MoTI	Ministry of Transport and Infrastructure
MoWT	Ministry of Works and Transport
MP	Master Plan
MPA	Marine Protected Area
MR	Main Arterial Road
NASA	National Aeronautics and Space Administration
NCTTCA	Northern Corridor Transit Transport Coordination Authority
ND GAIN	(University of) Notre Dame Global Adaptation Index
NEC	Northern Economic Corridor
NEMA	National Environment Management Authority
NOAA	National Oceanic and Atmospheric Administration
NP	National Park
NR	National Reserve
NT	Near Threatened
PA	Protected Area
PPP	Policy, Plan or Program
SC	Somali Current
SEA	Strategic Environmental Assessment
SEP	Stakeholder Engagement Plan
TEV	Total Economic Value
ToR	Terms of Reference
UNEP	United Nations Environment Program
UNEP FI	United Nations Environment Program Finance Initiative
UNESCO	United Nations Educational, Scientific and Cultural Organization
USGS	United States Geological Survey
VU	Vulnerable
WCMA	World Conservation Monitoring Centre
WHO	World Health Organization
WHS	World Heritage Site
WRMA	Water Resources Management Authority
WS	Wildlife Sanctuary

ABBREVIATIONS

%	Percent
µg	Microgram
□C	Degrees Celsius
COx	Carbonaceous Oxides
CO2	Carbon Dioxide
dB	Decibel
G	Gram
H2S	Hydrogen Sulphide
Ha	Hectare
KES	Kenya Shillings
kg	Kilograms
km	Kilometres
km2	Square kilometres
Kshs	Kenya Shillings
l	Litre
M	Million
m	Metre
m2	Square meters
Ma	Million Years Ago
Mw	Moment Magnitude
N	Nitrogen
Ni	Nickel
NOX	Nitrogenous Oxides
O2	Oxygen
Pb	Lead
PMX	Particulate Matter
S	Sulphur
SOX	Sulphurous Oxides
USD	United States Dollars
Zn	Zinc

NON-TECHNICAL SUMMARY

PPP: Master Plan on Logistics for the Northern Economic Corridor (NEC), along with an integrated regional development strategy consistent with sub-regional and national development plans in Kenya.

PPP Owner: Ministry of Transport and Infrastructure (MoTI).

Master Plan Study Team

The Japan International Cooperation Agency (JICA) Study Team (JST), consisting of the following 16 experts, undertook the Master Plan study:

- Team Leader/ Development Planning;
- Logistics Plan;
- Infrastructure Development;
- Logistics Infrastructure 1;
- Logistics Infrastructure 2 (Railway);
- Freight Traffic Analysis and Demand Forecasting;
- Industrial Development and Investment Promotion;
- Public-Private Partnership;
- Mineral Resources and Energy;
- Power;
- Agriculture and Agri-Business;
- Urban Development/Land Use Specialist;
- Water;
- Economist (Socio Economic Analysis);
- Environmentalist (Social and Environmental Considerations); and
- Coordinator/Human Resource Development.

Northern Economic Corridor

The Northern Economic Corridor (NEC) is a multi-modal corridor, consisting of road, rail, pipeline, and inland waterways transport, and is recognized as a significant corridor for logistics in East Africa. The main road network runs from Mombasa Sea Port through Kenya and Uganda, to Rwanda and Burundi, and to the Democratic Republic of Congo (DRC). The road network also links Kenya and Uganda to Juba in South Soudan.

There are some obstacles presently in the NEC that have led to an increase in transport costs and significant time delays within the NEC

and have hindered the economic development of the region, specifically inland areas. These obstacles include:

- inadequate infrastructure;
- poor connectivity of modes;
- long delays of cargo at the port and border posts; and
- lack of goods to transport for the return trip from the inland area to Mombasa port.

Based on these obstacles, the overall objective of the Master Plan is to improve logistics for the NEC as well as to provide an integrated regional development strategy consistent with sub-regional and national development plans. It is hoped that this will:

- spur regional economic development within Kenya, as well as Uganda,
- improve the development of the industrial, agricultural, mining, petroleum, manufacturing and tourism sectors,
- lead to transport and logistics infrastructure development,
- result in an efficient and integrated multi-modal transportation system,
- result in the diversification of financial sources for infrastructure through PPP arrangements and infrastructure bonds, and
- reduce the bottlenecks to efficient cargo transportation, such as road and port congestion, as well as cross border delays.

Master Plan Development Vision and Strategies

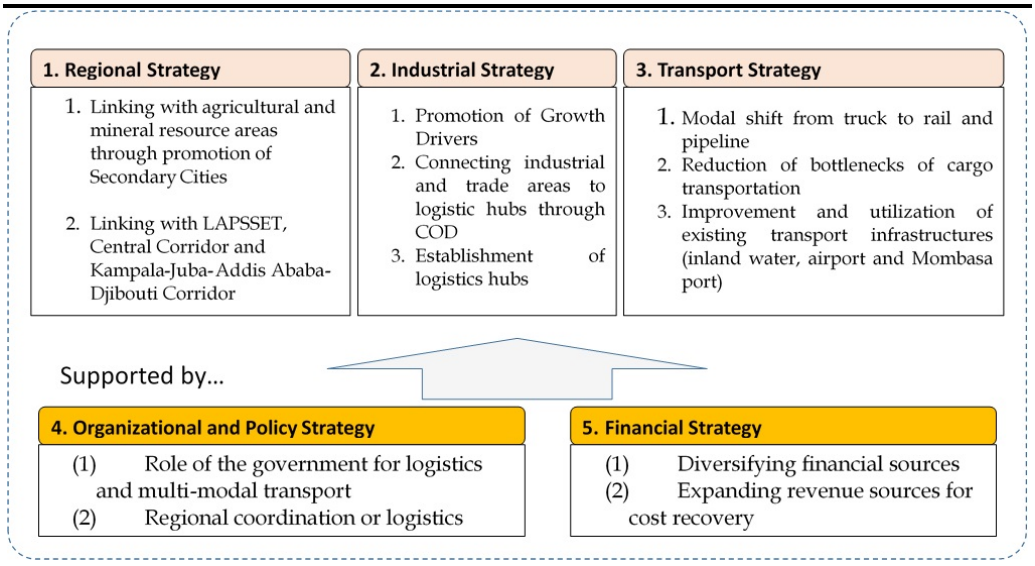
The development vision for the NEC is: '*to be the leading economic corridor with integrated transport and logistics systems in Africa*'. The Development Vision has four key words/phrases which make the NEC distinct from other corridors, and these are:

- *leading*, to be the leading, most efficient and reliable in Africa and the success can be applied to other corridors,
- *integrated transportation system*, which offers diversified and multi-modal options (road, rail, waterway, and pipeline) and facilitates regional integration in East Africa,
- *integrated logistic hub*, in which multi-modal options are available, and industrial areas connected and promoted by transport and logistic infrastructure,
- *economic corridor*, stimulate regional economic development in the area surrounding the corridor through development of

transport infrastructure, logistic facilities and creating industries (JST, 2016).

The proposed Development Vision will be attained through the implementation of 5 strategies, namely regional, industrial, and transport strategies, which will be strengthened by organizational and policy strategy as illustrated in *Figure* 0.1 below.

Figure 0.1 Proposed Five Strategies for the NEC



Source: JST, 2016

Master Plan Target Areas:

The target area of the Master Plan study covers the following routes and surrounding areas (1):

- **Main route**
  - Mombasa – Nairobi – Tororo –Kampala – Katuna – Kigali (Rwanda)

- **Sub-routes**
  - Eldoret – Nadapal – Juba (South Sudan)
  - Tororo – Gulu – Elegu – Juba
  - Kampala – Gulu – Elegu – Juba
  - Mbarara – Mpondwe – Kisangani (DRC)

Overall Implementation Strategy

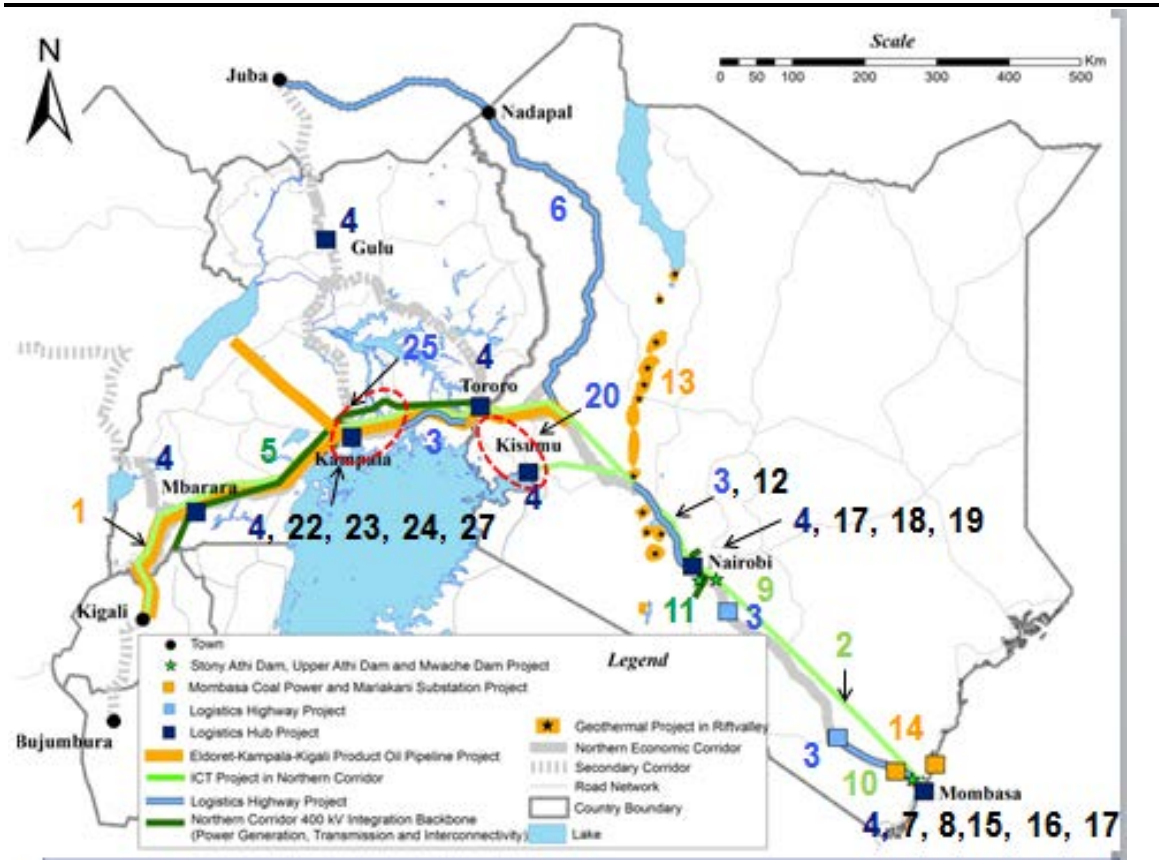
(1) It is important to note that an SEA is also being carried out in Uganda, under consultation with NEMA Uganda

The JST has selected 23 flagship projects that can contribute to continued logistics improvement along the NEC, to future economic development of Kenya and Uganda, as well as the region. The primary aim of these flagship projects is to:

- Solve future logistics bottlenecks along the NEC including at the port, roads, and logistic hubs,
- Contribute to cross border infrastructure, such as pipelines and transmission lines,
- Develop key industrial areas along the NEC,
- Ensure power and water supply to identified key industrial areas, and
- Support agribusiness and mining business developments.

The locations of the 23 NEC flagship projects are shown in *Figure 0.2* and *Table 0.1* below:

Figure 0.2 Location of Flagship NEC Projects in Kenya and Uganda



Source: JST, 2016

Table 0.1 Location of Flagship NEC Projects in Kenya and Uganda

No.	Sector	Project Title
1	Mining	Eldoret-Kampala-Kigali Oil Pipeline Project
2	Mining	ICT Project in Northern Corridor
3	Road	Logistics Highway Project
4	Logistics	Logistic Hub Project
5	Power	Northern Corridor Integration Backbone (Power Generation, Transmission and Interconnectivity)
6	Road	Eldoret-Juba Highway Project
7	Port	Mombasa Port Development Project
8	Urban Dev't	Project for Support of Re-organizing Logistics Facilities around Mombasa Port Area
9	Water	Stony Athi Dam and Upper Athi Dam Project
10	Water	Mwache Dam Project
11	Power	Isinya-Nairobi East Transmission Line Project
12	Industry	Geothermal Energy Based Regional Industrial Development in Rift Valley
13	Power	Geothermal Project in Rift Valley
14	Power	Mombasa Coal Power and Mariakani Substation Project
15	Power	Dongo Kundu-Mariakani Transmission Project
16	Industry	Mombasa Special Economic Zone Project

17	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Kenya
18	Agriculture	Agricultural Financing Improvement Project in Nairobi
19	Agriculture	Value Chain of Agriculture Development Pilot Project in Kenya
20	Urban Dev't	Logistics Based Kisumu-Kakamega Metropolitan Area Development Project
21	Mining	Study on Mining Master Plan in Uganda
22	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Uganda
23	Agriculture	Value Chain of Agriculture Development Pilot Project in Uganda
24	Power	Kampala-North-Namungona-Mutundwe 132 kV Transmission Line Refurbishment
25	Urban Dev't	Great Kampala (including Jinja) Logistic Based Urban Development Project
26	Urban Dev't	Study on master Plan for Urban Transport Development for Regional cities
27	Industry	SEZ Development Project in Kampala

Source: JST, 2016

Objectives of the Strategic Environmental Assessment (SEA) Study

To identify the potentially significant environmental and social issues relating to the Master Plan that will need to be addressed.

SEA Consultants

ERM East Africa Ltd. was appointed by JST to undertake the SEA for the Master Plan. ERM (and specialists appointed by ERM during the course of this SEA) have no financial ties to, nor are they a subsidiary, legally or financially, of JST.

ERM is a global environmental consulting organisation with over 150 offices in 40 countries employing more than 5,000 people. ERM, the world's leading sustainability consultancy, has operated throughout Africa for over thirty-five years, and our Sub-Saharan Africa Business Division with over 200 employees, is currently based in South Africa (Cape Town, Durban and Johannesburg), Mozambique (Maputo) and East Africa (Nairobi). Environmental Resources Management East Africa is registered with NEMA as a Firm of EIA/Audit Experts, Reg. No 7264.

SEA Methodology and Approach

The SEA was undertaken in fulfilment of:

- JICA Guidelines for Environmental and Social Considerations (2010) ,
- Kenyan Environmental Management Coordination Act of 1999 and 2015 (EMCA), and
- National Guidelines for SEA in Kenya (2012).

Screening

Screening is carried out to establish whether an SEA is appropriate and relevant to the development of a plan policy or program (PPP). It is used to determine the potential of a PPP to result in significant impacts on the environment and to determine if a SEA is required.

A PPP Brief was submitted to NEMA in June 2015 by the JST on behalf of MoTI. The screening results were thereafter communicated to the Ministry, i.e., the decision by NEMA that an SEA was necessary, and

was to be carried out in accordance with the National Guidelines for SEA in Kenya (2012).

Scoping

The scoping stage establishes the focus and content of the SEA and the relevant criteria for assessment. The scoping study identified the potentially significant environmental and social impacts relating to the PPP that needed to be addressed as part of the SEA Study. The scoping study was carried out by ERM between October 2015 and February 2016. The Scoping Report was submitted to NEMA on the 02nd March 2016 and the Report was approved by NEMA on 06th April 2016. Reference number NEMA/SEA/5/2/043.

Baseline Data Collection and Constraints Mapping

Due to the extensive coverage of the Master Plan, the level of baseline data was collected at County and City levels from secondary data, mainly the most recent County Integrated Development Plans (CIDPs), Strategic Plans and the Kenya National Bureau of Statistics. Baseline data was collected as per the National Guidelines for SEA in Kenya (NEMA, 2012), as indicated in *Box 0.1.*

Box 0.1 Baseline Data Collected

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

Document Review

A detailed literature review was undertaken based on the findings of the scoping process, which involved reviewing legislation, policies, County Development Plans, and previous studies carried out in the area to determine the baseline conditions and establish the legal, institutional and biophysical and socio-economic environmental setting of the proposed project.

The desk based study also included the development of Key Informant Interview (KII) questionnaires/guided discussions, as well as the approach to continued stakeholder engagement as outlined in the Stakeholder Engagement Plan (SEP).

Identifying Constraints and Opportunities

Constraints are features which limit the potential transport options available. Constraints identified by the SEA experts included:

- **areas with extensive development** within urban areas through to landscape and environmental constraints in most rural areas,
- **physical features** which exert special constraints on the shape of the logistics strategy, such as sensitive areas of landscape or heritage importance, areas of fertile soils with higher agricultural potential, water sources, groundwater conservation zones, built-up areas, hilly terrain, rivers and railways that are expensive to bridge, etc.,
- **biological features**, which most importantly include national parks, forest reserves, areas of conservation importance (such as wetlands, Important Bird Areas, areas of endemism), sites of international importance (recognised UNESCO and Ramsar sites and biodiversity hot-spots), and
- **Institutional or legal constraints** which are important to take into account, e.g., the provision of elements of the public transport system by private operators who will have their own commercial objectives. The extent to which these institutional and legal constraints have a material bearing on the outcome of the SEA depend on the extent to which the recommendations are developed with the private suppliers of transport.

In parallel with listing constraints, any **opportunities** to improve the transport and logistic system more widely or to have positive impacts on issues of wider concern, such as regeneration, were noted. Examples of opportunities include:

- ways of making better use of the existing infrastructure or existing underused assets (e.g. reopening rail lines),
- transport that opens up development land for regeneration or housing,
- enhancements to the environment,
- employment,
- contribution to the economy,
- opportunities to plan for better social infrastructure such as housing, schooling, health facilities, and

- the NEC Master Plan making tourism and heritage sites more accessible,.

Impact Assessment and Mitigation

The significance of the impact was formulated as a function of the receptor or resource environmental value (or *sensitivity*) and the *magnitude* of project impact (change). In other words, significance criteria are used to report the effect of the impact.

The approach to assigning the significance of impacts was based on reasoned arguments, professional judgement and taking on board the advice and views of appropriate Stakeholders.

Significance categories were used for positive (beneficial) as well as negative (adverse) effects. Applying the formula, the greater the environmental sensitivity or value of the receptor or resource, and the greater the magnitude of impact, the more significant the effect.

Determining the Significance of Cumulative Impacts

Five categories were e used as a framework for determining significance of cumulative effects, as follows:

- Severe - effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised
- Major - effects that may become a key decision-making issue
- Moderate - effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performances
- Minor - effects that are locally significant
- Not significant - effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

Stakeholder Engagement

The objectives of engaging stakeholders and the general public during the SEA process and beyond include:

- **Ensuring understanding:** An open, inclusive and transparent process of engagement and communication was undertaken to ensure that stakeholders were well informed about the Master Plan as it developed. Information was disclosed as early and as comprehensively as possible and appropriate.

- **Involving stakeholders in the assessment:** Stakeholders were included in the scoping of issues as well as the SEA Study. They also played an important role in providing local knowledge and information for the baseline to inform the impact assessment.

- **Building relationships:** Through supporting open dialogue, engagement helped establish and maintain a productive relationship between the Master Plan and stakeholders. This supports not only an effective SEA, but also strengthens the existing relationships and builds new relationships between MoTI and stakeholders.

- **Ensuring compliance:** The process was designed to ensure compliance with both national regulatory requirements and international best practice

Stakeholder Identification and Mapping

Stakeholder identification was undertaken through a brainstorming process and to guide the exercise, the following questions were asked:

- Which people/groups/institutions would be interested in the Master Plan development and implementation? What is/would be their role?
- Who are the potential beneficiaries of the NEC?
- Who might be adversely impacted? Who has constraints about the initiative?
- Who may impact the Master Plan? Who has the power to influence?

Thereafter, a list of stakeholder's organizations was developed and grouped as government, civil society, NGOs and private sector.

Stakeholder Meetings

Various stakeholder meetings were then held as shown in *Table 0.2* and *Table 0.3* below. It is important to note that since the coverage area of the Master Plan is so extensive:

- the target participants was limited to high level officials, and
- the places where the stakeholder meetings were conducted was limited to major cities/towns along the Corridor, namely Nairobi, Mombasa, Nakuru, Kisumu and Malaba (1) .

(1) This was agreed in consultative meetings between NEMA/JST/MoTI.

Baseline Phase Engagement

Two sets of opinion surveys/questionnaires were administered during the stakeholder meetings. The results were used to inform the baseline data.

Key Informant Interviews (KIIs) were held with stakeholders in April and May 2016, where the interviewees were taken through a guided discussion for the interview schedule. The interviews were held one on one between Stakeholders and individual SEA team members.

Website

A website for the purpose of information disclosure of the activities related to SEA was also developed. The website has been used for the advertisement of events such as stakeholder meetings but also reports and documents related to the Master Plan and SEA are kept there for download and review by the public. This website is hosted on the server of the MoTI and as such will continue to be updated after the SEA study by the Ministry. The address for the website is: http://www.transport.go.ke/Projects.html

Table 0.2 Stakeholder Meetings at the Scoping Stage

Date	Location	Venue	Attendees
02nd November 2015	Nairobi	Silver Springs Hotel	JICA, various Government Ministries, PIEA, LAPSSET Authority, KURA, Traffic Police, NEMA, KPC, SP Advisory, Toyota Tsusho East Africa Ltd, KIFWA, KURA, KeNHA, KeRRA
04th November 2015	Mombasa	Best Western Creekside Hotel	Ministry of Lands, KIFWA, KPRL, NCTTCA, KPA
06th November 2015	Nakuru	Merica Hotel	Ministry of Industrialisation, NEMA, KAM, Ministry of Labour, Social Security and Services, County Government of Nakuru
09th November 2015	Kisumu	Imperial Hotel	Ministry of Energy, NEMA, KeNHA and Lake Victoria Basin Development Authority
09th November 2015	Kisumu	Kisumu County Government Offices	Kisumu County Government CEC-Information Communication and Technology
10th November 2015	Kisumu	Kenya Association of Manufacturers (KAM) Offices in Kisumu	KAM Western and Nyanza Region and the Kenya National Chambers of Commerce and Industry (KNCCI)-Western and Nyanza Region
10th November 2015	Kisumu	County Government Offices, City Hall, Kisumu	Kisumu County Government City Planner
10th November 2015	Kisumu	Kisumu County Government Offices	Kisumu County Government CEC- Industrialisation
10th November 2015	Kisumu	Tom Mboya Labour College, Kisumu City	Government Officials from Busia County

Date	Location	Venue	Attendees
11th November 2015	Malaba	Hotel Lavantes	Sub County Officers - Busia County, Kenya Urban Roads Authority (KURA), Kenya National Highways Authority (KeNHA), Kenya National Chambers of Commerce and Industry (KNCCI), NEMA, Customs and Revenue Business Owners Association, Amagoro Motor Cycle Boda-Boda Association, Community of Malaba.

Table 0.3 Stakeholder Meetings at the SEA Study Stage

Date	Location	Venue	Attendees
04th May 2016	Kisumu	Imperial Hotel	MoTI, JST, KeNHA, LBDA, NIB, Maseno University, NEMA, KMFRI, AFFA
06th May 2016	Malaba	Hotel Lavantes	MoTI, JST, County Government of Busia, KeRRA, Ministry of Agriculture, Livestock and Fisheries, FOPPS SACCO, Immigration Malaba Border. KeNHA, KeRRA, NEMA
09th May 2016	Mombasa	Best Western Creekside Hotel	MoTI, JST, Immigration Department, CORDIO East Africa, Coast Water Services Board, KPRL, KMA, NEMA, KeRRA, KNCC, KFS, NCTTCA
11th May 2016	Nakuru	Merica Hotel	MoTI, JST, KeNHA, MOEID, Department of Immigration, KeRRA, Egerton University, NEMA
13th May 2016	Nairobi	Silver Springs Hotel	MoTI, JST, KARA, AFIPEK, Kenya Water Institute, JICA Kenya, FEAFFA, KWS, PIEA, Green Belt Movement, LAPSSET, KeRRA, Nature Kenya. RVR, Kenya Pipeline Company, KNCCI, KFWG, Transport Union, National Museums of Kenya
01st September 2016	Nairobi	CS Board Room, Works Building, MoTI	Principal Secretary (PS) Representatives from the following State Departments: Planning and Statistics, Water, Devolution, Public Work, MoTI, JST
22nd September 2016	Nairobi	Panafric Hotel	Representative from the Council of Governors, Ministry of Devolution and Planning, MoTI, JST.

The SEA Report will also be presented at future meetings, during the disclosure/validation process.

Key Impacts and Mitigation Measures

Table 0.4 below provides a summary of the key environmental and social impacts as well as mitigation measures identified during the SEA Study.

Table 0.4 Key Environmental and Social Impacts and Mitigation Measures

Impacts	Mitigation Measure
Environmental	
Habitat Alteration and Biodiversity Impacts	• Avoiding all high value biological constraints • Aligning new infrastructure with existing RoWs or defined corridors, • Limiting the size of construction RoWs where possible, and • Complying with existing land use and PA management plans
Air Emissions	• Complying with the Air Quality Regulations (2014) and emission standards as provided in KS 1515, • Using cleaner energy sources and promoting their use, • Limiting land conversion to only necessary areas, and • Managing wastes according to regulations in addition to employing the 3Rs to ensure they are managed sustainably.
Landscape Modification	• Locating infrastructure with existing land use plans, • Complying with ecosystem management plans of protected areas, • Limiting the size of construction RoWs, and • Avoiding protected areas and settlements
Soil	• Limiting excavations to only necessary areas, • Implementing soil conservation strategies in areas with high Soil Erosion Potential, • Complying with waste management regulations, • Complying with regulations and guidelines on soil conservation such as those provided by land use plan, ecosystem management plans and those gazetted by the Agriculture and Food Authority, and • Implementing run-off and water management measures
Hydrology and Hydrogeology	• Avoiding wetlands, water towers, groundwater conservation areas and flood plains, • Implementing water ingress management measures as appropriate, and • Controlling run-off from infrastructure and implementing sustainable drainage systems (SUDS) which mimic or allow natural percolation of water.
Pollution	• Developing complementary waste management facilities including a sanitary landfill and a hazardous waste disposal facility, • Integrating Life Cycle Assessments into the project level environmental risk management,

Impacts	Mitigation Measure
	• Managing wastes (collection, transport and disposal) in accordance to the provisions of the Waste Management Regulations (2006) and providing adequate equipment and facilities to do so, and • Integrating the 3Rs (Reduce, Reuse, Recycle) of waste management in NEC MP and at the project level.
Natural Resource Demand	• Integrating Life Cycle Assessment into the project level environmental risk management, • Complying with regulations governing resource extraction such as Forests Act (2005), EMCA (2014), Sand Harvesting Guidelines (2009), Water Resource Management Rules (2006) and Water Act (2014) amongst others, • Adopting sustainability standards at the project level such as those pertaining to green building and energy efficiency (LEED), • Ensuring building materials are sourced from sustainable sources, and • Implementing demand management and resource efficiency measures for water, electricity and materials.
Accidents	• Complying with industry guidelines and regulations in the design of infrastructure, • Implementing and supporting programs to ensure vehicles and crafts are maintained to regulatory approved standards, • Implementing and supporting programs that ensure drivers and pilots are adequately trained to operate their respective vehicles and crafts, • Implementing and supporting programs aimed at raising public awareness in the pertinent industries, and • Developing project level emergency/disaster preparedness and response plans.
Spills	• Developing project level emergency/disaster preparedness and response plans as well as spill contingency plans and providing resources to respond to spills, • Complying with the National Oil Spill Response Plan by integrating its provisions to any project level contingency plans, • Implementing and supporting monitoring programs at the project level, • Providing training to project staff on spill prevention and management, and • Adhering to industry guidelines on the design and maintenance of any fluid storage, loading and conveyance equipment and infrastructure.
Natural Hazard	• Avoiding construction in flood plains in line with industry guidelines, • Integrating considerations for seismicity in the engineering design of infrastructure in

Impacts	Mitigation Measure
	seismically active areas, • Complying with industry guidelines for the design and maintenance of dams such as those published by the International Commission for Large Dams (ICOLD), • Avoidance of fault zones, • Incorporating landslide prevention measures for any construction in landslide prone areas, • Implementing and supporting disaster/emergency preparedness and response plans and programs at the project level, • Implementing and supporting programs aimed at raising personnel and public awareness on potential hazards, and • Integrating the provisions of the National Disaster Response Plan into project level disaster/emergency preparedness and response plans, and coordinating with the pertinent authorities.
Socio-Economic	
Loss of Cultural Heritage	• The presence of cultural heritage assets would need to be confirmed in detailed studies associated with each potential project; this could influence the design and location of infrastructure, commercial enterprises and industrial facilities. • Incorporation of heritage sites into tourism master plans as a way of preserving such sites • Projects associated with the construction and operation of infrastructure should be subject to Environmental and Social Impact Assessment (ESIA) commensurate with the scale of the project and impacts which includes consideration of cultural heritage and the development of appropriate mitigation and management plans. • In terms of locally important cultural heritage sites, any loss or alteration to such sites should be consulted on, and agreed, with the local communities and the custodians of the site. If necessary, appropriate rituals should be undertaken to move the cultural asset, or to otherwise expiate disturbance or loss of the site. • A framework "chance finds procedure" should be developed to support the Master Plan which involves and references all relevant ministries, other agencies and major cultural heritage stakeholders in the country. The framework procedure should be deployed within the construction and management planning for all developments implemented under the auspices of the Plan.
Livelihood	• Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social

Impacts	Mitigation Measure
	risks are adequately understood and addressed through mitigation
Rural Urban Migration	• Infrastructure projects should be subject to Environmental and Social Impact Assessment (ESIA) undertaken in line with international standards such as those of the World Bank or the International Finance Corporation (IFC). The scope of the ESIA should always include consideration of rural – urban migration. • Urban development plans / CIDP should also cater for rural-urban migration.
Public Health	• Infrastructure projects should be subject to Environmental and Social Impact Assessment (ESIA) undertaken in line with international standards such as those of the World Bank or the International Finance Corporation (IFC). The scope of the ESIA should always include consideration of health related impacts. For large Projects this may require that appropriately qualified international experts are appointed to address impacts on health. • The development and implementation of HIV/AIDS/malaria policies and information documents for all workers directly related NEC projects. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS as well as malaria. • All projects should have a Worker Code of Conduct for all project personnel that include guidelines on worker-worker interactions, worker-community interactions and development of personal relationships with members of the local communities. As part of the Worker Code of Conduct, all project personnel should be prohibited from engaging in illegal activities including the use of commercial sex workers and transactional sex. Anyone caught engaging in illegal activities will be subject to disciplinary proceedings. If workers are found to be in contravention of the Code of Conduct, which they will be required to sign at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. • Working in conjunction with relevant partners (eg health authorities, NGOs, development agencies), information, education and communication campaigns around diseases and health practices should be developed as part of the Master Plan implementation
Insecurity	• The successful implementation of the NEC Master Plan Strategies will require the active participation of the Ministry of Interior and Coordination of National Government.
Land Acquisition and resettlement	• Formulation and implementation of a land title management project to establish a land title database with cadastral map information, and • Arrangement of technical assistance for a land acquisition and resettlement program

Impacts	Mitigation Measure
	• Any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation. • Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation • The budgeting process for any of the NEC initiatives must also include a budget for resettlement and compensation, as these costs can be quite significant
Land use and settlement pattern	• Institutions responsible for land use plans should ensure that they contain measures relating to infrastructure provision that are robust and fit for purpose, with a focus on the poorest and most vulnerable communities • Avoidance of conservation areas, national parks, wetlands, protected areas
Urbanisation	• Any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation. • Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation • Regional and/or County Integrated Development Plans (CIDP) to plan for such urbanisation
Land tenure	• Formulation and implementation of a land title management project to establish a land title database with cadastral map information.

Recommendations

Recommended Alternative

The *Multi-Core with Regional Industrial Development Type* alternative aims at balanced growth and efficient logistics in the NEC region by promoting urban functions of 18 Secondary Cites, including 6 Secondary cum Regional Production Centres (see *Figure 0.3*).

This alternative promotes:

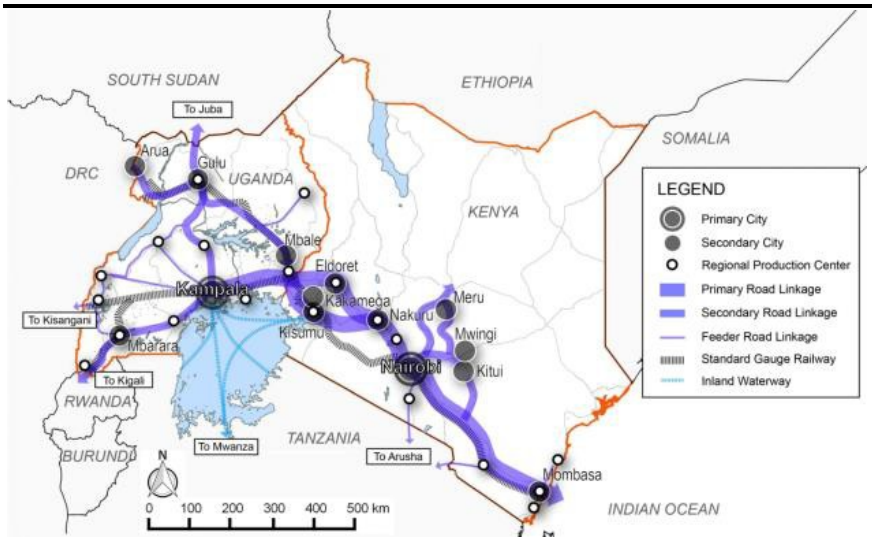
- decentralizing urban functions to Secondary Cities,
- the urbanization of Secondary Cities and the concentration of population on them from surrounding regions,
- regional production centres, as demand for commercial and services in urban area (which results from surrounding regional area) will promote the demand of Secondary Cities.

These Secondary Cities will serve as regional urban centres supplying urban services and logistics hub connecting Regional Production Centres and Primary Cities as consumption areas. In this alternative, the involvement of local Government is also essential.

It is important to note however, this structure plan requires more public engagement and management capacity for urban management and development control to avoid unnecessary development.

This is the preferred alternative because it is consistent with Vision 2030, the MoTI Strategic Plan and the goals of the Master Plan, which are to improve logistics for the NEC as well as provide an integrated regional development strategy consistent with sub-regional development plans and national development plans.

Figure 0.3 Alternative C: Multi-Core with Regional Industrial Development Type



Source: JST, 2016

Subsequent ESIA for NEC Projects

JST has proposed 119 projects for the development of the NEC in both Kenya and Uganda the following sectors:

- road
- railway
- border posts
- port, airport, and inland way
- logistic hub
- oil and mining
- agriculture and fishery
- manufacturing
- power
- water

It is recommended that these projects be subjected to Environmental and Social Impact Assessments (ESIA) in order to:

- identify all potentially project-specific significant adverse environmental and social impacts of the project and recommend measures for mitigation;

- gather baseline data to inform the assessment of impacts and to monitor changes to the environment as a result of each of the projects as well as evaluate the success of the mitigation measures implemented; and

- recommend measures to be used to avoid or reduce the anticipated negative impacts and enhance the positive impacts.

For each project the ESIA should be carried out in line with Kenyan regulations as well as international best practice as defined by the World Bank or International Finance Corporation (IFC).

The ESIA reports should also consider environmental impacts and also include the following socio-economic impacts, where possible:

- cultural heritage,
- loss of livelihoods,
- health, and
- rural – urban migration

It is also recommended that any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation

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1 INTRODUCTION

1.1 OVERVIEW

The *JICA Study Team* (JST) on behalf of the *Ministry of Transport and Infrastructure* (MoTI) appointed Environmental Resources Management East Africa Limited (ERM) as independent environmental and social consultants to undertake a Strategic Environmental Assessment (SEA) for the Master Plan on Logistics in the Northern Economic Corridor hereafter referred to as "the Master Plan".

This SEA is applicable for the entire Master Plan which covers both Kenya and Uganda, and as such, this SEA will be provided in two distinct parts; one document applicable for Kenya and one for Uganda. Both SEA documents will have many commonalities, but each will describe specifics separately for both Kenya and Uganda, and will be submitted separately to the applicable authorities in both countries.

1.2 THE NORTHERN ECONOMIC CORRIDOR

The Northern Economic Corridor (NEC) is a multi-modal corridor, consisting of road, rail, pipeline, and inland waterways transport, and is recognized as a significant corridor for logistics in East Africa. The main road network runs from Mombasa Sea Port through Kenya and Uganda, to Rwanda and Burundi, and to the Democratic Republic of Congo (DRC). The road network also links Kenya and Uganda to Juba in South Soudan.

There are some obstacles presently in the NEC that include:

- inadequate infrastructure;
- poor connectivity of modes;
- long delays of cargo at the port and border posts; and
- lack of goods to transport for the return trip from the inland area to Mombasa port.

These obstacles have led to an increase in transport costs and significant time delays within the NEC and have hindered the economic development of the region, specifically inland areas.

The Governments of Uganda and Kenya therefore requested the Government of Japan (GoJ) to implement a project to formulate a master plan on logistics in the NEC in order to promote regional development. In response to these requests, the Japan International

Cooperation Agency (JICA) dispatched a 'Detail Design Formulation Team for the Project' in October and November 2014. The Team proposed to develop a concept that would cover not only logistics, but also regional development along the NEC. The Governments of Kenya and Uganda agreed with the concept and signed the Record of Discussion with JICA for the implementation of the *Project for Formulation of the Master Plan on Logistics in the Northern Economic Corridor* (the Master Plan).

1.3 OBJECTIVES OF THE MASTER PLAN STUDY

The objective is to formulate a Master Plan on Logistics for the NEC, along with an integrated regional development strategy consistent with sub-regional and national development plans. The target year of this Master Plan is 2030.

1.4 PPP OWNER

The Plan Policy Program (PPP) Owner for the NEC in Kenya is the Ministry of Transport and Infrastructure (MoTI). A key task of this Ministry is to position Kenya as the logistics hub of the region by creating a modern and efficient transport system for goods and services within the Counties and also with other countries in the region (1) . The Ministry has two Departments, namely the State Department of Transport and the State Department of Infrastructure. This Master Plan falls under the latter.

1.5 DECISION TO UNDERTAKE THE SEA

In order to decide whether an SEA was appropriate and relevant to the development of the Master Plan, a Policy, Plan or Program (PPP) Brief was submitted to the National Environment Management Authority (NEMA) in June 2015 by the JST on behalf of the Ministry of Transport and Infrastructure (MoTI) as the PPP Owner. The screening results were thereafter communicated to MoTI, i.e., the decision to undertake an SEA.

Thereafter, ERM was contracted as the SEA Expert and commenced with a Scoping Study between October 2015 and February 2016 to establish the focus and the content of the SEA, as well as the relevant criteria for assessment. The objectives of the Scoping Study were to:

(1) Source: http://www.kenyans.co.ke/government/ministry-transport-infrastructure

- Determine whether significant environmental and social impacts are likely to arise from implementing the Master Plan;
- Develop a Stakeholder Engagement Plan (SEP) and provide a record of comments and responses received from Stakeholders;
- Communicate the results of the SEA scoping process; and
- Facilitate an informed, transparent and accountable decision-making process by the relevant authorities.

ERM submitted the SEA Scoping Report to NEMA on the 02nd March 2016 and the Report was thereafter approved by NEMA on 06th April 2016, Reference number NEMA/SEA/5/2/043, (see *Annex A* for the correspondence with NEMA). The outcomes of this Scoping Report, agreed to by NEMA, have been used in this SEA study.

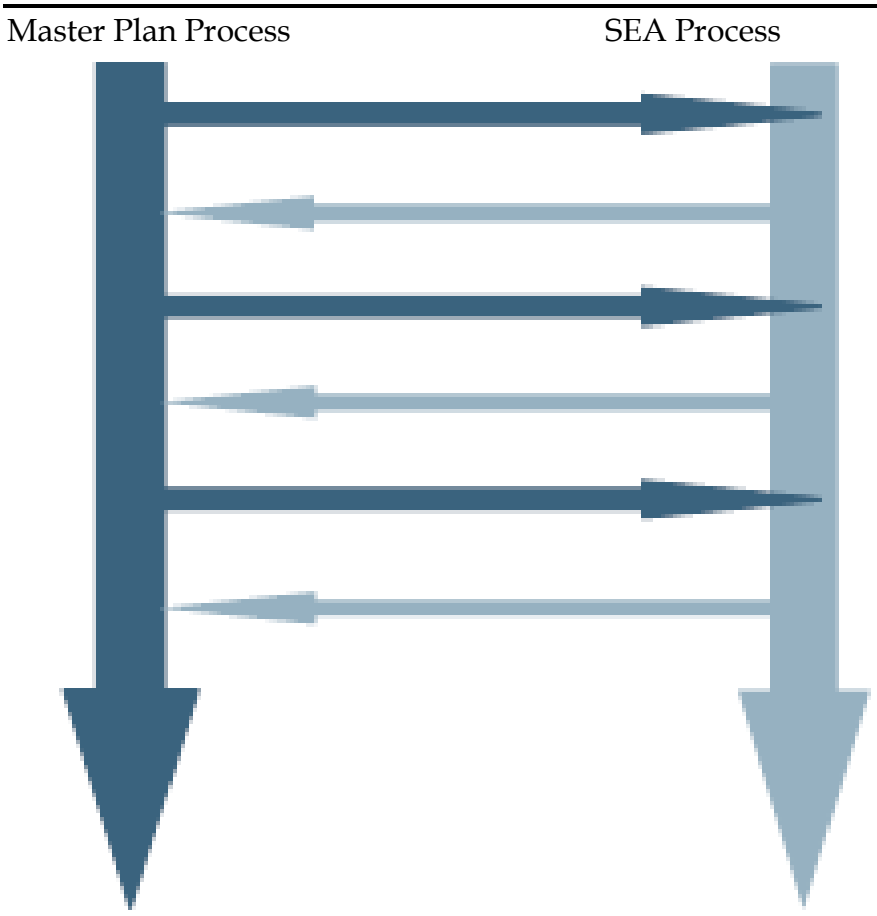
1.6 OBJECTIVES OF THE SEA

The objective of the SEA is to identify the potentially significant environmental and social issues relating to the Master Plan that will need to be addressed as part of the SEA Study. The SEA will therefore be conducted in order to:

- Ensure that the Master Plan is compatible with sustainable planning and environmental management;
- Enhance the consistency of the Master Plan across different Policy, Plan, or Program (PPP) sectors;
- Identify the potential environmental, socioeconomic and cultural impacts of the Master Plan; and
- Support decision-making and incorporate emerging environmental issues into sustainable development.

The SEA is being undertaken in parallel with the Master Plan formulation process (see *Figure 1.1*). This way, environmental and social considerations will be addressed in a proactive manner so as to better inform the decision making processes.

Figure 1.1 Parallel SEA Process



Source: Partidário, 2007

1.7 MASTER PLAN STUDY TEAM

The JST, consisting of the following 16 experts, is currently undertaking the Master Plan study in both Kenya and Uganda:

- Team Leader/ Development Planning;
- Logistics Plan;
- Infrastructure Development;
- Logistics Infrastructure 1;
- Logistics Infrastructure 2 (Railway);
- Freight Traffic Analysis and Demand Forecasting;
- Industrial Development and Investment Promotion;
- Public-Private Partnership;
- Mineral Resources and Energy;
- Power;
- Agriculture and Agri-Business;
- Urban Development/Land Use Specialist;

- Water;
- Economist (Socio Economic Analysis);
- Environmentalist (Social and Environmental Considerations); and
- Coordinator/Human Resource Development.

1.8 SEA CONSULTANTS

ERM East Africa Ltd. was appointed by JST to undertake the SEA for the Master Plan. ERM (and specialists appointed by ERM during the course of this SEA) have no financial ties to, nor are they a subsidiary, legally or financially, of the JST.

ERM is a global environmental consulting organisation with over 150 offices in 40 countries employing more than 5,000 people. ERM, the world's leading sustainability consultancy, has operated throughout Africa for over thirty-five years, and our Sub-Saharan Africa Business Division with over 200 employees, is currently based in South Africa (Cape Town, Durban, Johannesburg and Pretoria), Mozambique (Maputo) and East Africa (Nairobi).

ERM East Africa Ltd. is registered with NEMA as a Firm of EIA/Audit Experts, Reg. No 7264 (see *Annex B* for the NEMA Certificate of Registration and 2016 Practicing Licence). The SEA team is presented in *Table 1.1:*

Table 1.1 ERM SEA Team

Position	Name	Qualifications
Partner in Charge	Michael (Mike) Everett	M.Sc. Hydrology, B.Sc. (Hons) Hydrology and Soil Science, NEMA Kenya Lead EIA/Audit Expert (Reg. No 7263)
Project Manager	Wanjiku Githinji	MSc Environmental Assessment, Auditing and Management Systems, B.Sc. (Hons) Environmental Studies, NEMA Kenya Lead EIA/Audit Expert (Reg. no 1244)
Deputy Project Manager	Michael Waweru	Master's in Environmental Planning and Management (ongoing), BSc Environmental Studies, NEBOSH International General Certificate in Occupational Health and Safety, NEMA Kenya Associate EIA/Audit Expert (Reg. no 2760)
Team Leader	Haroub Ahmed	MSc in Energy Technology (MSc. ET), BSc Environmental Science, NEMA Kenya Lead EIA/Audit Expert (Reg. No. 1243)
Environmentalist	Nato Simiyu	MSc in Environmental Health Engineering, Post-Graduate Diploma in Environmental and Natural Disaster Management, BSc in Mathematics and Chemistry
Urban/Physical Planner	Geoffrey Njoroge	MA in Geography, MA in Planning, BA in Geography
Sociologist/Stakeholder Engagement Lead	Philip Wandera	M. Phil in Environmental Economics, BA (Hons) in Economics and Rural Economics
Transport Planner	Sylvia Njane	Bachelor of Technology (Civil and Structural Eng.)

1.9 REPORT STRUCTURE

The Structure of this SEA Report is as follows:

Table 1.2 Structure of the SEA Report

Section	Contents
Executive Summary	Non-technical summary
Chapter 1 Introduction	Contains a brief overview of the Northern Economic Corridor, SEA, purpose of the report, PPP owner, Master Plan consultant, SEA consultant and an outline of the report structure.
Chapter 2 Description of the NEC	Includes a description of the proposed Master Plan
Chapter 3 Legal and Institutional Framework	Outlines the legislative and policy requirements applicable to the PPP
Chapter 4 Methodology and Approach	Outlines the approach to the SEA and summarises the process undertaken to date.
Chapter 5 Environmental Baseline	Describes the receiving environmental baseline environment.
Chapter 6 Socio-Economic Baseline	Describes the receiving socio-economic baseline environment.
Chapter 7 Alternatives	Describes the alternatives that have been considered and the reasons for the selection of the preferred alternative
Chapter 8 Stakeholder Engagement	Describes the approach to and outcomes of the stakeholder engagement process
Chapter 9 Key Environmental Impacts	Describes and assesses the potential physical and biological impacts
Chapter 10 Key Socio-Economic Impacts	Describes and assesses the potential social, cultural, economic and human health impacts
Chapter 11 Mitigation and Management	Specifies the mitigation and management measures to be undertaken
Chapter 12 Conclusion and Recommendations	Summarises the key findings of the SEA and provides recommendations for the mitigation of potential impacts and the management of the proposed plan.

2 DESCRIPTION OF THE NEC

This *Chapter* provides an overview of the Northern Economic Corridor (NEC) and Master Plan. The main source of information for this *Chapter* is the Master Plan on Logistics in the Northern Economic Corridor - Interim Report (2016) prepared by the JICA Study Team (JST).

2.1 BOTTLENECKS TO EFFICIENT CARGO TRANSPORTATION

According to the JST (2016), bottlenecks to efficient cargo transportation, which have hindered the economic development of the region, include:

2.1.1 Road Congestion

This occurs mainly around Mombasa, Nairobi, Nakuru, Eldoret, Kisumu and Malaba in Kenya. The congestion around these points is caused by both cargo and passenger traffic. According to the JST (2016), while improvement of existing road networks and construction of new ones have been aggressively implemented, road congestion still remains a serious problem.

2.1.2 Mombasa Port Operations

Mombasa Port is the only international seaport on the NEC, and while the Port has implemented projects with capacity expansion and efficiency improvement, these developments have not matched the 10% average annual growth rate in demand for import cargo registered in the past five years (JST, 2016). As the container terminal construction and cargo handling improvement cannot catch up with the rapid increase in cargo demand, this translates to longer time at the Port.

In addition to the congestion of Mombasa port, Mombasa city is characterised by inadequate road capacity and inappropriately sited container freight stations. These factors make Mombasa to be the most heavily congested section by trucks in the NEC (JST, 2016)

2.1.3 Cross Border Delays

One Stop Border Post (OSBP) projects have greatly contributed to improved operational efficiency but it still a takes long time to cross

the borders. At the Malaba border located between Kenya and Uganda, for example, queues of more than 3km are commonly witnessed during the daytime. In addition, custom clearance procedures are still inefficient due to a lack of human capacity, electricity, internet communication, inadequate parking lots, and access roads, amongst others

2.2 *OBJECTIVES OF THE NEC MASTER PLAN*

Based on the bottlenecks described in *Section 2.1*, the overall objective of the Master Plan is to therefore to improve logistics for the NEC as well as to provide an integrated regional development strategy consistent with sub-regional and national development plans. It is hoped that this will spur regional economic development within Kenya and Uganda.

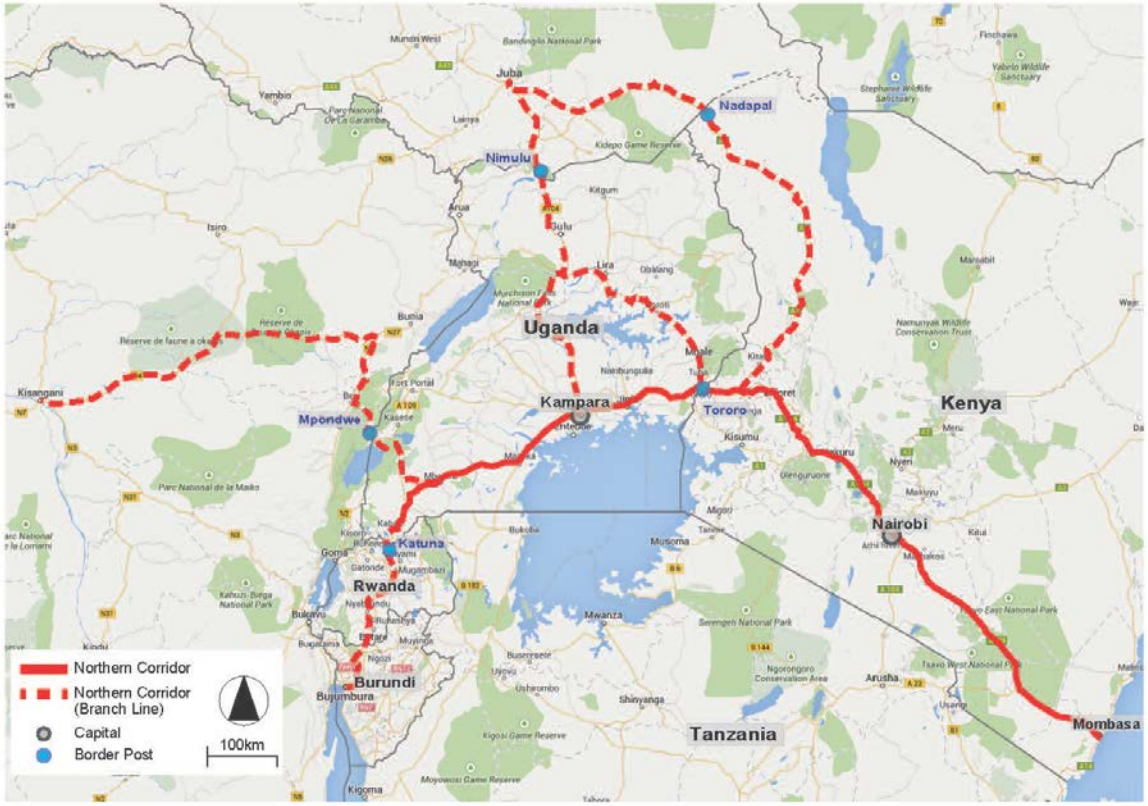
2.3 *TARGET AREAS*

The target area of the Master Plan study covers the following routes and surrounding areas (see *Figure 2.1* below):

- **Main route**
  - Mombasa – Nairobi – Tororo –Kampala – Katuna – Kigali (Rwanda)

- **Sub-routes**
  - Eldoret – Nadapal – Juba (South Sudan)
  - Tororo – Gulu – Elegu – Juba
  - Kampala – Gulu – Elegu – Juba
  - Mbarara – Mpondwe – Kisangani (DRC)

Figure 2.1 Routes of the Northern Economic Corridor



Source: JST, 2016

2.4 *REGIONAL STRUCTURE PLAN*

The significant issues with regards to the current spatial structure include an excess of imports and the concentration of functions on the country's capitals. The rate of import and export of East African Community (EAC) countries are 92% and 8% respectively, meaning that most of the income is outflowing to outside of the region. The area within a 50 km radius of Nairobi and Kampala accounts for 33% and 37% of the urban population in Kenya and Uganda respectively. Nairobi for instance, generates 40-50% of the GDP in Kenya, according to Kenya Vision 2030.

Three alternative spatial structures for the NEC were examined, taking into account the following factors:

i) *regional industrial development*: promoting regional industrial development;
ii) *urban centers of the region*: centralizing urban functions or decentralizing; and
iii) *Transport network*: promoting regional linkage.

These alternatives are discussed separately in the Alternatives Chapter of this report (*Chapter 7*). The preferred alternative for the NEC, as concluded by the JST (2016) is described in this *Chapter* in *Section 2.9* below.

2.5 *SECTOR DEVELOPMENT IN KENYA AND UGANDA*

2.5.1 *Industrial Development*

Despite primary commodities production from both the agricultural and mining sectors in Kenya and Uganda, value-addition within both countries is limited. Some products consumed in the domestic and/or regional market are processed; these products include primarily dairy and meat products and cement production, based on limestone deposits.

Kenya does have a relatively developed system of industries and a connection to the export market through the Port of Mombasa, as well as a relatively well facilitated air cargo network. The connectivity advantage further gives Kenya opportunities for an increased share in the domestic and regional markets. As such, Kenya's industrial development should expand the production not

only of currently available products, but also of products which can serve the multiple sectors across the region.

Uganda's value addition activities are still at the infancy stage. Manufacturing using imported materials does occur, and this serves both the domestic and export market in the other corridor countries, such as the DRC and South Sudan.

2.5.2 Agriculture Development

With regards agricultural development in Kenya, the candidate agricultural products selected as growth drivers for the Project include tea, coffee, cut flowers, processed fruits and vegetables, rice, and meat products.

With regards agricultural development in Uganda, the candidate agricultural products selected as growth drivers for the Project include coffee, oil seed, palm oil, rice, meat production, and maize.

These growth drivers were selected based on future demand from the global, regional, and domestic markets.

2.5.3 Mining and Petroleum Sector Development

Coal, crude oil, natural gas, soda ash, niobium and rare earth elements will be growth drivers for the mining and energy sectors in the NEC region in Kenya.

Petroleum and crude oil will be growth drivers in the NEC region for Uganda.

With regards to the expansion and extension of the regional oil product pipeline, construction of an oil product pipeline in the East African Community (EAC) member nations has been endorsed by EAC member nations, and the project is considered to have the potential to contribute to the economic development, as well as energy security, in the region.

The pipeline system in Kenya will be extended further and tied into Uganda's system, and further extended to Kigali in Rwanda, and/or Tanzania.

2.5.4 *Manufacturing Sector Development*

Growth drivers for Kenya's and Uganda's manufacturing sector are provided in *Table 2.1* and *Table 2.2* below:

Table 2.1 Categories of Kenya's Manufacturing Growth Drivers

Category	Timeframe for Development	Examples of Industries
Processing for domestic and regional market	Short to mid-term	Construction materials (e.g., iron and steel, glass), consumer goods (e.g., soaps and detergents, processed foods), plastics packaging Note: It can be both heavy and light industry.
Export-oriented light manufacturing	Short to mid-term	Textile and apparel, Leather

Source: JST, 2016

Table 2.2 Manufacturing sector in Uganda

Industries	Production and Income Increase
Construction materials (e.g., iron and steel)	The demand in domestic and regional markets will provide the income through the industry.
Consumer goods (e.g., soaps and detergents)	The demand in domestic and regional markets will provide the income through the industry.
Leather	World market is growing.

Source: JST, 2016

2.5.5 *Tourism Sector Development*

Kenya Vision 2030 has identified tourism as one of the six priority sectors. However, limited resources, poor infrastructure and facilities in and around the national parks, and security concerns have been cited as barriers for the sector's development. The development of cities as tourism hubs will generate additional flow of goods and passengers along the NEC, and the Corridor will also serve as a key infrastructure to tourist sites.

In Uganda, the total number of visitors has largely increased in recent years, although the rate of increase in tourism numbers year-on year has become slow and unstable. Six Tourism Development Areas (TDAs) are designated according to the current major and potential destination locations. TDAs will be connected to each other by air or by road, and the NEC will act as the necessary infrastructure to ensure access to most of these TDAs, which will serve to boost regional development.

2.6 KEY GROWTH DRIVERS

Key growth drivers considered in both Kenya and Uganda include those which will:

i) expand domestic and regional, and international markets for net profit;
ii) produce strategic products or industries which provide significant solutions for industrial structure upgrading, and
iii) Includes industries with strong forward and backward linkages.

Growth drivers categorized for both Kenya and Uganda are shown in *Table 2.3* below.

Table 2.3 Candidates for Growth Drivers

Source of Growth		Kenya	Uganda
i)	Expanding domestic and regional, and international markets for net profit	• Soda Ash, Niobium and Rare Earth Elements • Coffee, Tea, Rice, , Processed Fruits and Vegetables, Meat Products • Consumer Goods (soaps, cosmetics and detergents), • Construction Materials (cement, iron and steel)	• Coffee, Dairy Products, Consumer Goods (e.g., soaps and detergents), Leather Products, Rice, Maize, Construction Materials (iron and steel), Meat Products
ii)	Strategic products or industries which provide significant solutions for industrial structure upgrading	• Crude Oil • Coal, Natural Gas	• Crude Oil • Petroleum • Phosphate
iii)	Industries with strong forward and backward linkages	• Cut Flowers • Apparel Industry Leather Industry, Packaging	• Oil Seeds • Other Minerals (e.g., gold, iron ore), wolfram, tin, tantalite, copper etc) Palm Oil
iv)	Other Services	• Tourism, Logistics Services	• Tourism, Logistics Services
Total		**20 Drivers**	**15 Drivers**

Source: JST, 2016

The above 35 growth drivers have the potential for:

i) increasing exports to the East African region or international markets,
ii) decreasing imports through the expansion of domestic production, and
iii) Increasing the contribution to add value to the local economy.

2.7 TRANSPORT AND LOGISTICS INFRASTRUCTURE DEVELOPMENT

2.7.1 Overview

The current transport and logistics situation for the NEC is that the movement of cargo is heavily influenced by road traffic congestion, the operation of the Mombasa Port, and cross border operations.

For future operations, other important aspects such as how the corridor interacts with both the central and Lamu Port Southern Sudan-Ethiopia Transport (LAPSSET) corridors, how to deal with an increasing demand in logistics for minerals from Uganda, DRC and South Sudan to the port of Mombasa, and how to develop local industries and promote local products for export, needs to be considered.

2.7.2 Current and Future Gaps

Roads in Kenya

Major bottlenecks for road traffic are witnessed in the city centers of Mombasa, Nairobi, Nakuru, Eldoret, Kisumu and their surrounding areas, as well as around the borders of Malaba (in Kenya) and Busia (in Uganda), Mombasa Port and at railway stations.

Currently very long queues of trucks and trailers of more than 2km can be seen in both Mombasa urban areas and at Malaba's border area during the day.

Although the road surface on the main route is generally good, heavy trucks cause a deterioration in the road surface over relatively short periods of time. There is a need, therefore for continuous improvement and maintenance of the road network, to meet increasing traffic demand, for both safe and efficient logistics and passenger transport.

Roads in Uganda

In Uganda, bottleneck points for road traffic can be seen in the city centers of Kampala, Entebbe and Jinja. Passenger car demand is greater than cargo truck demand. Therefore, such bottlenecks should be dealt with through an urban transport management

plan, rather than through cargo traffic management.

Bottleneck points also exist at the Malaba border with Kenya, and around the Inland Container Depots (ICDs) and railway cargo station in Kampala. In order to unlock the bottlenecks, it will be necessary to expand network capacity by construction of new expressways, bypasses, ring roads, over/under passes, additional climbing lanes and conducting traffic demand management.

Railways

Rift Valley Railways (RVR) has invested in infrastructure and equipment but overall, it appears to have lost market share of cargo transportation to trucking. Further strengthening of track and infrastructure and additions to rolling stock should be considered to enable RVR to increase its cargo share.

The project to implement a standard gauge railway (SGR) serving the NEC has been commissioned, with the line between Mombasa and Nairobi expected to be complete, and in operation, by June 2017. The SGR project has as its objective, the provision of a world class railway service along the NEC, and to increase its competitive advantage by increasing its market share of cargo from trucking to rail.

Port

Although dwell time and loading/unloading times in the Mombasa Port have significantly reduced, it still takes too long to import and export cargo, to clear customs and to move cargo out of the port. Dwell time and loading/unloading times are the dominant factors in the total travel time for cargo in and out of the Mombasa port.

The roads within the Mombasa urban area are also heavily congested, resulting in cargo traffic rendered immobile during the day-time. The most fundamental problem is an inadequate road network and the capacity of the trunk road, with an urgent need to construct the Southern by-pass. Moreover, relocation of Container Freight Station (CFSs) services outside the port should be considered in the short term in order to avoid a concentration of cargo traffic on the Mombasa Port road.

Waterways

Currently only one ferry is in operation and very few boats come to Port Bell (in Uganda) from Kisumu port (in Kenya). Cargo throughput at Port Bell in Uganda has rapidly declined since 2005, with only 8,100 tons of cargo handled in Port Bell in 2014; this in relation to the peak figure of 478,115 tons of cargo handled in 2002.

Strategic targeting of several cargos with potential demand for lake transport as a form of transport should be considered. In this regard, inter-regional trade or Expected Further Clearance (EFCs') trade with both Uganda and Tanzania, as well as international trade, should be investigated. Kisumu and Port Bell should be well linked with Mwanza port (in Tanzania), through an improvement in infrastructure of wagon/car ferry ports, as well as through the provision of new vessels, including car ferries and passenger vessels.

Pipelines

Demand for petroleum products has increased significantly and a further increase is forecast. In addition, transit oil products to inland countries adjacent to Kenya, including Uganda, South Sudan, the DRC, etc. are also increasing. The majority of these transit oils are transported via Kenya's pipeline system. In order to meet the increasing demand, the capacity of the pipeline needs to be expanded. Currently, Line 5 is under construction so as to increase the capacity of the oil pipeline from Mombasa to Nairobi, replacing the old (Line 1) system. The Line 3, from Sinendet to Kisumu, will also be replaced with Line 6. Line 2 will also be decommissioned at the time of upgrading of Line 4.

Border Posts

The most serious bottleneck is the east side border between Kenyan and Uganda, especially at the Malaba border, where the largest number and longest queues of heavy goods vehicles are witnessed. Projected future bottlenecks are also expected to occur on the DRC borders, such as the Mpondwe and Goli border posts, where border infrastructure is insufficient, despite the fact that future cargo demand will probably increase due to DRC's envisaged increases in mineral and timber export.

Inland Container Depots (ICDs)

Although the Kenya Ports Authority (KPA) currently operates two Inland Container Depots (ICDs), namely one in Nairobi (in Embaski) and the other in Kisumu, their performance is relatively low. The Embaski ICD for instance, has an annual handling capacity of 180 000 Twenty Foot Equivalent Unit (TEU's), but less than 10% of this capacity is utilized. The Kisumu ICD has almost stopped operations due to the collapse of the railway service to Western Kenya from 1994. The low performances of ICDs are due mainly to poor railway performance, delays, unreliable service, and low frequency of trains, amongst other factors.

Construction of the new Mukono ICD in Uganda was completed in July 2015 and as such, all container cargo handling will be shifted from the current Kampala railway terminal from the beginning of 2016. The location of the new Mukono ICD is strategically located along the Kampala-Jinja highway, allowing for ease of access for both the Kampala city and industrial areas.

2.7.3 Future Total Freight Forecasting

Total freight forecasting shows that total import freight (tonnage/year) from the port of Mombasa is projected at 57 million tons in 2030, growing 2.4 times from the 24 million tons of freight in 2015. Total export freight in 2030 is estimated at 4,650 thousand tons, growing 1.9 times from the 2,451 thousand tons in 2015.

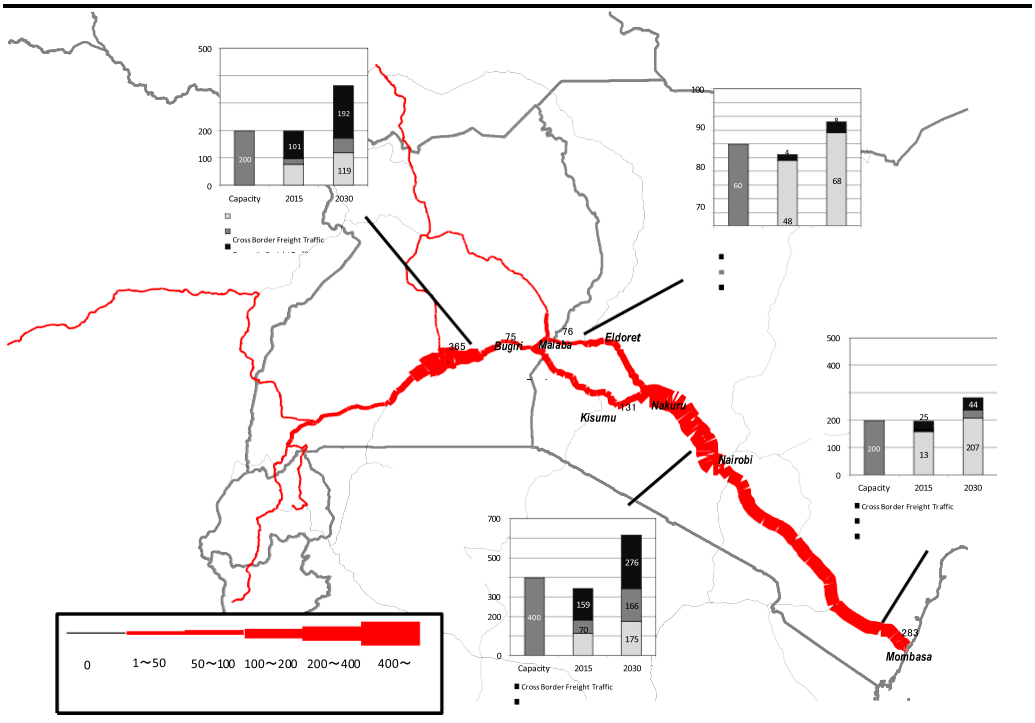
From the forecast results, it is predicted that the SGR and MGR railway share will become at least 50% between the Mombasa port and those zones with main railway stations.

2.7.4 Future Traffic Forecasting

Figure 2.3 indicates shows the main bottlenecks on the road by 2030, where:

- Maximum traffic for the cubic feet (CBFT) in 2030 is estimated at 21,000 pcu/day, on the section between Nairobi and Mombasa;
- In the future, total traffic will exceed 30,000 passenger car units per day (pcu/day) between Nairobi and Nakuru, and around the Kampala area.

Figure 2.2 Bottlenecks on the road in 2030



Source: JST, 2016

2.8 DEVELOPMENT SCENARIO FOR TRANSPORT AND LOGISTICS INFRASTRUCTURE DEVELOPMENT

2.8.1 *Scenario Modelling*

Several scenarios emerge from the future demand forecasting, which are described below:

- In the Base case in 2030, railway is forecasted to carry 20.4 million tons of cargo per year, and will achieve a market share of 33% between truck carrying cargo, railways and pipelines, for cargo at the Mombasa port. If the pipeline is excluded, railway will achieve a market share of 42%, with the truck cargo's share at 58%.
- In the Optimistic case for 2030, railway is forecasted to carry 28.5 million tons per year, obtaining a 46% share amongst truck carrying cargo, railways and pipelines for cargo at Mombasa port. If the pipeline is excluded, the share is 59% for railways, whereas truck carrying cargo's share is 33%. The Optimistic case is as highly effective case for controlling truck use, even though total ton-kilometers by trucks will increase by 22%, from 19,809 million ton kilometers to 24,283 million ton- kilometers.
- In the Pessimistic case for 2030, railways are forecasted to carry 9.2 million tons per year, obtaining a market share of 15%

amongst truck carrying cargo, railways and pipelines for cargo at Mombasa port. If the pipeline is excluded, the market share for railways is 19%, whereas for truck carrying cargo it is 81%.

2.8.2 Transport Network Improvements

Based on these scenarios, the following improvement scenarios for the NEC, to result in transport improvements, should be achieved:

- The NEC should be built as a **Comprehensive Multimodal Transport System** consisting of road transport, railways, airways, waterways and pipelines in order to effectively utilize the existing and planned assets of infrastructure, to maximize efficiencies and to provide for eco-friendly transport in the future.

- A **Modal shift from truck to rail and other modes of transport** is a key issue on the Northern Corridor in the near future. Currently 95% of cargo from Mombasa port to EACs is reported to be carried by truck. Railway is usually a cost-efficient mode for long distance, heavy and large volumes of freight (such as coal, cement, construction materials etc.) In future, railways (an in particular, the SGR) should be used more for cargo transport. Moreover, the pipeline should be promoted for oil transport; and inland water transport on Lake Victoria should be revived as an eco-friendly transport means, especially between Kenya, Uganda and Tanzania.

- **Improvement of the bottlenecks and safety on roads is urgently required;** particularly in Mombasa, Nairobi, Nakuru, Eldoret, Kisumu, Kampala and their surrounding areas. There is an increasing traffic demand, and bottlenecks of road traffic around these areas is steadily worsening; it is therefore necessary to expand the capacity of the road network through road widening.

- **Logistics hubs** near the Mombasa port, railway and airport cargo terminals, at the junction of major roads, at ICDs and borders, and within industrial park developments (for manufacturing, warehousing, fishery /agricultural/ timber processing etc.) should be planned. Such development can be referred as **Cargo-Oriented Development (COD),** and will activate regional economic vitality, will create jobs and effectively promote international trade. As a result, it would

lead to an improvement between the import and export of cargo, and will decrease the number of unloaded trucks and empty containers on the road back to the Mombasa port.

- **Transit times for import must be improved** through improved customs procedures at both the Mombasa port and border posts.

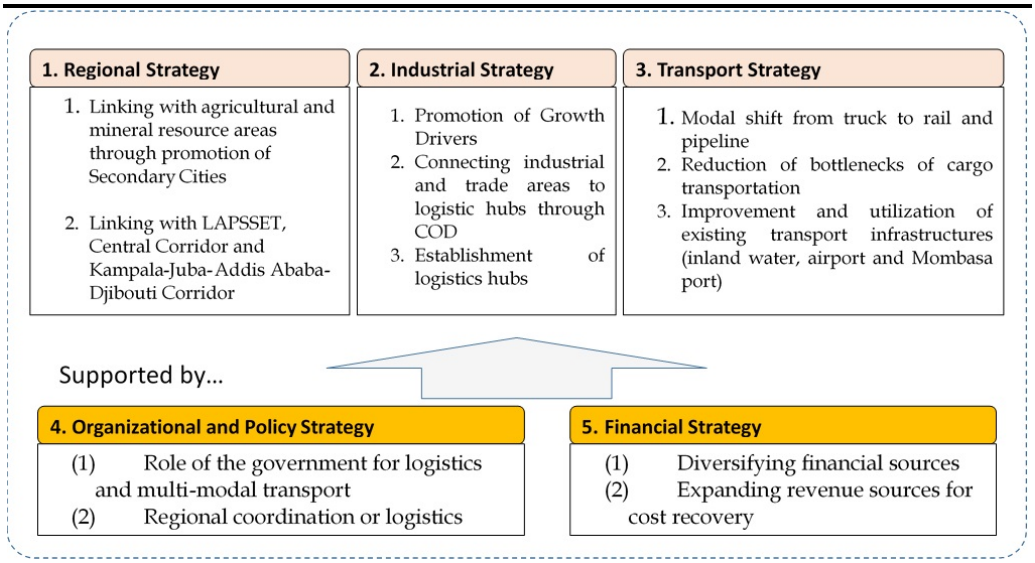
2.9 DEVELOPMENT VISION AND STRATEGIES

The development vision for the NEC is: '*to be the leading economic corridor with integrated transport and logistics systems in Africa*'. The Development Vision has four key words/phrases which make the NEC distinct from other corridors, and these are:

- *leading*, to be the leading, most efficient and reliable in Africa and the success can be applied to other corridors,
- *integrated transportation system*, which offers diversified and multi-modal options (road, rail, waterway, and pipeline) and facilitates regional integration in East Africa,
- *integrated logistic hub*, in which multi-modal options are available, and industrial areas connected and promoted by transport and logistic infrastructure,
- *economic corridor*, stimulate regional economic development in the area surrounding the corridor through development of transport infrastructure, logistic facilities and creating industries (JST, 2016).

The proposed Development Vision will be attained through the implementation of 5 strategies, namely regional, industrial, and transport strategies, which will be strengthened by organizational and policy strategy as illustrated in *Figure 2.2* below and summarised in the *Sections* below.

Figure 2.3 Proposed Five Strategies for the NEC



Source: JST, 2016

2.9.1 *Regional Strategy: Linking Production Centres and Corridors*

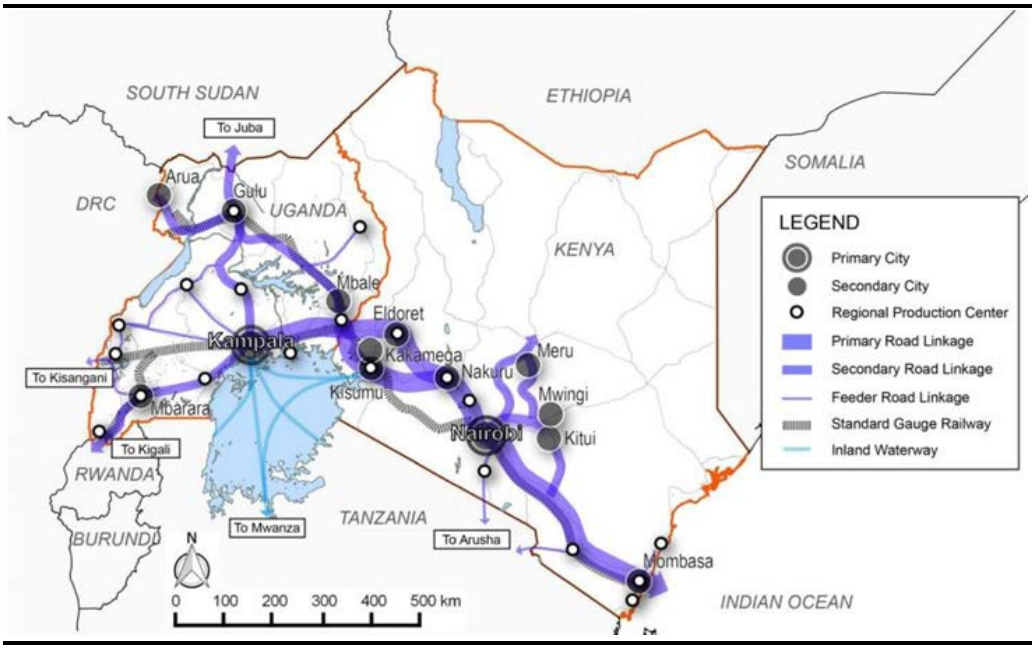
Linking Agriculturally Productive Areas and Mineral Resources through the Development of Secondary Cities

Major cities and economic activities have been developed along the NEC, and it is essential to link potential agricultural productive areas and mineral resources through feeder roads. In this regard, the JST proposes, as a spatial structure of the NEC, the development of multi-centers with regional development (distributing urban functions with a regional industries system), considering the distribution of growth drivers. The spatial structure plan has the following characteristics:

i) balanced growth and efficient logistics in the NEC region through promoting urban functions of 12 "Secondary Cities", and
ii) secondary Cities that serve as regional urban centers, which supply urban services and act as logistics hubs, which connects Regional Production Centers and Primary Cities as consumption areas.

The expected impact of this regional strategy is to realize smooth movement of products and the balanced development of the NEC region. This strategy is depicted in *Figure 2.5* below.

Figure 2.4 Proposal Spatial Structure Plan for the NEC



Source: JST, 2016

2.9.2 *Industrial Strategy: Effective and Efficient Logistical System for Industry and Trade*

Promotion of Growth Drivers to increase export, reduce import and develop the Local Economy

From an industrial development viewpoint within the NEC region, 35 growth drivers consisting of manufacturing, agriculture and livestock, and energy and mining products etc. are nominated. The JST deduced that growth drivers have the potential for:

i) increasing export to the East African region or the international market,
ii) decreasing imports through the expansion of domestic production, and
iii) contributing by adding value to the local economy.

Candidates for growth drivers are shown in *Table 2.3*.

Connecting Industrial Areas To Logistics Hubs through Cargo Orientated Development (COD)

Logistic hubs can be constructed at strategic locations such as at SGR stations, strategic cities, key industrial areas, and so on. The harmonization of such developments with industrial plans, mineral resource developments, and agricultural developments is

key for transport and logistics planning. Such developments can be referred to as Cargo-Oriented Developments (COD). The expected impact of such CODs is to realize an efficient and reliable logistics network for industry.

Special Economic Zones (SEZs) in Mombasa, Naivasha, Eldoret, and Kisumu), Industrial Parks (at Voi and Athi River) and Inland Container Depots (ICDs) atKonza City) are planned to be implemented along the NEC in Kenya.

Currently, ICDs are operational in Embakasi (Nairobi), Kisumu, and Eldoret. SGR stations will be constructed in Mombasa, Mariakani, Voi, Mtito Andei, Sultan Hamud, Athi River, Nairobi, Longonot, Narok, Bomet, Sondu, Ahero, Kisumu, Yala, Mumias and Malaba, and will be significant for transport and logistics activities in future.

If a logistic hub's catchment area is assumed to be 200km in diameter, requiring approximately 3 hours of travel time, making it possible to do a one days' round-trip, it becomes logical to install logistic hubs in at least 3 locations (namely Nairobi, Kisumu and Voi/Mombasa) in Kenya.

In Uganda, seven economic areas (Gulu, Moroto, Kabale, Mohondwe, Kampala, Nakasongolaa, Hoima) and three trade zones are proposed in the Vision 2040 document. In addition, the Vision 2040 document identifies four regional cities (Gulu, Arua, Mbale, and Mbarara) and five strategic cities (Jinja, Moroto, Fort Portal, Hoima, and Nakasongola). Cross border markets are also proposed in five border cities (Nimule, Mpondwe, Kabale, Busia, Bubulo) while ICDs are located in Mukono, Jinja, and Tororo. Gulu will be a strategic and regional location for transportation to South Sudan and Northern Uganda. Mbarara can serve as a strategic location to link with mining areas and border trade with both Rwanda and DRC. Pakwach can be a strategic and regional location to link DRC and inland waterways connecting to the oil and gas areas in Lake Albert. Soroto or Tororo/Mbale can be a strategic location for mineral resource transport from Moroto.

As in the case of Kenya, if the catchment area for the logistics hub is 200km, it is logical to install a logistic hub in at least four locations (Kampala (Mukono), Tororo, Gulu, and Mbarara) in Uganda.

Establishment of Logistics Hubs with ICD and Logistics Centre

A logistic hub is defined as a center or specific area designated to deal with activities related to transportation, collection, distribution, and storage of goods for national and international transit, where traffic is exchanged across several modes of transport.

A potential logistic hub could have multi-modal facilities such as an ICD that connects railway to road, inland water, and/or an airport. In addition to multi-modal facilities, a logistic hub provides a logistic center with facilities and services such as warehousing, a distribution center, and a "one-stop shop". Logistics Hubs therefore connect roads and railways through an ICD to domestic "door" delivery through a logistics center. Logistic hubs with ICDs and logistics centers are designed to connect with industrial parks, mineral resource areas, and agricultural zones in order to facilitate economic activities and investment opportunities.

The expected impacts of such logistics hubs will be to:

i) establish effective linkages between rail and truck modes,
ii) reduce empty container movement (by 7% in Mombasa), and
iii) Expand local logistics service providers, based on clients' needs.

2.9.3 Major Suggested Projects for the Industrial Strategy

Agricultural Projects

The following projects are identified in both Kenya and Uganda for agricultural and fishery development, and agribusiness development.

Kenya	Uganda
1) Agricultural financing improvement	1) Agricultural union commercialization support
2) Food processing hub development program	2) Irrigation Scheme Development project in Central and Eastern Uganda
3) Distribution improvement program of commercial crop	3) Fertilizer Promotion
4) Fertilizer promotion	4) Superior seed production enhancement projects for small scale sesame farmers support
5) Specialty coffee export promotion	5) Rice Production Promotion
6) Tea brand development	6) Maize promotion support
7) Flower export promotion	
8) Value chain of livestock development	

Source: JST, 2016

Industrial Development Projects

The following projects are identified in both Kenya and Uganda for industrial development.

Kenya

Special Economic Zone Development	The concept of Special Economic Zones (SEZ) is to provide quality infrastructure as well as a good business environment, together with fiscal incentives within designated areas. The locations include Dongo Kundu SEZ, Naivasha Industrial Park, Athi River Industrial Park, Machacos-Kajiado Leather Industrial Park, and Konza Tech City.
Packaging industry development for food-processing	The project is to assist local packaging industries to be able to supply quality packaging materials with functions such as keeping stability of processed foods or with aesthetic appearance. The project can comprise training for packing industries, research and development institutions, and agro-processing operators.

Source: JST, 2016

Uganda

Industrial Park Development	The project concept is to ease access to land with good infrastructure and business environment. The locations include Bweyogerere Industrial Park in the suburbs of Kampala, Mbarara, Masaka, Mbare, Sorcti, Gulu, and Kasese.
Building capacity of Standard, Metrology, Quality Infrastructure	The project is to establish standard, quality and metrology infrastructure In addition, the institutional capacities with involvement of private sector in the area of standard, quality and metrology should be developed.
Leather Industry Infrastructu re Upgrading	The project is to upgrade the leather industry from two aspects: improvement of the level of the processing to a higher level than wet-blue and valued raw material of quality final products; and establishing the functions for manufacturing final goods as shoes.
Marketing hubs for DRC and South Sudan	While frontier markets such as DRC and South Sudan are with potential, the conditions of infrastructure and business environment should be improved through the project to extensively explore the market with actual physical presence in such countries.

Source: JST, 2016

Mining and Oil Development Projects in Kenya and Uganda

The following projects are identified in both Kenya and Uganda for mining development.

Kenya

Name of Project	Outline
Coal Transportation Infrastructure	Construction of a railway branch line from the main rail line to the coal mines in Kitui is a priority infrastructure project. The feasibility study on the coal transportation system including coal terminals should be carried out.
Expansion/ Extension of Oil Product Pipeline	Kenya has operated an oil product pipeline from Mombasa to Nairobi since 1978, and it was further extended to Eldoret and Kisumu. Due to rapid growth of imported oil product, the replacement and expansion as well as additional pipelines should be carried out.

Source: JST, 2016

Uganda

Name of Project	Outline
Refinery and Oil Product Tailing Pipeline Construction	Refinery Project consists of refining facilities and oil product shipping pipeline from the refinery to an oil product terminal near Kampala. Project entity will be founded through a PPP scheme.
Cross Border Product Oil Pipeline	With the economic development of these land locked countries, demand of product oils has increased significantly and road traffic is started to be over loaded. To mitigate the road traffic situation, and to enhance the traffic safety, extension of the pipeline to Kampala, and to Kigali will be constructed.
Mining Master Plan	The Project objective is to maximize the value of mineral resources and boost initial part of the economic development of the country. The master plan include: i) Mineral Strategy , ii) List of Strategic Minerals and Target area, iii) Development of Strategic Mineral Mapping and Database, vi) Mineral Identification Capability, etc.

Source: JST, 2016

Logistics Hub Projects

Logistic Hubs should be constructed at Mombasa, Nairobi, Kisumu, Tororo, Kampala, Gulu, and Mbarara.

Most of the logistics hubs have two common functions, namely:

i) ICD function for modal shift and empty container depot service as far as SGR extension is expected, and
ii) Logistics center function, which focuses on inventory and delivery service whose catchment area is set up at approximately a 200km radius, in order to achieve one-day delivery.

2.10 TRANSPORT STRATEGY: EFFICIENT AND INTEGRATED MULTI-MODAL TRANSPORTATION SYSTEM

2.10.1 Modal Shift from truck to railway and pipeline

In both Kenya and Uganda, around 95% of cargo freight is transported by trucks, while other transport modes such as railways and inland waterways, contribute less than 5% of total freight. Currently, trucks carry all types of goods from bulk cargo, mineral resources and liquid fuels. It is more efficient to transport large amounts of heavy freight such as coal, cement, and construction materials over long distances by railway. As such, railways should be used more for cargo transport through the SGR project, as opposed through rail. According to the result of preliminary freight traffic demand forecasting, the transit cost by SGR is almost 50% of a truck's transit cost, and total railway demand of MGR and SGR can be nearly 40% of all freight tonnage via Mombasa port. This means that the service level of SGR, including the cargo transport charge, is a key success factor in order to realize a modal shift from truck to rail.

Furthermore, the GoK plans to replace old pipelines and establish new ones with an expanded capacity to meet increasing demand for petroleum products in future. It is, therefore important that the pipeline should be constructed and operated as planned.

2.10.2 Reduction of Bottlenecks of freight traffic and logistics

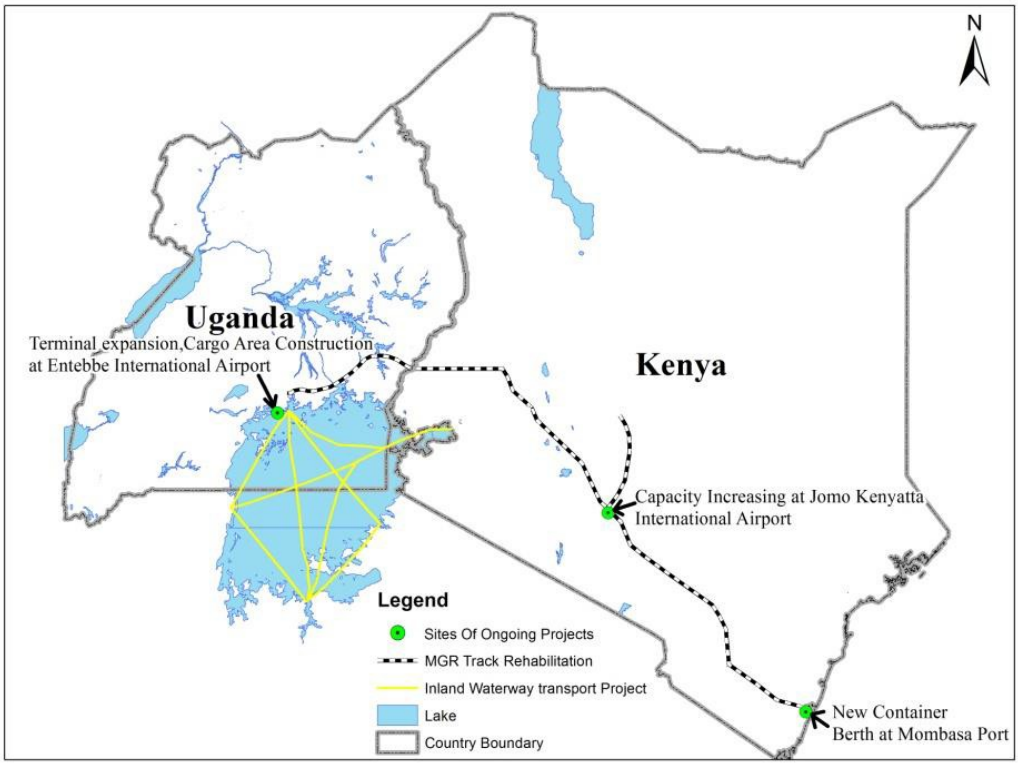
Based on the Origin and Destination survey, together with the traffic survey for cross border traffic on the roads, bottlenecks caused by

cargo traffic are identified, particularly in sections around Mombasa port and the Malaba border.

2.10.3 Enhancement of existing transport infrastructure

In addition to roads and the new SGR, existing transport structures such as the MGR, the Mombasa port, Lake Victoria waterway, and international airports should be enhanced. Promotion of these modes of transport can contribute to the improvement of logistics along the NEC. The expected impact is to realize a multi modal system, covering sea port, air, existing rail, and waterways for the NEC in addition to truck, new rail and pipelines. The location of the existing transport structures to be enhanced is illustrated in *Figure 2.5* below.

Figure 2.5 Location of the existing transport structures to be enhanced



Source: JST, 2016

2.10.4 Major Suggested Projects for Transport Strategies

Roads

Logistics Highway Project

The main route of the NEC from Mombasa, Nairobi, Kampala, Kigali and Bujumbura should have at least a dual carriageway. This is due to the fact that most sections of this route will require four lane capacity, at least up to 2030. A double carriageway with a median strip is much safer than a single carriageway without a median strip.

Truck Service Stations Project:

Truck Service Stations should be established which must be large enough to accommodate at least 100 trucks, as more than 100 heavy goods vehicles heading in one direction are currently witnessed during the daytime on many sections of the NEC. In addition, sufficient accommodation, open 24 hours a day, should be provided for long distance drivers. Traffic restriction information should also be provided to drivers before selecting a border to pass.

Railways

The Base case railway strategy has several elements:

Short term:
Determine an operating format for the Mombasa-Nairobi SGR:

- Implement SGR from Nairobi to Malaba and Malaba to Kampala.
- Involve the private sector in railway investments such as in ICDs or terminals or smaller initiatives, such as leasing rail wagons and locomotives to the railways and shippers.

Medium term:
- Implement SGR to Gulu, Pakwach and Nimule.
- Implement ICDs and railway yards and obtain operators.
- Develop a plan for meter gauge and standard gauge side-by-side operations.
- Use policies and regulations to support the shift of cargo from road to rail.

Long term:

- Invest in and maintain the standard gauge railway.

It is expected that Kenya and Uganda will retain ownership of the SGR infrastructure and contract operations to a private company. The two countries should closely monitor the condition of the railway and ensure that sufficient time and expenditure is devoted to maintenance.

Port

The Mombasa port is expected to be one of the hub ports in the world in the long term, and will need to be able to handle more than 3 million TEUs per year. The following projects should be completed in the short to medium term in order to at least accommodate such volumes:

- Construction of Second Container Terminal (depth: 15m and 11m; 2xberths);
- Construction of an access road (approx. 1.6km);
- Dredging works (dredging volume: approx. 3 million cubic meters);
- Construction of a new SGR linking Mombasa with Nairobi, Kampala and other hinterland destinations; and
- Construction of a southern by-pass for Mombasa linking the south to north coasts.

Airport

Jomo Kenyatta International Airport (JKIA) is improving capacity to deal with increasing passenger and cargo demand through an on-going project. JKIA already has 5 cargo terminals which are privatized. Air carriers can choose cargo terminals depending on the service standard and cost performance. The service improvement will be a key factor to becoming an Air-Air Cargo Hub in the region.

The Eldoret International Airport runway and cargo handling facilities will be expanded to start export of fresh agricultural produce. This runway will be extended to 4.3km, from its present length of 3.5km.

The Entebbe International Airport will improve its air cargo facilities. Considering the current (good) JKIA performance, the Entebbe International Airport should adopt a fresh strategy, such as

an air and truck services with good cross border facilitation, to for example, facilitate the cross border movement of higher value goods into the DRC.

Waterways

From a cargo and tourist transport point of view, several alternatives for Lake Victoria waterways should be examined. Currently, the rehabilitation of Port Bell in Uganda is being supported by the World Bank and EU, and is underway.

Development of Mwambani port in Tanga, Musoma Port and New Kampala Port at Bukasa are also projects under consideration. The Bukasa Port development project, as the new port, was proposed in the past to realize better port functions, expand port-areas, and to add not only wagon ferries but also roll-on/roll-off (RORO) boats. Further review of the project should be considered.

Border Posts

Malaba border is the main border crossing for several countries and therefore its congestion is a serious bottleneck for the whole of the EAC region. In order to reduce the risks of congestion, the following two interventions should be considered:

(i) Establishing multiple lanes
It is a common practice in the world to set up multiple lanes at the border as they help in reducing congestion;

(ii) Designated lanes for specific commodities/transporters (fast lanes).
Dedicated lanes (fast lanes) will be an incentive for Authorized Economic Operators (AEO). A dedicated lane for petroleum products will be beneficial for speeding up its border crossing, also to be considered for other commodities.

2.11 FINANCIAL STRATEGY

2.11.1 Financial Capacity in Kenya and Uganda

Kenya

The Government of Kenya established a Railway Development Fund, which collects 1.5% as Railway Development Levy (RDL) on

all imports. It is projected that the RDL will increase from Ksh 19.7 billion in 2013/14 to Ksh 32.3 billion in 2017/18. The RDL is to be used solely for the financing of the SGR.

The transport sector stands at 26% of the total capital expenditure, a figure that will increase to 41% in 2015/16, mainly due to increased expenditure in the railway sub-sector. The construction of the SGR has been prioritized in the transport and logistic sectors over the medium term, with the SGR section between Nairobi and Mombasa expected to be complete by 2017. The road sector is also expected to increase steadily by an annual average growth rate of 15%. The expenditure pressure for the road sector remains strong, despite the recent emphasis of a shift from truck to railway for freight cargo. The expenditure for marine transport and air transport accounts for 2.2% and 3.4% of the total transport expenditure.

Uganda

The 2nd National Development Plan 2015/16-2019/20 adopted an expenditure strategy focusing on infrastructure and human capital development. The Works and Transport Sector received the largest share in the Ugandan budget, from 18.2% to 23.4% of the budget between 2015/16 and 2018/19 (2nd National Development Plan 2015/16-2019/20, Uganda).

The majority of the budget will be allocated to the road sector. In the 2015/2015 financial year, the Uganda National Road Authority (UNRA) is expected to receive the largest share of the sector's budget (around 70%), followed by the Uganda Road Fund (Ush 428.1 billion) and the Kampala Capital City Authority (Ush 170 billion) in 2015/16. Of significance, a transport policy of shifting away from truck to railway and inland waterways was not elaborated in the NDP.

2.11.2 Diversifying Financial Sources

Currently, financing for infrastructure is largely limited to government grants and external sources. It is therefore important to diversify sources of funding, especially from the private sector to more commercially oriented projects through a PPP arrangement and by issuance of infrastructure bonds. To minimize transaction costs and duplication, regional financing mechanisms can be sought for regional projects.

2.11.3 *Expanding the revenue sources of the governments for cost recovery*

Related to the above, internally generated sources, or cost recovery from users, are currently limited to road maintenance and airport operations in the transport sector. Cost recovery from users should be expanded to the extent possible, in order to respond to increasing financing needs and for financial sustainability. The largest financing needs for the NEC is the SGR investment in the medium to long term, and a principle of cost recovery should be analyzed to the extent possible for this investment.

2.12 *ORGANISATIONAL AND POLICY STRATEGY*

2.12.1 *Regional Coordination for logistics improvement*

The organizational and regulatory framework for logistics and multi-modal transportation needs to be established at the regional level. Regional coordination for planning and monitoring for the NEC is so far being implemented by the Northern Corridor Transit Transport Coordination Authority (NCTTCA). NCTTCA's function with coordination of ministries concerned for both Kenya and Uganda should be maintained. On the other hand, regional coordination mechanisms and private sector involvement are being developed through the Northern Corridor Integration Projects (NCIP).

2.12.2 *Proposed Organisational Framework*

Considering the current situation, some recommendations for organizational framework as well as organizational structure are proposed.

Once the Management Plan is approved and implementation thereof has commenced, there must be a monitoring and evaluation mechanism. It is essential therefore, under the initiative of MoTI / Ministry of Works and Transport (MoWT) in Uganda, to establish a taskforce covering various ministries/agencies in charge of transport, finance, trade, industry, agriculture, mining, energy, water etc. as well as private sector organizations and NCTTCA, to monitor and evaluate the implementation of this Plan.

It is recommended that the working group and steering committee should be maintained after the JICA study as a further monitoring and implementation mechanism.

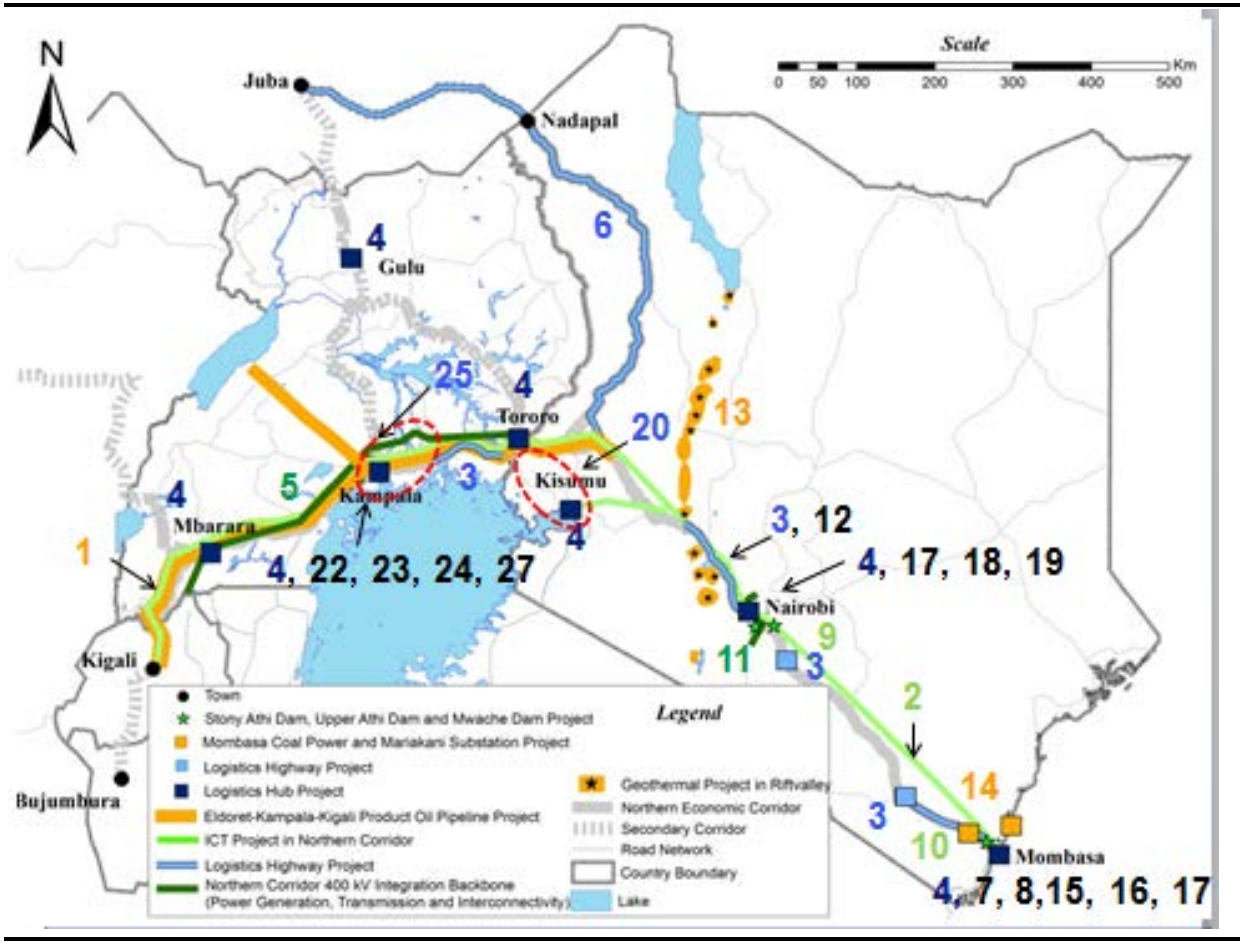
2.13 OVERALL IMPLEMENTATION STRATEGY

Out of all the suggested 119 projects for the development of the NEC (see Annex C for a detailed list of these projects and the respective maps of their location), the JST has selected 23 flagship projects that can contribute to continued logistics improvement along the NEC, and to future economic development of each country, as well as the region. The locations of the 23 NEC flagship projects are shown in *Figure 2.6* and Table 2.4 below:

The primary aim of these flagship projects is to:

- Solve future logistics bottlenecks along the NEC including at the port, roads, and logistic hubs,
- Contribute to cross border infrastructure, such as pipelines and transmission lines,
- Develop key industrial areas along the NEC,
- Ensure power and water supply to identified key industrial areas, and
- Support agribusiness and mining business developments.

Figure 2.6 Location of NEC Flagship Projects



Source: JST, 2016

Table 2.4 Location of Flagship NEC Projects in Kenya and Uganda

No.	Sector	Project Title
1	Mining	Eldoret-Kampala-Kigali Oil Pipeline Project
2	Mining	ICT Project in Northern Corridor
3	Road	Logistics Highway Project
4	Logistics	Logistic Hub Project
5	Power	Northern Corridor Integration Backbone (Power Generation, Transmission and Interconnectivity)
6	Road	Eldoret-Juba Highway Project
7	Port	Mombasa Port Development Project
8	Urban Dev't	Project for Support of Re-organizing Logistics Facilities around Mombasa Port Area
9	Water	Stony Athi Dam and Upper Athi Dam Project
10	Water	Mwache Dam Project
11	Power	Isinya-Nairobi East Transmission Line Project
12	Industry	Geothermal Energy Based Regional Industrial Development in Rift Valley
13	Power	Geothermal Project in Rift Valley
14	Power	Mombasa Coal Power and Mariakani Substation Project

15	Power	Dongo Kundu-Mariakani Transmission Project
16	Industry	Mombasa Special Economic Zone Project
17	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Kenya
18	Agriculture	Agricultural Financing Improvement Project in Nairobi
19	Agriculture	Value Chain of Agriculture Development Pilot Project in Kenya
20	Urban Dev't	Logistics Based Kisumu-Kakamega Metropolitan Area Development Project
21	Mining	Study on Mining Master Plan in Uganda
22	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Uganda
23	Agriculture	Value Chain of Agriculture Development Pilot Project in Uganda
24	Power	Kampala-North-Namungona-Mutundwe 132 kV Transmission Line Refurbishment
25	Urban Dev't	Great Kampala (including Jinja) Logistic Based Urban Development Project
26	Urban Dev't	Study on master Plan for Urban Transport Development for Regional cities
27	Industry	SEZ Development Project in Kampala

Source: JST, 2016

3 LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 GENERAL OVERVIEW

This *Chapter* addresses the relevant legislative framework and related PPP documents as well as the gap analysis.

3.2 PLANS, POLICIES AND PROGRAMS (PPPS)

Table 3.1 below lists the PPPs that are relevant to the Master Plan.

Table 3.1 Relevant PPPs

PPPs	Brief Description	Relevance to the NEC Master Plan
Policies		
Vision 2030	Long-term development blueprint for the country. It aims to transform Kenya into "a newly industrialized, middle-income country providing a high quality of life to all its citizens.	Contribution to economic and social development along the NEC is among the key objectives of the Master Plan and this is in tandem with Kenya's transformation theme of Vision 2030.
Regional Development Policy	The policy revolves around four key pillars namely; the establishment of a sound institutional framework for implementing the policy; the formulation of integrated regional plans; reforms in the legal environment in order to create a more cohesive framework for regional development and a robust monitoring framework that will develop and monitor the achievement of key indicators and milestones of regional development	The implementation of this Master Plan will need to be consistent with the provisions of this Policy in order to avoid conflicts with development in the various regions and counties.
Development and Management of the Roads Sub-Sector for Sustainable Economic Growth, Sessional Paper No 5 of 2006	Management of the roads sub-sector for sustainable economic growth and being implemented by the Roads' Authorities, specifically Kenya Rural Roads Authority (KeRRA), Kenya Urban Roads Authority (KURA) and Kenya National Highways Authority (KeNHA)	The NEC includes the development of roads infrastructure and the Sessional Paper presents various policies for the roads sub-sector

PPPs	Brief Description	Relevance to the NEC Master Plan
Integrated National Transport Policy, 2010	This Policy identifies a number of challenges inhibiting the transport sector from performing its facilitative role in respect of national and regional economies.	The document proposes measures aimed at "Consolidation of Urban Public Transport", through encouraging a shift to high occupancy vehicles amongst other measures. These measures will have to be considered in the implementation of the Master Plan.
National Land Policy, Sessional Paper No. 3 of 2009	The National Land Policy provides a platform for addressing current issues such as access to land, land use planning, restitution of historical injustices, environmental degradation, conflicts, unplanned proliferation of informal settlements, out-dated legal framework, institutional framework and information management.	The implementation of the Master Plan will need to be consistent with the provisions of this Policy in order to avoid conflicts. Among the issues that will have to be addressed, are the modalities for the acquisition of land in order to accommodate activities prescribed by the Master Plan.
The Agricultural Sector Development Strategy 2010-2020	This is the overall national policy document for the agricultural sector. The strategy promotes sustainable food production and agroforestry. There are also broad implications for the forestry sector that are detailed in one of the six sub-sectors of the agriculture sector	All guiding principles in this policy that promotes sustainable development of the agricultural sector will be considered in the development and implementation of the Master Plan.

PPPs	Brief Description	Relevance to the NEC Master Plan
Environment and Sustainable Development Policy, Sessional Paper No. 6 of 1999	This Policy aims to harmonize environmental and developmental goals for sustainability. It also provides comprehensive guidelines and strategies for government action on the environment and development.	Activities associated with the implementation of the Master Plan could give rise to both environmental and social impacts. Therefore the specific projects within the Master Plan should be developed in a sustainable manner.
Wildlife Policy, Sessional Paper No. 3 of 1975	This Policy governs wildlife management in Kenya and its goal is "to optimize returns from this resource, taking account of returns from other land use". The policy not only recognises economic benefits from tourism and consumptive uses but also the intangible benefits that include the aesthetic, cultural and scientific gains that accrue from conservation of habitats and the fauna within them.	The NEC traverses some protected areas such as the Tsavo East and Tsavo West National Parks. Potential impacts on these protected areas will need to be assessed and minimised.
National Disaster Management Policy, 2009	This Policy establishes the guiding principles and architecture for disaster management in Kenya by presenting the institutional structures, roles, responsibilities, authorities, and key processes required to achieve a coordinated, coherent, and consistent approach.	Both the SEA and Master Plan will address the risks of natural disasters to the various infrastructure projects.

PPPs	Brief Description	Relevance to the NEC Master Plan
Energy Policy, 2005	The Energy Policy seeks to ensure an adequate, quality, cost-effective and affordable supply of energy to meet development needs, while protecting and conserving the environment, with a bias towards the exploitation of green energy	The NEC is traversed by energy infrastructure that could be impacted by activities related to the Master Plan. Some infrastructure projects of the NEC will also require energy to power them.
Sessional Paper on Energy, 2004	The broad objective of the energy policy is to ensure adequate, quality, cost effective and affordable supply of energy to meet development needs, while protecting and conserving the environment.	The need and demand for energy is at the core of all three development strategies being considered in the NEC Master Plan, being the key driver to economic growth being led by the Industrial Strategy.
Draft Energy and Petroleum Policy, June 2015	The overall objective of the energy and petroleum policy is to ensure affordable, competitive, sustainable and reliable supply of energy to meet national and county development needs at least cost, while protecting and conserving the environment. Similar to the Sessional Paper on Energy (2004), this Policy aims at providing guidelines to the provision and distribution of quality energy services within Kenya.	Energy distribution as well as issues regarding the Oil Pipeline along the NEC will have to be mainstreamed into the Master Plan
Gender Policy, 2011	This aims at ensuring inclusion of gender related issues in all government PPP to ensure that the needs and interests of each gender are addressed.	Gender concerns will have to be mainstreamed into the Master Plan

PPPs	Brief Description	Relevance to the NEC Master Plan
Integrated National Transport Policy, 2009	This aim of the Transport Policy is to develop, operate and maintain an efficient, cost effective, safe, secure and integrated transport system that links the transport policy with other sectoral policies, in order to achieve national and international development objectives in a socially, economically and environmentally sustainable manner	The Policy identifies the need for the integration of the different modes of transport, which is critical for the NEC, a multi-modal transport corridor.

PPPs	Brief Description	Relevance to the NEC Master Plan
National Policy on Water Resources Management and Development, Sessional Paper No. 1 of 1999,	This Policy recognizes that water is one of the most important resources for human survival and is guided by four specific policy as follows: 1) Preserve, conserve and protect available water resources and allocate it in a sustainable, rational, and economic way. 2) Supply water of good quality in sufficient quantities to meet the various water needs, including poverty alleviation, while ensuring the safe disposal of wastewater and environmental protection. 3) Establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector. 4) Develop a sound and sustainable financing system for effective water resources management, water supply and sanitation development.	The implementation of the Master Plan should conform to sound integrated water resource management practices.
Kenya Health Policy 2014- 2030	The goal of the Kenya Health Policy 2014–2030 is attainment of the highest standard of health in a manner responsive to the needs of the Kenya population. This Policy stands on the principle of equitable distribution of health services within the Country.	The majority of the County's population is currently along the NEC thus having an inclusive health strategy is key to the implementation of the Master Plan.
Plans		

PPPs	Brief Description	Relevance to the NEC Master Plan
Various County Integrated Development Plans (CIDPs)	The CIDPs are development blueprints made by each of the 47 Counties in Kenya for the period between 2013 – 2017	The NEC will pass through a number of Counties and as such the Master Plan will need to be aligned to these CIDPs
Strategic Development and Investment Plans in various metropolitan regions (Nairobi, Mombasa, Kisumu-Kakamega, Nakuru-Eldoret, Wajir-Garissa-Mandera,Kitui-Mwingi-Meru)	The Plans guide development and investment in the respective regions	The Master Plan will also need to be aligned to the aims and objectives of these Plans
Second Mid-Term Plan (MTP), 2013-2017	This Plan is geared towards the implementation of Vision 2030 and Kenya is currently implementing the second MTP, which outlines the policies, programmes and projects which the Government intends to implement between 2013 to 2017	Some of the aims of this Plan are to deliver: accelerated and inclusive economic growth, increased job creation especially for youth, improved manufacturing sector and more diversified exports, which are all related to the NEC. As such the Master Plan will need to be aligned to this MTP.
National Integrated Transport Master Plan	Its aim is ensuring that investment and location of transport infrastructure and services are consistent with public policies while ensuring optimal transport infrastructure investment to position Kenya as a transport hub of the East and Central African region. This Master Plan is being implemented by KeNHA, KURA and KeRRA	The NEC Master Plan will need to align to National Integrated Transport Master Plan

PPPs	Brief Description	Relevance to the NEC Master Plan
National Electricity Supply Master Plan	The Plan will identify new generation and supply sources to ensure that the national electricity supply dependable energy is tripled in the next ten years from the current 1,050MW (in 2008) to 3,000MW by 2018.	The NEC is traversed by energy infrastructure that could be impacted by activities related to the Master Plan. Some infrastructure projects of the NEC will also require energy to power them.
Kenya ICT Master Plan 2014 - 2018	The purpose of this Master Plan is to review and update the Connected Kenya Master Plan launched in February 2013 with a view to extend stakeholders participation	The NEC will include the installation of fibre optic cables, which will need to be aligned to the National ICT Master Plan
Kenya National Climate Change Action Plan, 2013-2017	This comprehensive National Climate Change Action Plan (NCCAP) takes forward the implementation of Kenya's Climate Change Strategy. The NCCAP is expected to inform national development and policy decisions in all sectors of the economy. A wide range of actors including Government agencies, private sector and civil society organizations will contribute to the implementation of the NCCAP.	The Master Plan for the NEC will need to consider aspects of **Climate Variability**, **Resilience** and **Vulnerability** in agricultural sector development. Agriculture is the backbone of the Kenyan economy directly contributing 24% of the GDP valued at KSh342 billion in 2009 (1) and another 27% indirectly, valued at KSsh.385 billion.
Programs		

(1) This is as analysed in the Kenya National Bureau of Statistics. 2012. *Economic Survey 2011*. Nairobi: Government of Kenya.

PPPs	Brief Description	Relevance to the NEC Master Plan
Rural Electrification Program (REP)	A Rural Electrification Program financed to the tune of Kshs. 2.7 billion to cover various parts of the Country. Upon completion the project will facilitate connection of power to 460 trading centres and 110 secondary schools, among other public amenities	The NEC is traversed by energy infrastructure that could be impacted by activities related to the Master Plan. Some infrastructure projects of the NEC will also require energy to power them.
Energy Access Scale-up Program	Through this Program, the government aims to connect one million households with electricity over a five year period at an estimated cost of Kshs. 84 billion targeting major trading centres, secondary and primary schools, community water supply works and health centres. Also two common user LPG handling facilities will be constructed in Mombasa and Nairobi with capacities of 6,000 ton and 2,000 ton respectively	The NEC is traversed by energy infrastructure that could be impacted by activities related to the Master Plan. Some infrastructure projects of the NEC will also require energy to power them.

PPPs	Brief Description	Relevance to the NEC Master Plan
The East African Marine Systems (TEAMS)	This is a submarine cable that will extend from Mombasa to Fujairah in the UAE, thus providing Kenya with an affordable high-capacity bandwidth. The TEAMS cable is connected to the Kenya national fibre backbone network and other major backhaul providers, thus extending the gigabit submarine capacity to the rest of the neighbouring East African countries (Uganda, Rwanda, Burundi, Tanzania and Ethiopia) through cross-border connectivity arrangements	The NEC includes the installation of fibre optic cables
Government Common Core Network (GCCN)	Is intended to function as a shared and secure interoperable government-wide ICT architecture. The system will not only integrate work processes and information flow, but will also improve inter-ministerial sharing of databases and exchange of information.	The NEC will include the installation of fibre optic cables,
Kenya Transparency Communication Infrastructure Program (KTCIP)	This Program aims to ensure equity in the provision of ICT services. The Program will incorporate establishment of digital villages and bandwidth subsidies	The NEC will include the installation of fibre optic cables

3.3 LEGAL FRAMEWORK

3.3.1 East African Regional Legal Framework

Table 3.2 discusses the East Africa Regional Legislation that is relevant to the Master Plan.

Table 3.2 Relevant East African Regional Legislation

Regional Legislation	Brief Description	Relevance to the Master Plan
The Constitutive Act of the African Union, 2000	This Act establishes the African Union to achieve several objectives, including: • Accelerate the political and socio-economic integration of the continent. • Establish the necessary conditions which enable the continent to play its rightful role in the global economy and in international negotiations. • Coordinate and harmonize the policies between the existing and future Regional Economic Communities for the gradual attainment of the objectives of the Union.	The NEC will need to consider the objective set by the African Union to coordinate and harmonise policies (such as the Master Plan) between existing and future regional communities (i.e. East African Communities) in order to attain the goal of accelerated harmonised political and socio economic integration.

Regional Legislation	Brief Description	Relevance to the Master Plan
Treaty for the Common Market for Eastern and Southern Africa, 1993;	This Treaty establishes the Common Market of the Eastern and Southern Regions of Africa. The Treaty has the objective to attain sustainable growth and development of the Member States by promoting a more balanced and harmonious development of its production and marketing structures. In addition, the Treaty aims to co-operate in the creation of an enabling environment for foreign, cross border and domestic investment including the joint promotion of research and adaptation of science and technology for development.	As noted above, the Treaty for Common market for Eastern and Southern Africa aims to harmonise regional economic growth and increase regional trade and industry. As such the NEC aims to create an enabling environment for foreign cross border investments, industry and trade.
Treaty for the establishment of the East African Community (EAC), 1999	This treaty establishes the East African Community (EAC).	The NEC aims to increase efficient trade and industry between the three countries within the EAC i.e. Rwanda, Uganda and Kenya among others.

Regional Legislation	Brief Description	Relevance to the Master Plan
Northern Corridor Transit and Transport Agreement, 1986	In order to overcome transit transport constraints affecting them, the governments of Burundi, Kenya, Rwanda and Uganda decided to negotiate a treaty, the Northern Corridor Transit Agreement, with a view to promoting an efficient, cost-effective and reliable transit transport system.	The NEC aims to improve the transit and transport constraints as identified in this report as well as the Master Plan for the Corridor. This should be done in line with the objectives under this Agreement, including: • Ensure freedom of transit among the member states; • Safeguard right to access to/from the sea for landlocked countries; • Develop and integrate the regional transport facilities and services; • Facilitate inter-state and transit trade.

3.3.2 National Legal Framework

Table 3.3 discusses the National Legislation that is relevant to the Master Plan in Kenya.

Table 3.3 Relevant National Legislation

National Legislation	Brief Description	Relevance to the Master Plan
Kenya Constitution, 2010	This is the supreme law in the Country and it, among other things, establishes the right of every person to a clean and healthy environment	The Master Plan should be consistent with the sustainable development provisions enshrined in the Constitution.
Environmental Management and Coordination Act, 1999 and Amendment of 2015 (EMCA)	Establishes the appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. It addresses itself primarily to Environmental Impact Assessment (EIA).	The environmental and social impacts of the proposed Master Plan will have to be ascertained in order to inform any future project-level EIAs that would come after the SEA. Project level EIAs would need to take cognisance of the outcomes of this SEA.
The Environmental (Impact Assessment and Audit) Regulations, 2003	These Regulations apply to all policies, plans, programmes, projects and activities specified in EMCA. They also recognise as a measure of environmental assessment at a strategic level.	The SEA will be undertaken to comply with the requirements of these Regulations and will ensure that environmental and social considerations are integrated into the Master Plan.
National Guidelines for SEA in Kenya, 2012	These Guidelines are an outline of the concept, principles, basic steps, expected outputs and outcomes of the SEA Process	The SEA will be undertaken to comply with these Guidelines and will ensure that environmental and social considerations are integrated into the Master Plan.
Land Act, 2015	Revises, consolidates and rationalises land laws, to provide for the sustainable administration and management of land and land based resources, and for connected purposes.	The Master Plan will have to consider the land tenure systems in the respective Counties traversed by the NEC.

National Legislation	Brief Description	Relevance to the Master Plan
National Land Commission Act, 2012	Makes provision as to the functions and power of the National Land Commission, qualification and procedures for appointments to the Commission, and gives effect to the objects and principles of devolved government in land management and administration	The Master Plan will have to consider the land tenure systems in the respective Counties traversed by the NEC.
Land Registration Act, 2012	This is an Act of Parliament intended to revise, consolidate and rationalise the registration of titles to land, to give effect to the principles and objects of devolved government in land registration, and for connected purposes.	The Master Plan will have to consider the land tenure systems in the respective Counties traversed by the NEC.
Antiques and Monuments Act, Cap 215 and National Museums and Heritage Act, Cap 216,	These Acts been used for gazettement of areas of historical importance, museums and threatened heritage as they protects the archaeological, historical and cultural sites such as monuments, elements or structures of an archaeological nature, inscriptions and cave dwelling.	All reasonable measures will need to be taken to ensure that the integrity of any historical monuments and objects of archaeological, paleontological, ethnographical and traditional interest along the NEC are not affected by the implementation of the Master Plan.
Physical Planning Act, Cap 286	The Physical Planning Act is the main statute that provides for the planning in Kenya. It provides for the various types of plans, their contents and the procedures for the preparation of the same. .	The NEC should confirm to the requirements within the Physical Planning Act and land use planning. Of special significance is the need to undertake the plan through a participatory process that requires the involvement of stakeholders in the planning process

National Legislation	Brief Description	Relevance to the Master Plan
Kenya Roads Act No. 2 of 2007	Provides for the establishment of the Roads Authorities	The Roads Authorities are key Stakeholders in the SEA and development of the Master Plan
The Energy Act, 2006	Deals with all matters relating to all forms of energy including the generation, transmission, distribution, supply and use of electrical energy as well as the legal basis for establishing the systems associated with these purposes	The NEC is traversed by energy infrastructure that could be impacted by activities related to the Master Plan. Some infrastructure projects of the NEC will also require energy to power them.
Forestry Services Act, 2005	The Act led to the establishment of Kenya Forest Service which is charged with management of forests in consultation with the forest owners. The body enforces the conditions and regulations pertaining to logging, charcoal making and other forest utilisation activities.	The NEC traverses through forests and as such, project planning will need to ensure that disruption of the environment in these areas is minimised and appropriate mitigation measures are established and implemented.
Water Act, 2002	Provides for the management, conservation, use and control of water resources and for acquisition and regulation of rights to use water; to provide for the regulation and management of water supply and sewerage services.	The implementation of the Master Plan should conform to sound integrated water resource management practices.
Public Health Act (Cap 242)	This is an Act of Parliament to make provision for securing and maintaining health	The necessary public health safeguards will have to be factored into the Master Plan.

National Legislation	Brief Description	Relevance to the Master Plan
Lake Victoria Transport Act, 2007	This Act grants the Lake Victoria Basin Commission (LVBC), the powers to regulate maritime safety on Lake Victoria water which entails; registration, licensing and ascertaining the transportation worthiness of lake vessels.	Lake Victoria is a transboundary shared resource and key economic zone, and such, its efficient transport connectivity will have to be considered by the Masterplan.
Kenya Ports Authority's Act (Cap 391)	The Act establishes the Kenya Ports Authority, mandated to establish and operate the port services and facilities.	The implementation of the Master Plan should conform to the operation guidelines as set under *Part VII- Operation of the Authority* of this Act- such as determination of the conditions upon which goods shall be handled or stored at the Port. The Master Plan for the NEC should conform to the different tariffs, rates and charges directed under this Act.
Kenya Export Processing Zone Act (Cap 517) of 1990	This Act establishes the Export Processing Zone (EPZ) Authority, develops all aspects of the EPZs, regulates and administers approved activities within the EPZs and protects Government revenues and foreign currency earnings	The NEC Master Plan should conform to regulation and requirements as set in the Act. Planning and implementation of industrial activities under the Regional Industrial Strategy should be in line with the requirements set under this Act.
Industrial and Commercial Development Corporation Act (Cap 445)	This Act establishes the Industrial and Commercial Development Corporation, for the purposes of facilitating the industrial and economic development of Kenya	The Master Plan Industrial Strategy should conform to the guidelines set by the Industrial and Commercial Development Corporation and engage the institution in the implementation of the Master Plan.

National Legislation	Brief Description	Relevance to the Master Plan
Civil Aviation Act No. 21 of 2013	This Act establishes the Kenya Civil Aviation Authority (KCAA) with the objective and purpose to economically and efficiently plan, develop and manage civil aviation, regulate and operate a safe civil aviation system in Kenya in accordance with the provisions of this Act	The NEC Master Plan covers several aviation ports such as the Jomo Kenyatta International Airport (JKIA) among others that are managed under the Act. All functions of the Authority should be considered by the Master Plan development and implementation.
The Kenya Railways Corporations Act (Cap 397)	This Act establishes the Kenya Railways Corporation also known as Kenya Railways (KR). The Act gives KR the mandate to manage and own both movable and immovable assets on behalf of the Kenya Government. The Act also allows KR to enter into an agreement/ concession to operate the railway transport in the country.	The NEC Master Plan should consider all agreements and established functions by the KR as well as expansion of railway transport led by the Corporation.
Wildlife Conservation and Management Act (2013)	This Act establishes the different strategies to conserve and protect Kenya's Wildlife. In the Act, conservation measures and management principles are guided by effective public participation and ecosystem approach.	It is important that the Master Plan considers participatory approach to implementing the different strategies in order to ensure sustainable development along the NEC where several Wildlife Conservation regions are located- including the Nairobi National Park and Nakuru National Park among others that are managed by the Kenya Wildlife Service (KWS) - mandated by Government under this act.

National Legislation	Brief Description	Relevance to the Master Plan
Agriculture, Fisheries and Food Authority Act (2013)	This Act establishes an authority to be known as the Agriculture, Fisheries and Food Authority. That is mandated to promote best practices in, and regulate, the production, processing, marketing, grading, storage, collection, transportation and warehousing of agricultural and aquatic products excluding livestock, livestock products as may be provided for under the Crops Act, and the Fisheries Act. The Authority is also mandated to give advice the national government and the county governments on agricultural and aquatic levies for purposes of planning, enhancing harmony and equity in the sector.	The necessary agricultural and fisheries industrial development strategies will have to be factored into the Master Plan in consultation with the Authority.

3.4 INSTITUTIONAL FRAMEWORK

3.4.1 National Institutions

Table 3.4 discusses the National Legislation relevant to the Master Plan

Table 3.4 National Institutions

National Institutions	Responsibility	Relevance to the Master Plan
Government Ministries		
Ministry of Transport and Infrastructure	To position Kenya as the logistics hub of the region by creating a modern and efficient transport system for goods and services within the Counties and also with other countries in the region	PPP Owner
Ministry of Lands, Housing and Urban Development (MoLHUD)	The Directorate of Land is charged with the responsibility of ensuring efficient administration and sustainable management of the land resource in the country, while the Housing Directorate is responsible for policy formulation, coordination and monitoring of programmes concerning all issues of urban development	The MoLHUD is responsible for, among others: lands policy management, physical planning , land transactions, land adjudication, settlement matters, land registration, as well as land and property valuation services which is extremely important in acquisition and resettlement issues for the NEC, as well as urban planning.

National Institutions	Responsibility	Relevance to the Master Plan
The National Land Commission	The National Land Commission: • Manages public land on behalf of the national and county governments; • Advises the national government on a comprehensive programme for the registration of land titles; • Investigates present or historical land injustices, and recommends appropriate redress; • Encourages the application of traditional dispute resolution mechanisms in land conflicts; • Monitors/oversees land use planning throughout the country; • Ensures that public land/land under the management of designated state agencies is sustainably managed; • Manages and administers all unregistered trust land and unregistered community land on behalf of the county government; and • Develops and encourages alternative dispute resolution mechanisms in land dispute handling and management.	This Commission will be integral in the land acquisition and compensation processes as the entire procedure will be coordinated by it.
Ministry of Industrialization and Enterprise Development	This Ministry is formulating an industrialization policy in line with vision 2030, and is instrumental in ensuring that Kenyan goods and services find ready market in both national and County Governments	The Master Plan will have to align with the principles of Vision 2030 as well as the County Governments

National Institutions	Responsibility	Relevance to the Master Plan
Ministry of Information, Communication and Technology	This Ministry is responsible for policy formulation for the telecommunication, broadcasting and postal sectors.	The NEC will include the installation of ICT which will need to be aligned to that of the Ministry
Ministry of Interior and Coordination of National Government	This Ministry is charged with the responsibility of public administration, internal security, printing of Government documents, Immigration and Registration of Persons, Betting Control Probation Services, Prison Services and championing campaign against drug and substance abuse.	Security is an extremely important aspect that the Master Plan will have to address
Ministry of Environment, Water and Natural Resource	This Ministry is responsible for policies and programmes aimed at improving, maintaining, protecting, conserving and managing the Country's natural resources (water, forestry, wildlife and environment). It is also responsible for ensuring access to clean, safe, adequate and reliable water supply	The Master Plan will have to align with the policies and programs of this Ministry
Ministry of Devolution and Planning	This Ministry includes the Department of Devolution as well as the Department of Planning that national development planning and economic policy management	The Master Plan will have to align with the policies and programs of this Ministry, with specific regard to the Department of Devolution
Government Institutions and Authorities		
National Environment Management Authority (NEMA)	The responsibility of NEMA is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment.	Regulation and licensing of the SEA
Communications Commission of Kenya (CCK)	Regulation of the cyber optic infrastructure	CCK will be responsible for cyber optic infrastructure under the NEC

National Institutions	Responsibility	Relevance to the Master Plan
Kenya Revenue Authority (KRA)	Regulation of taxes on cargo, trade and business	Responsible for taxation on cargo, trade and business within the NEC
Kenya Civil Aviation Authority (KCAA)	Regulation of air transportation	Air transport is one of the multi modal means of transport considered in the NEC Masterplan
Kenya Maritime Authority	A semi-autonomous agency in charge of regulatory oversight over the Kenyan maritime industry	The registration of any ships and vessels within the NEC
Kenya Marine and Fisheries Research Institutes (KEMFRI)	Undertake research in marine and freshwater fisheries, aquaculture, environmental and ecological studies, and marine research including chemical and physical oceanography	The NEC Master Plan should be in consultation with the Institute in order to protect the any endangered species at the Coast of Mombasa during implementation of projects as part of the Master Plan.
Kenya National Highways Authority (KeNHA)	Development and maintenance of highways	KeNHA will be responsible for the construction, upgrading, rehabilitating and maintaining of highways in the NEC
Kenya Urban Roads Authority (KURA)	Development and maintenance of the urban road network	KURA will be responsible for the construction, upgrading, rehabilitating and maintaining of urban roads in the NEC
Kenya Rural Roads Authority (KeRRA)	Development and maintenance of the rural road network	KeRRA will be responsible for the construction, upgrading, rehabilitating and maintaining of the rural roads in the NEC
National Transport and Safety Authority (NTSA)	Harmonize the operations of the key road transport departments and help in effectively managing the road transport sub-sector and minimizing loss of lives through road accidents.	All transport strategies should be informed by all guidelines under this authority during the promotion of transport/ road safety along the NEC.

National Institutions	Responsibility	Relevance to the Master Plan
Kenya Railways (KR)	KR is mandated to promote, facilitate and participate in the National and Metropolitan Railway development.	KR will be responsible for railway development under the NEC
Kenya Ports Authority (KPA)	Development of sea and inland ports and handling of cargo	Responsible for the development of any sea and inland ports within the NEC
Kenya Pipeline Corporation (KPC)	Development, use & maintenance of pipeline	Responsible for the development of pipelines within the NEC
Water Resources Management Authority (WRMA)	WRMA is the lead agency in nationwide water resources management.	Wetlands and water resources located along the NEC are protected If some development works are planned to be conducted inside of those wetlands or water to be abstracted for use, a special permit shall be obtained from WRMA.
Kenya Wildlife Service (KWS)	Protection and management of Wildlife in Kenya	The Master Plan implementation should be in consultation with the institution in strategizing sustainable ways of development along the NEC
Kenya Forest Services (KFS)	Protection and management of Forests and Reserves in Kenya	KFS will be responsible for guiding the development within forests and reserves under the NEC
LAPSSET Corridor development Authority	Policy implementation, operational coordination and technical oversight organ for the LAPSSET Corridor Project	The NEC Master Plan development and implementation should coordinate and corporate with the Authority to integrate development strategies under the respective plans.
County Government	Responsible for county legislation as well as county development	The NEC will traverse 29 counties

3.4.2 Regional Institutions

East African Community

The East African Community (EAC) is the regional co-operation body that comprises the Republic of Tanzania, Kenya, Burundi, Rwanda and Uganda.
Under the EAC, a number of common transport and communications programs and projects aiming at simplifying transport and communications in the region are being developed.

Most of the constrains to cross-border trade and investment in the region are considered to be related to the limited development of transport and communications networks in the region and to inadequacies in the rules and regulations governing trade, payments and investment in different countries.

The EAC is also undertaking huge efforts to improve infrastructure in the region, especially road and rail transport, the upgrading of ports and the construction of new ports along the Indian Ocean coast which is in line with the Record of Discussion signed between the GOU and GoK with JICA for the implementation of the Master Plan.

Community of Eastern and Southern Africa

The Community of Eastern and Southern Africa (COMESA) is a regional organisation, based in Lusaka, Zambia, which also undertakes transport planning activities for an extensive area of Eastern and Southern Africa. Under COMESA, transport corridors (of particular relevance to Kenya is the NEC) are a key focus of trade facilitation in the region and are viewed as a solution to the challenge of fragmentation among countries in the region by providing the much needed facilitation.

African Development Bank

The African Development Bank (AfDB) is a regional multilateral development finance institution established to contribute to the economic development and social progress of African countries that are the institution's Regional Member Countries (RMCs) (1)

(1) Source: http://www.afdb.org/en/about-us/frequently-asked-questions/

The African Development Bank Transport Forum (ATF) 2015 ended on November 27, 2015, with the AfDB reiterating its support for transport development to ensure economic growth on the Continent.

The Northern Corridor Transit Transport Coordination Authority

The Northern Corridor Transit Transport Coordination Authority (NCTTCA) was created in the mid-1980s, following the signing of the Northern Corridor Transit Agreement, by Burundi, Kenya, Rwanda and Uganda. The Democratic Republic of Congo became a contracting state of the NCTTCA in 1987 after ratifying the treaty.

The NCTTCA mandate is stipulated in the Transit Agreement and it includes:

- Safeguarding the freedom of transit and right of access to and from the sea for the landlocked countries;
- Ensuring implementation of and compliance with the provisions of the Transit Agreement;
- Joint promotion and coordination of the development of regional transport infrastructure;
- Reduction of transport costs through the removal of all customs barriers in the corridor;
- Harmonisation of transit transport policies and technical standards in order to facilitate operations along the corridor;
- Promotion of regional consensus on all matters relating to the management of the corridor and which are of mutual benefit to the member States; and
- Cooperation with other international organizations.

The mandate of NCTTCA rhymes with the project's objective of formulation of a Master Plan on Logistics for the NEC.

Trade and Markets East Africa Trade and Markets East Africa (Trade Mark East Africa – TMEA) is an East African not-for profit Company Limited by Guarantee established in 2010 to support the growth of trade - both regional and international - in East Africa. Trade Mark East Africa (TMEA) is focused on ensuring gains from trade result in tangible gains for East Africans. The Masterplan will address bottlenecks in the transport sector thereby reducing the cost of transport thus improving the gains for East Africans in a way of reduced prices of goods.

3.4.3 *International Institutions*

Japan International Cooperation Agency

Japan International Cooperation Agency (JICA) is a governmental agency that coordinates Official Development Assistance (ODA) for the Government of Japan. JICA aims to contribute to the promotion of international development cooperation and addressing the global agenda by supporting the socioeconomic development, recovery and economic stability of developing countries. The Official Development Assistance coordinated by JICA is broadly divided into bilateral aid, in which assistance is given directly to developing countries, and multilateral aid, provided through international organizations.

JICA is responsible for the implementation of the Project to formulate the Master Plan.

3.5 *INTERNATIONAL REGULATIONS*

3.5.1 *The Japan International Co-operation Agency (JICA) Guidelines for Environmental and Social Considerations, 2010*

The objectives of these Guidelines are to encourage PPP owners to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavours to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

The requirements in JICA's guidelines were fulfilled by the SEA Study.

3.5.2 *The Organisation for Economic Co-operation and Development (OECD) Guidelines and Reference Series for Applying Strategic Environmental Assessment, 2006*

The Organization for Economic Cooperation and Development is a unique forum where the governments of 34 democracies with market economies work with each other, as well as with more than 70 non-member economies to promote economic growth, prosperity, and sustainable development. The OECD Guidelines for Multinational

Enterprises are far reaching recommendations for responsible business conduct that 44 adhering governments – representing all regions of the world and accounting for 85% of foreign direct investment – encourage their enterprises to observe wherever they operate. The ultimate objectives of the guidelines are to ensure that:

- Environmental considerations, and their linkages with social and economic factors, are adequately understood, recognising the contribution of environmental management to economic growth and poverty reduction.
- Environmental and social considerations are appropriately analysed and taken into account in development policy, planning and strategic decision making at the formative stage and appropriate response measures, effectively integrated into the development of PPPs and projects.
- As a result of the above, the outcomes of PPPs have better prospects to contribute to sustainable development and attainment of the MDGs.

The OECD guidelines will supplement the JICA and National SEA Guidelines.

3.6 COMPARATIVE ANALYSIS OF THE MASTER PLAN WITH OTHER PPPS

3.6.1 Comparative Analysis of the Master Plan with other Polices

Table 3.5 Analysis of Relevant Policies with the NEC Master Plan

Policy	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Vision 2030	Building a just and cohesive society with social equity in a clean and secure environment	Social, economic and political pillars in vision 2030 will be of great importance when it comes to implementation of the Master Plan	None
Regional Development Policy	To reform in the legal environment in order to create a more cohesive framework for regional development	Prevents conflicts with development in the various regions and counties	None
Development and Management of the Roads Sub-Sector for Sustainable Economic Growth, Sessional Paper No 5 of 2006	Management of the roads sub-sector for sustainable economic growth	Various policies for the roads sub-sector will be availed	None
National Land Policy, Sessional Paper No. 3 of 2009	To address environmental degradation and look into land access.	Detailed information on how to go about acquisition of land will be availed	None
Environment and Sustainable Development Policy, Sessional Paper No. 6 of 1999	To provide comprehensive guidelines and strategies for government action on the environment and development.	Specific projects within the Master Plan will be carried out sustainably	None

Policy	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Wildlife Policy, Sessional Paper No. 3 of 1975	To optimize the benefits that include the aesthetic, cultural and scientific gains from conservation of habitats and the fauna within them.	Able to prevent the impact caused to the wildlife.	Where the corridor transverses through forest and other protected areas
National Disaster Management Policy, 2009	Pays attention to environmental concerns in the design and management of disaster programmes, constantly reviewing the changing status and trends of the environment to ensure sustainable compliance Addresses the risks of natural disasters to the various infrastructure projects.	The Master Plan will use the policy to curb any disaster that is likely to occur along the NEC	None
Energy Policy, 2005	To protect and conserve the environment, with a bias towards the exploitation of green energy	Infrastructure projects of the NEC will require energy	None
Gender Policy, 2011	To ensure the needs of each gender is addressed.	Gender concerns will be considered by the Master Plan	None

Policy	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Integrated National Transport Policy, 2009	To develop, operate and maintain an efficient, cost effective, safe, secure and integrated transport system	Different modes of transport will be integrated in the master plan	None
National Policy on Water Resources Management and Development, Sessional Paper No. 1 of 1999,	To preserve, conserve and protect available water resources and allocate it in a sustainable, rational, and economic way.	Water Resources along NEC will be managed	None

3.6.2 Comparative Analysis of the Master Plan with other Plans

Table 3.6 Analysis of Relevant Plans with the NEC Master Plan

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Sectoral Plans			
Updated Least Cost Power Development Plan 2011-2013 (2013) (LCPDP)	The LCPDP establishes a path of increasing Kenya's energy outputs through a variety of sources based on natural resources. It provides a forecast of energy demand taking into consideration social and economic parameters of the country including the Vision 2030 flagship projects.	The NEC Master Plan (MP) can provide the demand to justify investments proposed by the LCPDP. Also, power infrastructure projects can be undertaken in line with the LCPDP.	The NEC MP projects have the potential of having bias preference on energy sources based on economics. This can potentially increase demand against the propositions of the LCPDP.
Kenya Distribution Master Plan 2012-2030 (2013) (KDMP)	The KDMP includes a detailed assessment of KPLC's distribution network over 2012-2030 period and proposes a master plan for power distribution projects. It includes an environmental and social scoping assessment of these projects wherein it predicts potential impacts and proposes mitigation measures.	The NEC MP can undertake its power distribution project in line with or under the framework of the KDMP and thus be synergistic. Mitigation measures for the NEC MP's potential negative impacts can similarly borrow or update those proposed by KDMP.	Mandate and project alignment/priority conflicts can occur in the event that the NEC MP projects are not undertaken outside of the considerations of the KDMP. The KDMP's propositions are also based on the LCPDP's forecasts of energy demand.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Kenya Petroleum Master Plan (2015) (KPMP)	The Kenya Petroleum Master Plan (KPMP) provides a development plan of up to the year 2040 for the petroleum sector. It identifies projects in each sub-sector and provides a framework for managing environmental and social issues of these projects and the sector. A Strategic Environmental and Social Assessment (SESA) is also being prepared for the petroleum sector as part of the Kenya Petroleum Technical Assistance Project.	Petroleum sector projects can be implemented under planning framework of the KPMP thereby being synergistic. Other sectoral projects can also create demand for petroleum products. On implementation, petroleum sector projects can implement mitigation measures in line with the petroleum sector SESA's propositions once the study is completed.	Mandate and priority conflicts are possible with the institutional realignments proposed by draft regulations in the energy sector. These are institutions such as ERC (ERC) will be key in implementing and regulating the KPMP projects.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Kenya National ICT Master Plan (2014) (KNIMP)	The KNIMP presents a roadmap to develop the country's knowledge economy that leads to socioeconomic growth. Amongst its guiding principles it requires all institutions involved in its implementation to adhere to the green ICT concept.	The implementers of the NEC MP can integrate the green ICT into their respective projects. Integration of ICT into the NEC MP projects and providing industry related data can promote the attainment of the KNIMP goals. Direct ICT projects such as the SCADA system will add to the infrastructure available in the country increasing connectivity.	Potential negative impacts associated with ICT equipment can undermine the achievement of the green ICT concept at the project level.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
National Water Master Plan 2030 (2013) (NWMP)	The NWMP proposes the direction of water development plan and water management plan in Kenya based on Vision 2030 with water development projects to solve water scarcity of Kenya. It provides interventions based on water balances in each basin and in an updated regulatory context as compared to the previous water master plan. The NWMP also proposes environmental management plans (EMPs) for each basin and sub-catchments in addition to identifying the impact factors of its projects.	The NEC MP project's demand on water resources can add to the justification for sectoral investments under the plan. The NEC's water sector projects can also be implemented in line with the EMPs in each basin thereby promoting synergies. Some of these projects are also proposed by the NWMP. Monitoring the water sector projects in their respective catchments can provide an opportunity for the NEC MP implementers to collect and share data with other stakeholders. This would promote holistic decision making in each catchment.	Creation of additional demand outside of the scope of the NWMP can cause water imbalance or undermine other forms of demand. The water sector also has numerous stakeholders who implement a variety projects in the different basins traversed by NEC and thus mandate and project priority conflicts are possible on project implementation and regulation.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
National Climate Change Action Plan 2013-2018 (2013) (NCCAP)	The NCCAP has been developed with a purpose of reducing Kenya's vulnerability to climate change and enabling the country exploit any opportunities therein. The plan seeks to draw a low carbon resilient development pathway towards the achievement of Vision 2030. The plan proposes sectoral adaptation actions and mitigation measures.	The NEC MP can implement low carbon development modes in each of its proposed interventions promoting the achievement of the NCCAP. The NEC MP can integrate the NCCAP's sectoral priority adaptation actions and mitigation measures into its sectoral projects where feasible to promote synergies.	In lieu of following or supporting low carbon development or implementation paths, the NEC MP can contribute to raising Kenya's emission profile whereas other negative impacts can increase the country's vulnerability to climate change. This would undermine the goals of the NCCAP.
Kenya Green Economy Strategy and Implementation Plan (2015) (GESIP)	The Kenya GESIP proposes a development path towards Vision 2030 that promotes resource efficiency and sustainable management of natural resources, social inclusion, resilience, and sustainable infrastructure development. It promotes investments in renewable energy, promotion of resource-efficient and cleaner production, enhanced resilience to economic and climatic shocks, pollution control and waste management, environmental planning and governance, and restoration of forest ecosystems.	The NEC MP has the potential of implementing its projects through methods congruent to the propositions of GESIP via its mitigation measures. This would promote the achievement of the goals in GESIP's five strategic areas.	Without adequate implementation of mitigation measures the potential negative impacts of the NEC MP can undermine the achievement of the green economy.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Kenya National Biodiversity Strategy and Action Plan (2000) (NBSAP)	The NBSAP seeks to address the national and international undertaking elaborated in the Convention on Biological Diversity (CBD). It is a national framework of action for implementation of the convention to ensure that the rate of biodiversity loss is reversed and prevailing levels of biodiversity resources are maintained at sustainable levels for posterity.	Through its mitigation measures on biodiversity the NEC MP can where possible prevent or otherwise mitigate biodiversity losses in line with NBSAP.	Residual biodiversity losses will undermine the NBSAP or result in priority conflicts between sustainable use and conservation efforts.
Master Plan for the Conservation and Sustainable Management of Catchment Areas in Kenya (2012)	This Master Plan for Water Catchment Areas (WCAs) has been developed to provide strategies aimed at protecting Kenya's water catchment areas from degradation and ensuring their sustainable use.	The NEC MP can use low carbon development strategies and similar propositions of the GESIP to promote conservation and protection of WCAs. Any developments in WCAs can also be implemented in line with the propositions of the WCA MP.	There is potential for land use restrictions or different priorities in catchment areas which are located in the NEC amongst the two MPs. These also include conflicts between sustainable use and conservation strategies. Transboundary catchments can present more complex mandate and priority challenges due to different regulatory regimes across borders.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
National Marine Spills Response Contingency Plan (NMSRCP)	The NMSRCP provides procedures for responding to oil and HNS spills in the marine environment of Kenya. It is updated bi-annually or after any major oil spill.	Oil spill contingency measures can be developed in line with the NMSRCP.	Limitations on technology approved under the NMSRCP and the response efficiency of spill response agencies can limit the effectiveness of spill response procedures.
National Nutrition Action Plan 2012-2017 (2013)	This plan has been developed with a purpose of providing a framework for coordinated implementation of nutrition interventions activities by its stakeholders. The plan is focussed on High Impact Nutrition Interventions which were aimed at supporting the achievement of MDGs 1, 2, 3, 4, 5 and 6.	The NEC MP's benefits of improving access to services will promote the achievement of the NNAP since there will be better access to markets for produce.	The potential negative impacts of the NEC MP can compromise the achievement of the NNAP's strategic objectives.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
National Spatial Plan 2015-2045 (2016) (NSP)	The NSP) has been developed with a purpose of providing a national spatial structure that defines how the national space is utilized to ensure optimal and sustainable use of land. The plan itself is a Vision 2030 flagship project and it is anticipated to promote the attainment of national, social, economic and environmental goals and objectives. This plan aims at achieving an organized, integrated, sustainable and balanced development of the country.	Location of the NEC MP's projects according to the NSP's regional development proposals will be synergistic. The NSP's strategic objectives can also be integrated into the NEC MP. Some of these are already integrated into the NEC MP such as promoting regional growth centres; decentralizing development from the existing major cities, and linking production and tourism areas.	There is potential of spatial development priority conflicts between the two plans.
Sustainable Tourism Master Plan (STMP) for the Inter-Governmental Authority on Development (IGAD) Region 2013-2023 (2013)	The STMP's main aim is to provide IGAD member states with a regional framework for sustainable tourism development with a view to contributing to socio-economic development and poverty alleviation as well as promoting regional integration. Amongst its underlying principles include ensuring that tourism development is sustainable, providing equity for both inter-generational, whereby the current exploitation of tourism resources should not compromise the ability of future generations, and intra-generations, taking into account issues relating to enhancing social justice and poverty alleviation.	The NEC MP has direct benefits to the STMP and tourism sector as a growth driver in Kenya. The NEC MP can increase Kenya's global competitiveness in the industry. Infrastructure development is amongst the strategic areas of intervention identified by the STMP.	Potential for conflict on priorities between conservation and sustainable use with respect to natural and cultural resources which are tourist attractions. The NEC MP's potential adverse impacts (land use and landscape changes) can threaten these resources.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Master Plan For Kenyan Industrial Development 2008 (MAPSKID)	MAPSKID has been developed with an overall goal of promoting the industrial development of Kenya with emphasis of target subsectors. MAPSKID identifies the environmental issues associated with industrial development in Kenya and provides guidance on how these may be addressed based on lessons learnt from previous and existing strategies.	The NEC MP's strategic interventions coincide with those of MAPSKID. These include promoting value addition, global competitiveness, decentralizing production and balancing imports and exports amongst others. Additionally, the NEC's potential benefits will support the target sectors covered by MAPSKID.	The manufacturing sector is interlinked with other sectors and there is thus potential for mandate conflicts on implementation of sectoral interventions. Competition of interests between manufacturers in EPZs and those outside with respect to access to local markets.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Capital Markets Master Plan 2014-2023 (CMMP)	The CMMP seeks to develop Kenya's capital markets to become deep and dynamic to stimulate domestic development (mainly projects under Vision 2030), while simultaneously providing a gateway to Middle Africa for regional and international capital flows. It anticipates that Kenya will be transformed into the choice market for domestic, regional and international issuers and investors looking to invest in and realize their investments in Kenya, within East Africa and across Middle Africa. In this respect, any such investments will be guided by international best practices that require such investments adhere to environmental standards, regulations and guidelines.	Capital markets can provide a source of funding for the NEC MP's infrastructure projects. The CMMP also promotes funding for service devolution as proposed by the NEC MP.	The CMMP has a preference on the Vision 2030 projects since it has been developed as a flagship project of the policy.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
East African Railways Master Plan (2009) (EARMP)	The EARMP aims to close capacity gaps in the railway infrastructure in East Africa by developing the required level of infrastructure and services to make a maximum contribution in facilitating and catalysing more robust regional trade and economic development. The EARMP review the existing environmental regulatory framework of the EAC states and develops an environmental checklist to ensure its proposed railway investments can be carried out in an environmentally responsible manner. The plan also identifies potential issues that may require particular attention when project-specific environmental assessments are conducted.	Development of ancillary railway network infrastructure such as ICDs, marshalling yards, rolling stock maintenance facilities and equipment maintenance depots, will improve efficiency of existing and new networks. Additionally, improvements on the operational standards and logistics of other linked infrastructure (ports, roads and airports) will also improve the efficiency of the railway system.	There is potential of conflicting priorities between the development of standard gauges and rehabilitation of the existing meter gauges or cape gauges. Similar, there are also technological compatibility issues associated with differences in rail gauges amongst existing networks in the region. Not all rail lines in the region are of the same gauge. Conversion of main lines would reduce network connectivity within the same network.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Kenya Scaling-Up Renewable Energy Program (SREP) Investment Plan (2011)	This plan outlines how Kenya will invest in renewable projects under SREP. It identifies renewable energy projects to be scaled up and for which Sectoral Environmental Impact Assessments (SEAI) were carried out. These SEIAs identified cumulative environmental and social risks and proposed mitigation measures.	The NEC MP's increased energy demand can add to the justification of the investments under this plan.	Energy preference is typically decided at project design stage. Economics often dictates energy preference whilst users have little influence on energy supplied by regulators.
Kenya Integrated Water Resources Management and Water Efficiency Plan (2009) (IWRM and WE Plan)	The IWRM and WE Plan's long-term objective is to achieve optimum, long-term, environmentally sustainable social and economic benefit from the nation's water resources for society from their use. In the short-term is aims to accelerate action towards addressing key water resources-related challenges in national development in a more effective and comprehensive manner especially in environmental flows, social development, tourism, agriculture, industry, health and energy among others.	The NEC MP's water sector projects can contribute to the achievement of the objective of the IWRM and WE Plan by adopting its guiding principles.	There is potential for mandate conflicts in the water sector due conflicting mandates in the sector. Similarly, there is potential for project priority conflicts. The potential negative impacts on hydrological regimes can undermine the objectives of the IWRM and WE Plan.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Northern Corridor Infrastructure Master Plan 2010-2030 (2011)	This plan presents a comprehensive infrastructure master plan for the northern corridor as a long term program for strategic development of the corridor's infrastructure. This master plan includes an environmental assessment of the risks associated with its proposed interventions and prescribes mitigation measures.	Development interventions of the two master plans can be consolidated resulting in synergy since some interventions are in both.	There is potential of mandate and priority conflicts (duplicity) between the two master plans.
Regional/County Spatial and Integrated Development Plans			
Nairobi Integrated Urban Development Master Plan (2014) (NIUPLAN)	NIUPLAN reviews and develops concepts on sustainable urban development and improvement of living conditions based on integrated urban development plan for Nairobi city. This plan integrates several findings/interventions of previous plans proposed for the region. A SEA was prepared for it which details its strategic position and proposes a framework for managing its environmental and social risks.	Linking and/or consolidating the NEC MP's interventions in the region with those of NIUPLAN can be synergistic.	Mandate conflicts particularly between national and regional implementation stakeholders are possible. Promoting regional growth centres/secondary cities under the NEC MP can reduce the gross economic viability of some of the NIUPLAN's interventions.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Master Plan for Urban Transport in The Nairobi Metropolitan Area (2006) (NUTRANS)	This MP has been developed with an aim of solving the transport challenges experienced in the Nairobi Metropolitan area (Nairobi City and its environs). It includes a SEA which establishes a management framework for environmental and social risks of its proposed interventions.	The NEC MP's interventions in the region can be linked or consolidated with those of NUTRANS.	There is potential for priority and mandate conflicts. Primary mandate conflicts are between national and regional authorities.
Comprehensive Development Master Plan for Mombasa Gate City (2016)	This MP aims to ensure that Mombasa contributes to economic and social development along the NEC, with a target year of 2040. The MP seeks to strengthen the urban function of Mombasa as the gate city of the NEC. A SEA has been prepared alongside the MP for the management of the environmental and social risks of its interventions.	Synergies are possible through integration and consolidation of the interventions of the two master plans.	Mandate conflicts are also possible between national and regional implementation authorities. Decentralization of economic activities as proposed by the NEC MP can lower gross incentives for investing in the Gate City MP's proposed interventions.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Master Plan for Development of Mombasa Special Economic Zone (2015)	This MP aims to develop a SEZ at Dongo Kundu in Mombasa. A SEA was prepared for this MP and it presents a management framework for its environmental and social risks.	The NEC MP's benefits of improved infrastructure and access can promote the achievement of the objectives of Mombasa SEZ MP since it links with this SEZ. The achievement of the SEZ's objectives can also support infrastructure investments proposed by the NEC.	The potential negative impacts of the NEC MP can undermine the SEZ MP, primarily in the maritime and port sectors.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
County Integrated Development Plans (CIDPs)	Each of the 29 NEC Counties have enacted a CIDP to guide their development. These CIDPs entail interventions in the economic sectors or thematic areas categorized by each county. These interventions and any others in the counties are expected to comply with county regulations on environment and socio-economic development. Additionally, they also provide policy objects for managing environment and social issues and risks within the context of their jurisdictions.	Alignment with CIDPs can synergize the benefits of both the CIDPs and the NEC MP.	There is potential for mandate and project priority conflicts between national government agencies and county governments. Moreover, there is potential of project duplicity and overlap between the NEC MP and the CIDPs. The potential negative impacts of the NEC MP can undermine the achievement of CIDPs' development goals.
Master Plan for the Development of the Leather Industrial Park in Machakos County (LIP MP)	The MP proposes to develop a Leather Industrial Park for value additional and transformative research and innovation to exploit the economic potential of the leather sector in Kenya. The facility is intended to be developed at Kananie in Machakos County. A SEA has been prepared for this MP and it details how environmental and social risks will be managed.	Improved efficiency on the transport network will promote the achievement of the LIP MP. Also, the LIP can be amongst the growth drivers and industries that the NEC MP intends to promote.	Negative impacts of the NEC MP can undermine the objectives of the LIP MP.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Local Development Plans			
Ecosystem Management Plans for Protected Areas	These plans have been developed under WCMA and they govern the management of protected areas. They control development and conservation efforts within these areas to ensure sustenance or posterity of the ecosystems.	Compliance with the recommendations or guidelines of these management plans can promote the conservation and sustenance of the ecosystems. This will apply with the NEC MP's interventions which intersect such ecosystems with management plans.	Potential negative impacts of the NEC MP on these ecosystems will threaten their sustenance. Spatial priority conflicts are also possible with the concerned PAs based on those impacts. Such conflicts can be associated with differences between sustainable use and conservation.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Participatory Forestry Management Plans (PFMP) for Forest Reserves	Under the Forest Act PFMP have been developed to guide and control development and the conservation of forest reserves in Kenya. At least 144 FRs in Kenya have such management plans whereas 87 of these are established with community approval and participation in the management of the reserves.	Compliance with these management plans can promote the conservation and sustenance of those reserves directly intersected by the NEC MP's interventions.	Potential negative impacts of the NEC MP on these reserves will threaten their sustenance. Spatial priority conflicts are possible within the jurisdictions with respect to the potential negative impacts. Such conflicts can be associated with differences between sustainable use and conservation.
Updated Mombasa Port Master Plan 2005-2030 (2009)	This Master Plan establishes a development program for the Port of Mombasa up to the year 2030.	The NEC MP's port sector interventions can be consolidated or integrated with those of the Port MP for synergy.	There is potential for priority conflicts on interventions between the two Master Plans at the port.

Plan	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Land Use Plans/County Physical Plans	These land use plans developed for various jurisdictions under the premise of the Physical Planning Act (Cap 286). They control land based developed within their jurisdictions. They include both local and regional physical development plans as defined by CAP 286.	Compliance of the NEC MP with these plans will be mutually beneficial to both local authorities (County Governments) and the implementers of the NEC MP.	There is potential for spatial priority conflicts between these plans and the NEC MP's interventions at their jurisdictions.

3.6.3 Comparative Analysis of the Master Plan with other Programmes

Table 3.7 Analysis of Relevant Programmes with the NEC Master Plan

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
The Land Cover and Land Use Mapping Initiative	Vision 2030 flagship progamme that will map land cover and use in the country	Detailed information on land use and land cover in the NEC will be availed.	None
The Water Catchment Management Initiative	Vision 2030 flagship progamme that will manage water catchments in the country	Water catchments within NEC such as the Athi and Tana, South and Northern Lake Victoria Basin, will be managed	None
Securing the Wildlife Corridors and Migratory Routes Initiative	Vision 2030 flagship progamme that will provide and keep open wildlife corridors in the country	Wildlife corridors and migratory routes such as in the Tsavo West, Tsavo West, Chyulu, Nairobi National Park, Longonot, Hell's Gate, Lake Nakuru National Parks will be secured and protected	In areas traversed by the roads and railway
The Solid Waste Management System Initiative	Vision 2030 flagship progamme that will develop solid waste management system	The system will indicate how solid waste especially in urban areas including those in the NEC will be collected and disposed or used.	None
Rehabilitation and protection of indigenous forests in the 5 water towers	This project entails full rehabilitation of the 5 water towers in the country.	Indigenous forests in the Mau Escarpment Abadares Ranges, Mt. Kenya, Cherengani Hills and Mt. Elgon will be rehabilitated and protected	None

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Rehabilitation, Regeneration & Restoration of Nairobi Rivers	The aim of the programme is to fully rehabilitate the catchment basin of the Nairobi River in order to make it a recreation site.	Nairobi rivers will be rehabilitated, regenerated and restored. Other rivers like Ngong will also be covered under this programme.	None
Water harvesting and storage programme	Water from rivers that flood will be harvested and stored	The floods of Western Kenya will be managed through construction of large multi-purpose dams along Rivers Nzoia and Nyando. Water dykes will also be constructed along the lower reaches of Nzoia and Nyando rivers	None
Urban sewerage programme	Managing environmental pollution in towns and in water basins	Urban sanitation and hygiene improved and pollution of shared water basins in the NEC will be controlled.	None
The Plastic Bags Initiative	Vision 2030 flagship progamme that will require tightening regulations in order to limit production and usage of environmentally-detrimental plastic bags	Production and usage of environmentally detrimental bags will be regulated	None
Rural Electrification programme (REP)	Rural Electrification Programme financed to the tune of Kshs. 2.7 billion to cover various parts of the country.	The programme will facilitate connection of power to 460 trading centres and 110 secondary schools, among other public amenities, many which are within the NEC	None

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Energy Access Scale-up Programme	Energy Access Scale-up Programme at an estimated cost of Kshs. 84 billion targeting major trading centres, secondary and primary schools, community water supply works and health centres.	Major trading centers, schools, water works and health facilities in the NEC will get more electricity. Also two common user LPG handling facilities will be constructed in Mombasa and Nairobi with capacities of 6,000 ton and 2,000 ton respectively.	None
Olkaria IV appraisal drilling of 6 wells	Drilling of wells for purposes of producing geo-thermal electricity	The programme will produce more electricity for use in the NEC. The programme targets to commercially exploit steam available in this field	None
Wind Power generation by IPPs at various sites	More wind generated power will be produced	Targets exploitation of about 150MW of wind power will be exploited through Public Private Partnerships (PPP).	None

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Economic Stimulus Program (ESP)	The stimulus was in response to the economic decline in economic growth rate from 7.1% in 2007 to 1.7% in 2009.	A boost to the country's economic recovery; expanded economic opportunities in rural areas for employment creation; promoted regional development for equity and social stability; improved infrastructure and the quality education and healthcare; and expanded the access to, and built the ICT capacity to expand economic opportunities and accelerate economic growth.	None
Kenya Rural Development Programme (KRDP)	To promote sustainable livelihood diversification in Arid and semi arid lands	Livelihoods in ASAL counties within the NEC are being diversified	None
Agricultural Sector Development Support Programme (ASDSP)	The overall objective is to achieve agricultural growth rate of 7% per year through commercialization and modernization of the sector	Increased agricultural cargo to be handled by the NEC	None
Kenya's Industrial Transformation Programme	Economic Pillar of Vision 2030 which aims to transform Kenya into a newly industrializing, "middle-income country providing a high-quality life to all its citizens by the year 2030	Creates a robust, diversified and competitive manufacturing sector in the NEC in three ways: 1) boosting local production, 2) expanding to the regional market and 3) taking advantage of global market niches.	None

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Kenya Extractive Industries Development Programme (KEIDP)	Supports efforts to develop a stable, transparent and sustainable extractive industry covering oil, gas and mining, which delivers inclusive benefits to Kenyan citizens. KEIDP's objective and principal outputs are achieved through four key components: (i) Ministry of Mining; (ii) Ministry of Energy and Petroleum; (iii) Community Engagement Component; (iv) Cross Cutting Component comprising a Local Content Study and the Information Centre for the Extractives Sector(ICES)	The Programme is structured around two principal outputs: (i) Increased capacity of key national government agencies to govern the sector well; and (ii) Significantly improved participatory, equitable and sustainable collective stewardship of the extractive sectors	None
School Feeding Programme	Used to incentivize the enrollment and retention of rural children and girls, as part in the realizing the country's goal of universal primary education	Through providing daily meals, schools are able to meet immediate food needs, provide future safety nets, and offer long-term assistance and empowerment to children, families and communities within the ASAL areas of the NEC	None
National Aids and STI Control Programme (NASCOP)	Controlling the spread of HIV and sexually transmitted diseases	Increasing labor productivity and reducing public expenditure on these diseases in the NEC	None

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
The East African Marine Systems (TEAMS)	A submarine cable that will extend from Mombasa to Fujairah in the UAE.	Kenya will have affordable high-capacity bandwidth	None
National Terrestrial Fibre Optic Network Project	Intended to compliment the TEAMS programme.	Programme ensures maximum utilization of capacity and connectivity in all the counties	
Government Common Core Network (GCCN)	Intended to function as a shared and secure interoperable government-wide ICT architecture.	The system does not only integrate work processes and information flow, but also improves inter-ministerial sharing of databases and exchange of information	None
Local and Wide Area Networks	Local Area Networks (LANS) have been installed in all government ministry headquarters.	This eases communication. It has been extended to all the counties	None
Kenya Transparency Communication Infrastructure Programme (KTCIP)	This programme aims to ensure equity in the provision of ICT services.	The programme incorporates establishment of digital villages and bandwidth subsidies in the counties.	None
Data Centre/Data Recovery Centre	The government Data Centre (GDC) will be established to provide storage for all government data bases.	The Neutral Data Centre will provide world-class services to government ministries, departments and agencies, private sector operators and businesses.	None

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Digital Literacy Programme	Promoting computer based learning in primary schools	More than 12,000 digital devices for the programme will be distributed to 150 primary schools for the pilot phase of the Digital Literacy Programme	None
Women Enterprise Fund	The fund capacity builds women entrepreneurs through the concept volunteerism. The volunteers are based at constituency level and their roles include recruiting women, training them and monitoring their projects and loan repayments.	The fund will empower women so that they can participate in businesses in the NEC	None
Youth Enterprise Development Fund	The Fund is one of the flagship projects of Vision 2030, under the social pillar. Its strategic focus is on enterprise development as a key strategy that will increase economic opportunities for, and participation by Kenyan Youth in nation building.	The Fund creates employment opportunities for young people through entrepreneurship and encouraging them to be job creators and not job seekers. It does this by providing easy and affordable financial and business development support services to youth who are keen on starting or expanding businesses.	None

Programme	Environmental and Social Considerations within the Policy	Opportunities for the Master Plan	Potential areas of Conflict
Uwezo Youth Development Programme	Flagship programme for vision 2030 which aims at empowering women, youth and persons with disabilities.	Enables women, youth and persons with disability access finances to promote businesses and enterprises at the constituency level, thereby enhancing economic growth towards the realization of the same and the Millennium Development Goals No.1	None
Gender mainstreaming	This will ensure inclusion of gender related issues in all government policies, plans and programmes	The needs and interests of each gender (i.e. women and men, girls and boys) are addressed	None
Special Programmes (Famine and disaster risk reduction)	Reduction of risks associated with famine and disasters	Minimize the effects of famine and disasters on the people and the economy	None

4 METHODOLOGY AND APPROACH

This SEA methodology *Chapter* is based on the:

- NEMA National Guidelines for SEA in Kenya, 2012, specifically *Appendix 7 – Consolidated Checklist for the Quality Assurance, Review and Performance Evaluation of a Comprehensive SEA*, and the
- Transport Analysis Guidance (TAG), Transport Appraisal Process from the UK Department of Transport publication of January 2014.

4.1 SEA STUDY AREA

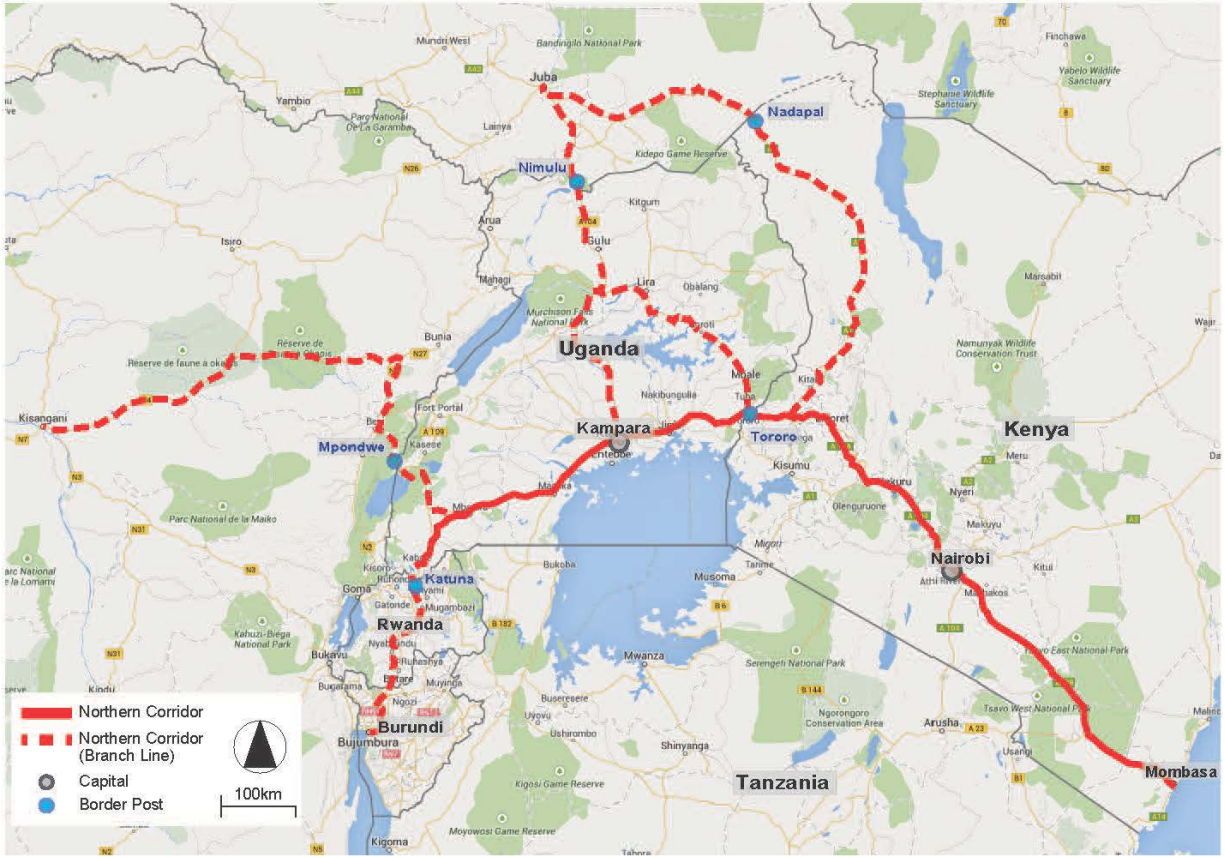
The target area of the Master Plan study covers the following routes and surrounding areas (see below) (1):

- **Main route**
  - Mombasa – Nairobi – Tororo –Kampala – Katuna – Kigali (Rwanda)

- **Sub-routes**
  - Eldoret – Nadapal – Juba (South Sudan)
  - Tororo – Gulu – Elegu – Juba
  - Kampala – Gulu – Elegu – Juba
  - Mbarara – Mpondwe – Kisangani (DRC)

(1) It is important to note that an SEA is also being carried out in Uganda, under consultation with NEMA Uganda

Figure 4.1 NEC Master Plan Study Area



Source: JST, 2016

4.2 SCREENING

Screening is carried out to establish whether an SEA is appropriate and relevant to the development of a PPP (NEMA, 2012). It is used to determine the potential of a PPP to result in significant impacts on the environment and to determine if a SEA is required. The screening stage of the SEA is when:

- objectives are set, and
- the process of identifying stakeholders is carried out.

As discussed in *Chapter 1* of this SEA Report, a PPP Brief was submitted to NEMA in June 2015 by the JST on behalf of MoTI. The screening results were thereafter communicated to the Ministry, i.e., the decision by NEMA that an SEA was necessary, and was to be carried out in accordance with the National Guidelines for SEA in Kenya (2012).

4.3 SCOPING

The scoping stage establishes the focus and content of the SEA and the relevant criteria for assessment. The scoping study identified the potentially significant environmental and social impacts relating to the PPP that needed to be addressed as part of the SEA Study. The scoping study was carried out by ERM between October 2015 and February 2016.

As part of the Scoping Study the following activities were undertaken:

- Identification of sources of secondary data on baseline conditions;
- Identification of, and consultation with, stakeholders who would be interested and/or affected by the NEC Master Plan;
- Identification of cross-sectoral issues and impacts, prioritising them on a shortlist which would need to be considered as part of the SEA; and
- Defining the environmental, social and legislative setting of the Master Plan.

The following methods of data collection were used during the Scoping Study:

- A desk-top review of documents including the JST Master Plan Inception Report and Progress Report Number 1, as well as other relevant PPPs,

- Consultative meetings with Stakeholders in Nairobi, Nakuru, Mombasa, Kisumu and Malaba (1) , and
- Preparation and circulation of a questionnaire that was administered during the Stakeholder Meetings in the 5 towns.

The Scoping Report was submitted to NEMA on the 02nd March 2016 and the Report was approved by NEMA on 06th April 2016 (Reference number NEMA/SEA/5/2/043).

4.4 BASELINE DATA COLLECTION AND CONSTRAINTS MAPPING

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

4.4.1 Baseline Data Collection

Due to the extensive coverage of the Master Plan, the level of baseline data was collected at County and City levels from secondary data, mainly the most recent County Integrated Development Plans (CIDPs), Strategic Plans and the Kenya National Bureau of Statistics.

Other sources of data included:

- United Nations Educational, Scientific and Cultural Organization (UNESCO), for data on cultural and scientific significance;
- Ramsar, for the identification and mapping of wetlands of international importance;
- Ministry of Planning and Devolution (Kenya), for County Profiles;
- USGS and NASA – Satellite Imagery and Earthquake Data, for seismic and satellite information;
- NOAA – Tropical Storm Data, for information on natural hazards;
- International Union for the Conservation of Nature (IUCN), for the identification of conservation areas and identification of threatened species;
- UNEP-WCMC and IUCN – Protected Planet, for the identification of protected areas and areas of conservation value;
- BirdLife International and Nature Kenya, for the identification of important bird areas (IBAs);

(1)It is important to note that since the coverage area of the Master Plan is so extensive, the places where the stakeholder meetings were conducted was limited to major cities/towns along the Corridor. This was agreed in consultative meetings between NEMA/JST/MoTI.

- Kenya Institute for Public Policy Research and Analysis (KIPPRA) Economic Report 2014 Data, for the performance of the Kenyan economy;
- Kenya Wildlife Service (KWS), for the identification and mapping of nature reserves and national parks; and
- Kenya Forest Service (KFS), for the identification and mapping of gazetted forest reserves.

Baseline data was collected as per the National Guidelines for SEA in Kenya (NEMA, 2012), as indicated in *Box 4.1.*

Box 4.1 Baseline Data Collected

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

Source: NEMA, 2012

4.4.2 Document Review

A detailed literature review was undertaken based on the findings of the scoping process, which involved reviewing legislation, policies, County Development Plans, and previous studies carried out in the area to determine the baseline conditions and establish the legal, institutional and biophysical and socio-economic environmental setting of the proposed project.

The desk based study also included the development of Key Informant Interview (KII) questionnaires/guided discussions, as well as the approach to continued stakeholder engagement as outlined in the Stakeholder Engagement Plan (SEP).

4.4.3 Stakeholder Consultation

Stakeholder consultation during baseline data collection was carried out as follows:

- Key Informant Interviews (KII) with various high-level Stakeholders in Nairobi, Nakuru, Mombasa, Kisumu and Malaba,
- A second round of consultative meetings with Stakeholders in Nairobi, Nakuru, Mombasa, Kisumu and Malaba;
- Additional meetings with the Ministries relevant to the Master Plan, as well as the County Representatives that the NEC traverses.

4.4.4 Identifying Constraints and Opportunities

This stage was concerned with identifying the physical, legal and institutional **constraints**, and the **opportunities** affecting the Area of Interest (AoI).

Identifying Constraints

Constraints are features which limit the potential transport options available. Constraints identified by the SEA experts included:

- **areas with extensive development** within urban areas through to landscape and environmental constraints in most rural areas,
- **physical features** which exert special constraints on the shape of the logistics strategy, such as sensitive areas of ecological or landscape or heritage importance, built-up areas, hilly terrain, rivers and railways that are expensive to bridge, etc., and
- **Institutional or legal constraints** which are important to take into account, e.g., the provision of elements of the public transport system by private operators who will have their own commercial objectives. The extent to which these institutional and legal constraints have a material bearing on the outcome of the SEA depend on the extent to which the recommendations are developed with the private suppliers of transport.

Early appreciation of any constraints, especially those which may be "show-stoppers", is essential when developing and assessing options. However, identification of constraints, can limit the option generation process unnecessarily. The SEA Experts therefore assessed the extent to which each of the identified constraints can or cannot be overcome (and how).

Identifying Opportunities

In parallel with listing constraints, any **opportunities** to improve the transport and logistic system more widely or to have positive impacts on issues of wider concern, such as regeneration, were noted. Examples of opportunities include:

- ways of making **better use of the existing infrastructure** or **existing underused assets** (e.g. reopening rail lines),
- transport that **opens up development land** for regeneration or housing, and
- **enhancements** to the environment.

4.5 IMPACT ASSESSMENT AND MITIGATION

The SEA assessment and mitigation methodology relied heavily on the Transport Analysis Guidance (TAG), Transport Appraisal Process from the UK Department of Transport publication of January 2014: https://www.gov.uk/transport-analysis-guidance-webtag

Additional useful information on the reporting of specific impacts, and on the assessment of significance of impacts, was sourced from: http://www.standardsforhighways.co.uk/dmrb/

4.5.1 *Assessing the Significance of Impacts*

The significance of the impact was formulated as a function of the receptor or resource environmental value (or *sensitivity*) and the *magnitude* of project impact (change). In other words, significance criteria are used to report the effect of the impact.

Table 4.1 Environmental Value (or Sensitivity) and Typical Descriptors

Value (sensitivity)	Typical Descriptors
Very High	Very high importance and rarity, international scale and very limited potential for substitution
High	High importance and rarity, national scale and limited potential for substitution
Medium	High or medium importance and rarity, regional scale, limited potential for substitution
Low (or Lower)	Low or medium importance and rarity, local scale
Negligible	Very low importance and rarity, local scale

Source: UK Department of Transport, 2014

Table 4.2 Assessment Magnitude of Impact

Magnitude of Impact	Typical Criteria Descriptors
Major	Loss of resource and/or quality and integrity of resource, severe damage to key characteristics, features or elements (adverse) Large scale or major improvement of resource quality, extensive restoration or enhancement, major improvement of attribute quality (beneficial)
Moderate	Loss of resource but not so adversely affecting the integrity, partial loss of damage to key characteristics, features or elements (adverse) Benefit to, or addition of, key characteristics, features or elements, improvement of attribute quality (beneficial)
Minor	Some measureable change in attributes, quality or vulnerability, minor loss of, or alteration to one (maybe more) key characteristics, features or elements (adverse) Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements, some beneficial impact on attribute or a reduced risk of negative impacts occurring (beneficial)
Negligible	Very minor loss or detrimental alteration to one or more characteristic, feature or element (adverse) Very minor benefit to or positive addition of one or more characteristic, feature or element (beneficial)
No Change	No loss or alteration of characteristic, features or elements, no observable impact in either direction.

Source: UK Department of Transport, 2014

The approach to assigning the significance of impacts was based on reasoned arguments, professional judgement and taking on board the advice and views of appropriate Stakeholders. The five significance categories are set out in *Table 4.3*.

Table 4.3 Assigning Significance Rankings

Significance Category	Typical description of Effect
Very large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision making process
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision making process, but are important in enhancing the subsequent design of the project
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Source: UK Department of Transport, 2014

It is important to note that significance categories are required for positive (beneficial) as well as negative (adverse) effects. The five significance categories gave rise to eight potential outcomes. Applying the formula, the greater the environmental sensitivity or value of the receptor or resource, and the greater the magnitude of impact, the more significant the effect. The consequences of a highly valued environmental resource suffering a major detrimental impact would be a very significant adverse effect (*Figure 4.1*).

Figure 4.2 Arriving at the Significance of Effect Categories

ENVIRONMENTAL VALUE (SENSITIVITY)	MAGNITUDE OF IMPACT (DEGREE OF CHANGE)				
	No change	Negligible	Minor	Moderate	Major
Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large
High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
Medium	Neutral	Neutral or Slight	Slight	Moderate	Moderate or Large
Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

Source: UK Department of Transport, 2014

Change can be either beneficial or adverse, and effects can also, therefore, be either beneficial or adverse. In some cases above the significance was shown as being one of two alternatives. In these cases a single description was decided upon with reasoned judgement for that level of significance chosen.

It is important to note that at the early stages of project design, the details of mitigation are likely to be poorly defined. The significance assigned to impacts by the SEA Consultant should be based upon the assumption that only standard mitigation practices should be put in place. Where other mitigation measures may be feasible or desirable to address the effects, then these should be noted but these should not influence the significance score that is assigned at this early stage. The uncertainty regarding their adoption needs to be made clear and subsequently resolved by the PPP Owner at the later stages of the project assessment and design.

Topics seek to ensure that the following questions, where relevant, should be considered in evaluating the significance of potential effects:

i. Which receptors/resources would be affected and in what way?
ii. Is the receptor/resource of a local, regional, national or international importance, sensitivity or value?

iii. Does the effect occur over the long or short term; is it permanent or temporary and increase or decrease with time?
iv. Is the change reversible or irreversible?
v. Are environmental and health standards (e.g., local air quality standards) being threatened?
vi. Are feasible mitigating measures available?

4.5.2 *Determining the Significance of Cumulative Effects*

When considered in isolation, the environmental effects of any single project upon any single receptor/ resource may not be significant. However, when individual effects are considered in combination, the resulting cumulative effect may be significant. The focus in assigning significance to cumulative effects should be determined by the extent to which the impacts can be accommodated by the receptor/resource.

Thresholds (limits beyond which cumulative change becomes a concern) and indicative levels of acceptable performance of a receptor/resource may also aid the assessment process.

The following factors should be considered in determining the significance of cumulative effects:

- Which receptors/resources are affected?
- How will the activity or activities affect the condition of the receptor/resource?
- What are the probabilities of such effects occurring?
- What ability does the receptor/resource have to absorb further effects before change becomes irreversible?

It is useful to standardise significance criteria for cumulative effects. The 5 categories below could be used as a framework for determining significance of cumulative effects:

Table 4.4 Determining the Effects of Cumulative Impacts

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised
Major	Effects that may become a key decision-making issue
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performances
Minor	Effects that are locally significant

Significance	Effect
Not Significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

Source: UK Department of Transport, 2014

4.5.3 Impact Mitigation

The SEA sought to incorporate measures to avoid or reduce the significant environmental and social impacts following a hierarchical system, where avoidance was always the first mitigation measure to be considered, as presented in *Box 4.2* below.

Box 4.2 Mitigation Hierarchy

Avoidance – consider and incorporate measures to prevent the effect (for example, consider alternative design options or phase the project to avoid environmentally sensitive periods).
Reduction – where avoidance is not possible, then methods to lessen the effect should be considered and incorporated into the project design. Consultation with the Overseeing Organisation will determine whether any remaining 'residual' effect is considered to be environmentally acceptable.
Remediation – where it is not possible to avoid or reduce a significant adverse effect, then measures to offset the effect should be considered.

Source: NEMA, 2012

4.6 APPRAISING STRATEGIC ALTERNATIVES

The SEA should assess reasonable alternatives taking into account current knowledge and methods of assessment. Each alternative can be tested against the SEA objectives. Positive as well as negative effects should be considered, and uncertainties about the nature and significance of effects should be noted. This will often be an iterative process, with the alternatives being revised to enhance positive effects and reduce negative ones. It is, in any case, important to highlight that it is not the purpose of SEA to decide which alternative should be chosen for the plan or programme. This is the role of the decision makers who have to make choices on the plan or programme to be adopted. The SEA simply has to provide information on the relative environmental impact of alternatives.

The alternatives considered at project, corridor and network level vary from country to country, and between transport infrastructure plans. It is possible, however, to identify indicators that may be used to compare certain types of alternatives. The main distinction is between:

- alternative indicative routing, or siting in the case of nodal infrastructure (normally assessed at corridor level);
- Alternative modes and measures to influence traffic flows (assessed at corridor level or network level).
- In all cases impacts are deemed relevant if they can be influenced by the infrastructure plan.

Table 4.5 shows indicators appropriate for comparing the above outlined types of alternatives.

Table 4.5 Types of Alternatives for which an Indicator is sensitive

Impact	Indicative Routing or Siting	Modal Alternatives
Resource depletion/waste	• resource intensity • energy use (if modes are compared)	• resource intensity • energy use
Climate change	In cases where significant differences in route length arise) • Emission of CO_2 • Vehicle kilometres	• emission of CO_2 • vehicle kilometres by vehicle type • modal share in passenger kilometres and tonne kilometres • congestion • fuel consumption
Acidification	In cases where significant differences in route length arise) • Emission of NO_x or SO_2 • Vehicle kilometres	• emission of SO_2 and NO_x • vehicle kilometres by vehicle type • modal share in passenger kilometres and tonne kilometres • congestion
Local air pollution	Exposure of the population to above standard pollutant concentrations	• emission of pollutants • likelihood that a large number of people will be affected • congestion
Photochemical Smog	(In cases where significant differences in route length arise) • emission of NO_x or SO_2	• modal share in passenger kilometres and tonne-kilometres • vehicle kilometres • emission of NO_x and hydrocarbons
Biodiversity	Land take and fragmentation of ecologically sensitive sites	• length of infrastructure • land take and land fragmentation of ecologically sensitive areas • distance from ecologically sensitive areas • risk of affecting key species populations

Impact	Indicative Routing or Siting	Modal Alternatives
Landscape	Land take, visual and other impacts on character of valued landscape areas	Land take, visual and other impacts on character of valued landscape areas
Noise/tranquillity	Exposure of the population to above standard noise level-area affected by noise above a certain level	• vehicle type and speed • vehicle kilometres • likelihood that a large number of people or tranquil areas will be affected
Land take/ Proximity	• land take in different categories of land • distance from sensitive Areas	Total land take per category
Impacts on water	Distance from sensitive Areas	Distance from sensitive Sites
Accidents	Number of accidents or casualties Environmental damage caused by accidents	• Number of accidents or casualties • Environmental damage caused by accidents

Source: UK Department of Transport, 2014

A summary of the main alternatives studied by the Overseeing Organisation that emerge in pursuit of the project objectives, the reason for the Overseeing Organisation's choice of project (taking into account potential significant environmental effects), and an indication of the main reasons for continuing with the project taking consideration of potential significant environmental effects, must be provided in the SEA. The main alternatives typically relate to 'Demand', 'Activity' or 'Location' alternatives e.g., those considered and presented at public consultation for a major project.

4.7 REPORTING

As a result of the SEA process a comprehensive SEA Report (this document) was developed for submission to NEMA for review.

4.8 GAPS AND UNCERTAINTIES

In any SEA process it is inevitable gaps remain. This section summarises the gaps and uncertainties which were considered when undertaking the SEA.

4.8.1 Environmental Baseline Gaps and Uncertainties

Several data gaps and uncertainties have been identified through the preparation of the environmental baseline. These are the following:

Air Quality Baseline:

It is observed that there is no central baseline of air quality within the country and by connection the NEC. This study therefore depends on past studies on air quality within several nodes of the NEC.

Ecology and Spatial Data of Protected Areas (PAs) and Conservation Areas (CAs)

Whilst this study was able to identify their location, there is limited information available in literature on the ecology of PAs and CAs. Furthermore, from the spatial data obtained, the spatial extent of many of these areas is not discernible since they only appear as points.

Aquifer Maps

This study was only able to identify groundwater potential but not accurately map aquifers. It is recommended that further studies on

hydrogeology be done at the project level when the NEC MP is implemented.

Influence of Soil Characteristics:

Soils influence the development of infrastructure depending on the type of infrastructure. This influence can thus mean mapped characteristics of soils such as texture and pH can be constraints. However, the data used for this study is coarse in resolution and accurate mapping can only be done at the project level through geotechnical investigations.

4.8.2 Social Baseline Gaps and Uncertainties

Land Use Information

There was no adequate land use information and there was no up to date land use shapefiles. Therefore the land uses maps were based on the KWS land use shapefiles. There was also the lack of an integrated land use framework plan.

Land Values

Land values along the NEC constantly fluctuate, therefore the SEA study is based on the current land values.

Additional Gaps

These included information on community cultural sites, household incomes and gender issues within the NEC. This information was either unavailable or incomplete for the Counties that the NEC traverses.

5 ENVIRONMENTAL BASELINE

5.1 INTRODUCTION AND OVERVIEW

This *Chapter* presents a description of the physical and biological baseline environment of the NEC. It is essential that the baseline conditions of an environment are characterised in order to accurately predict the potential impacts the PPP may have on the environment. The collection of baseline data also focuses on providing information to support the assessment of any potential impacts.

Information was collected at the following levels:

- *National Level*: Secondary information was collected at national level to provide a high level contextual overview of Kenya, and
- *County Level*: Secondary information was collected at the county level aimed at providing a contextual overview the various counties that the NEC traverses.

The baseline data was also collected to perform a situational analysis of the receptive environment. Through this process potential constraints in the NEC were identified and assessed.

Several regulations and Good International Industry Practice (GIIPs) were consulted in developing this SEA's baseline with the main ones being:

- National Guidelines for SEA in Kenya (NEMA, 2012),
- JICA Guidelines for Environmental and Social Considerations (2010), and
- EIA Regulations of Kenya (2003).

5.1.1 Master Plan Components and Layout

The Kenyan Section of the NEC is the basis of this Baseline Study. Its primary infrastructure component is the Main Arterial Road (MR) (A109 and A104 highway) which links Mombasa and Malaba. A total of 29 counties are traversed by the corridor in the main route with an additional 2 in the sub route as identified in *Table 5.1*. These counties are together termed as the 'NEC Counties' in this Report.

Table 5.1 Intersected Counties (NEC Counties)

County	NEC Area (Km²)	Infrastructure Components		
		MR (Km)	MGR (Km)	SR (Km)
Mombasa	216.0	12.2	5.7	
Kilifi	3,673.3	31.6	33.4	
Kwale	5,001.8	52.5	40.4	
Taita/Taveta	12,075.5	118.9	176.6	
Kitui	4,896.6			
Bomet	247.9			
Makueni	7,925.2	147.8	221.3	
Kajiado	10,667.9	40.9	47.7	
Machakos	3,155.7	44.7	57.0	
Nairobi	706.4	38.2	46.2	
Kiambu	2,495.0	46.3	76.9	
Murang'a	1,315.4		9.5	
Nyeri	617.8			
Nyandarua	2,911.4	3.4	58.8	
Nakuru	7,362.6	147.5	246.4	
Narok	2,047.8			
Laikipia	107.6		3.0	
Baringo	3,528.9	18.8	45.0	
Kericho	1,566.9	2.3	43.2	
Kisumu	344.9		35.9	
Nandi	2,475.0			
Vihiga	82.8			
Uasin Gishu	3,407.0	91.5	112.6	35.0
Elgeyo Marakwet	2,835.8		23.7	
Kakamega	2,937.8	34.6	40.2	15.2
Siaya	415.0			
Trans-Nzoia	2,495.1		19.9	45.6
Bungoma	2,992.0	48.7	59.7	
Busia	1,394.8	12.9	15.1	
West Pokot	8,254.3			104.4
Turkana	35,159.0			415.2
Totals	**133,313.2**	**892.8**	**1,418.2**	**615.4**

5.1.2 Methodology

To achieve its objectives, this baseline study involves an initial review of literature and recent secondary data to identify and describe the nature of the corridor under its three main subjects of focus. A second in-depth review of literature and data was then performed to describe trends within the NEC whilst identifying environmental and social

(E&S) features of interest. These features were then screened on the basis of their sensitivity with respect to the potential impact of the MP on them. The features are then classified as constraints in any of the three categories of High, Moderate or Low explained in *Table 5.2* Constructability of the MP's subsequent projects against these features is also considered in this classification.

The methods used by this study are informed by GIIP guidelines such as those of the International Finance Corporation (IFC), JICA and the World Bank in addition to similar practices used in routing risk assessment studies.

Table 5.2 Constraint Classification Criteria

Constraint Class	Description
Low	A **Low Constraint** is one which is worth considering but does not require additional mitigation measures beyond those normally employed for infrastructure projects under normal conditions.
Moderate	A **Moderate Constraint** is one which definitely requires mitigation measures to prevent impacts even under normal conditions. It may have pre-determined mitigation measures from characteristic practices in the infrastructure sector but without these measures, the cost (social, legal, environmental and financial) will be significant. The key difference between it and High Constraints is the magnitude of the impact for a Moderate Constraint is lower and under normal conditions acceptable with mitigation.
High	A **High Constraint** is one which is sensitive or pristine in nature and should otherwise be avoided through re-routing or refinement. They are features which impacts would result in legal, social, environmental and financial costs on the MP that would undercut its benefits. They are features upon which the acceptability of impacts is low to negligible whilst the magnitude of impact is higher than Moderate Constraints.

A table of identified constraints as well as the constraints maps are included in *Annex D*.

5.1.3 Data Sources

The receptive baseline environment of the NEC is described through a review of literature and analysis of secondary data. This description is focussed on the southern region of Kenya and then more specifically on the NEC and the intersected counties. This baseline study not only focusses on describing the receptive environment but importantly it identifies and classifies potential constraints in the NEC.

Classification of these constraints was thus based on findings and developments of works from: United National Environment Program (UNEP), International Union for Conservation of Nature (IUCN), Food and Agriculture Organization of the United Nations (FAO), Conservation International and United Nations Educational, Scientific and Cultural Organization (UNESCO) amongst other organisations. Close attention is paid to good practice advocated by GIIPs and regulations from institutions such as: JICA, World Bank, IFC, United Nations Environment Program Finance Initiative (UNEP FI), NEMA (Kenya) and the Equator Principles. By answering to the requirements of these GIIPs this study provides knowledge that informs decisions of the SEA.

5.2 GENERAL SETTING

The study area, the NEC, is Kenya's main economic corridor that stretches from Mombasa to Kenya's western border in Busia County and north-western border with South Sudan. The NEC Main Route and Eldoret-Nadapal-Juba Sub-Route occupy an area of 136,998.56 km^2, within 31 counties, comprising of both terrestrial and marine regions. The climate of this area is influenced by five main factors which are: The Inter-Tropical Convergence Zone (ITCZ), monsoons, latitude, topography and inland lakes. The NEC experiences a bi-modal system of rainfall wherein rainfall ranges from 42 mm to 302 mm during the long rains and 26 mm to 220 mm during the short rains. Influenced by the aforementioned five factors, the highlands in the NEC generally experience a cooler climate as compared to low-lying areas. On the other hand, air quality is generally poorer in densely populated areas and within the neighbourhoods of industries.

The geomorphology of the NEC is similar to the rest of country which has been part of the African continent since Mesozoic times during which the processes that occurred shaped the country's geology. The NEC is covered with the following rock classes: metamorphic rocks 25.8%, igneous rocks 34.6%, sedimentary rocks 13.8% and

unconsolidated rocks 25.4%. The remaining 0.3% are water bodies. Analogous to the rest of Kenya, soils in the NEC vary due to topography, amount of rainfall and parent material. 74.4% of the NEC is covered by clay soils, 5.4% by sandy soils and 19.3% by loams. The remaining 0.9% is unclassified or water.

Hydrologically, the NEC intersects all of Kenya's five drainage basins as follows in terms of percentage area: 16.0% Lake Victoria Basin, 46.0% Rift Valley Basin, 34.1% Athi River and Coast Basin, 3.4% Tana River Basin and 0.6% Ewaso Ng'iro Basin. As a result, four of Kenya's five main water towers are traversed by the NEC. These are Aberdares, Cherangani Hills, Mau Complex and Mt Elgon. Hydrogeologically, the NEC is located in regions with high and moderate likelihood of groundwater in its central and western sections.

In the marine environment, it is observed that Kenya has a narrow continental shelf which drops below 200 m within less than 4 km from the coast. Semi-diurnal tides are also experienced most of the year in the country whereas four coastal currents feature in Kenya's coast. These currents are South Equatorial Current (SEC), East African Coastal Current (EACC), Equatorial Counter Current (ECC), and Somali Current (SC). The monsoon season also influences sea surface temperature (SST) and salinity in Kenya's coast.

With respect to natural hazards, The International Disaster Database (EM-DAT) shows hydro meteorological hazards to be the most common hazards in Kenya. Prevailing poverty levels predispose the country's population to vulnerability. The Index for Risk Management (INFORM) assesses Kenya's humanitarian and disaster risk profile to a value of 6.2, ranking the country 16 out of 191 countries.

As mentioned, the NEC includes intersects both the terrestrial and marine eco-regions. It traverses all ecosystems therein except for the glacial ecosystem that is only found at the summit of Mt Kenya. In this respect, the NEC also includes all 7 humidity zones of Kenya's Agro-Ecological Zones.

The main land cover classes in the NEC's terrestrial area in 2012 were grassland, cropland/natural vegetation mosaic, woody savannas and savannas which occupied 39.77%, 23.97%, 10.67% and 9.79% of the area respectively. Deciduous and evergreen needleleaf forests occupied 0.0014% of the area whilst permanent wetlands, water, croplands, evergreen broadleaf forests, and urban and built up areas occupied 0.23%, 4.08%, 3.59%, 3.4% and 0.36% of the area respectively.

Due to its extent, the NEC covers an area that supports numerous species including several that are at risk globally according to IUCN's Red List. In both eco-regions, a total of 166 species, are identified to be at risk, divided amongst the threatened assessment categories as follows: 61 NT, 56 VU, 31 EN and 18 CR. The NEC is thus rich in species diversity and it includes national and international designated and sensitive areas with the following typologies: Protected Areas (PAs), Wetlands and Ramsar Sites, UNESCO World Heritage Sites (WHS), UNESCO Man and Biosphere Reserves (MAB), Important Bird Areas (IBAs) and Endemic Bird Areas (EBAs), Alliance for Zero Extinction Sites (AZE), Eastern Afromontane Biodiversity Hotspot (EAM), Flyways, Corals, Sandy Beaches, Sea Turtle Nesting Sites and Transboundary Resources.

5.3 PHYSICAL BASELINE

5.3.1 Climate and Air Quality

The climate of the NEC is influenced by the five factors explained below in a similar manner as the rest of Kenya:

Inter-Tropical Convergence Zone (ITCZ)

The movement of the ITCZ southwards between October and December, and northwards between March and May results in a bi-modal rainfall system. The rainfall that falls during the former period are termed as the 'short rains' and during the latter the 'long rains'[1].

Monsoon Winds

The climate of the coastal belt (Kilifi, Kwale and Mombasa Counties) is influenced by the monsoons whereby:

- ***November - early March:*** The weather at the Kenyan coast is dominated by the Northeast Monsoon (Kaskazi) which is comparatively dry. This period is characterized by warm temperatures (mean 28.4 °C, max 31-32 °C), shorter and lighter rains (8 to 84 mm/month), calm seas and steady light winds (<0.25 m/s)[2].

[1] McSweeney C. et al (n.d). UNDP Climate Change Country Profiles. Kenya. Retrieved February 15, 2016 from http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Kenya/Kenya.lowres.report.pdf
[2] UNEP, (1998). East Africa Atlas of Coastal Resources.

- ***March - April:*** The wind blows in an east-to-south-easterly direction with strong incursions of maritime air from the Indian Ocean causing heavy rains inland.

- ***May - August:*** The Southeast Monsoon (Kusi) influence gradually sets in and the weather becomes more stable with overcast skies and comparatively cooler temperatures. This period is characterized by cool temperatures (mean 26.4^{o}C, max 30^{o}C), prolonged and heavier rains (55 to 272 mm/month), rougher seas and strong winds (0.5 to 0.75 m/s).

- ***September - November:*** The Northeast Monsoon gradually re-establishes itself and by December the Northeast Monsoon is dominant once again.

Latitude

This influences the timing of rainfall minima and maxima by determining the amount of sunlight a place receives[1]. Higher latitudes receive less sunlight as compared to lower latitudes. As a result, higher latitudes receive less rainfall compared to regions closer to the equator or lower latitudes.

Topography

Kenya is separated into four distinct climatic zones based on topography. These are explained as follows:

- ***Central Highlands and Rift Valley:*** This region receives high annual rainfall in the mountains (up to 3,000 mm). This rain feeds the lakes of the Rift Valley. Average daytime temperatures in Nairobi (altitude 1,661 m) which is in this region, are between 21-26 °C. NEC Counties in this region include: Uasin Gishu, Kericho, Baringo, Nakuru, Nyandarua, Nairobi and the north-western regions of Kajiado.

- ***Western Kenya:*** This region is hot and wet throughout the year, with annual rainfall over 1,000 mm and average daytime temperatures in areas such as Kisumu ranging between 27-29 °C. NEC Counties located here are Kakamega, Busia and Bungoma.

[1] Raphael W. (n.d). Some Aspects of the Geography of Kenya.

- ***Northern and Eastern Kenya:*** Here the land is hot and arid, with vast 'lake' beds/deserts of lava, sand, salt and soda. Average annual rainfall is less than 510 mm and daytime temperatures are mostly between 30 and 40 °C, soaring to 39 °C in some desert areas. NEC Counties in this region include Central and South Eastern regions of Kajiado, Machakos, Makueni and western regions of Taita Taveta.

- ***Coastal Belt:*** Kenya's beaches are hot and humid but tempered with cooling sea breezes. A narrow plain of land along the coast is suitable for crops such as fruits, nuts and cotton, before the terrain becomes semi-desert. Annual rainfall is usually over 1,000mm and daytime temperatures in Mombasa average 28-31°C. NEC Counties in this region are Kwale, Kilifi, Mombasa and the eastern regions of Taita Taveta.

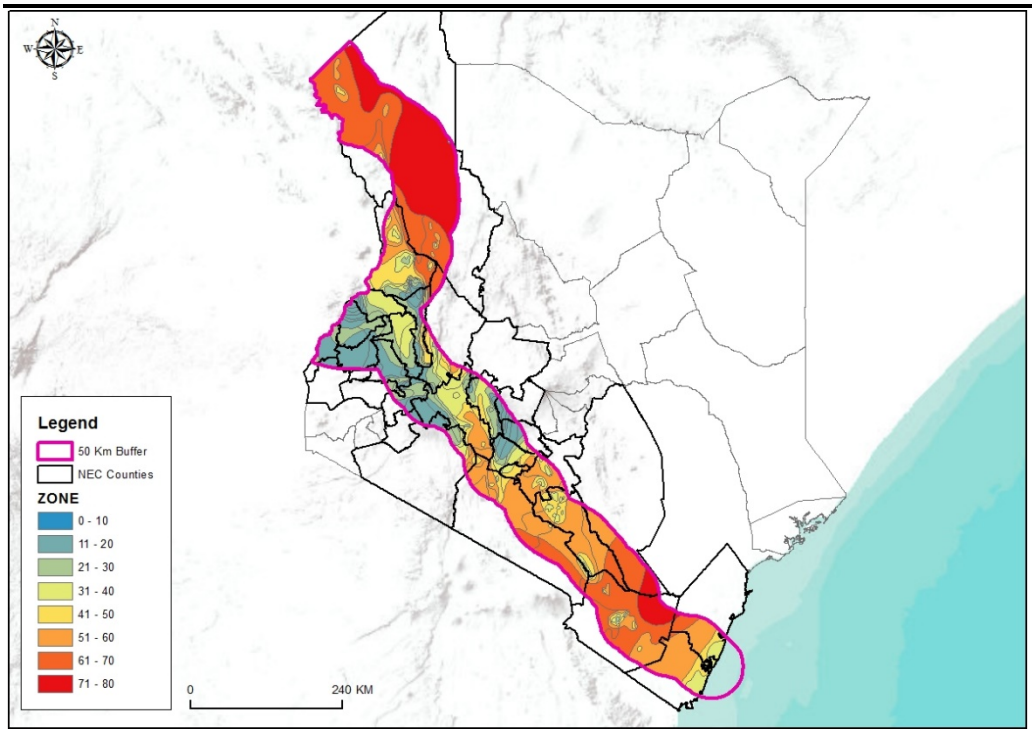
Inland Lakes

These provide inland sources of moisture influencing humidity and rainfall patterns. Inland lakes located within the NEC include Lakes Nakuru, Elementaita and Naivasha.

Using humidity and temperature, Sombroek et al. (1982) sub-distinguished Kenya's land mass into Agro-Climatic Zones (ACZs). Each ACZ is assigned a double digit numerical value achieved by combining the index of moisture and temperature zones. Moisture availability zones comprise of the following seven zones according to relative humidity: (I) >80-Humid, (II) 65-80-Sub-humid, (III) 50-65-Semi-humid, (IV) 40-50-Semi-humid to Semi-arid, (V) 25-40-Semi-arid, (VI) 15-25-Arid and (VII) <15-Very arid. On the other hand, temperature zones comprise the following nine zones in accordance to their temperature ranges: (1) 24-30, (2) 22-24, (3) 20-22, (4) 18-20, (5) 16-18, (6) 14-16, (7) 12-14, (8) 10-12 and (9) <10.

Figure 5.1 shows the ACZs zones found within the NEC.

Figure 5.1 ACZs of the NEC



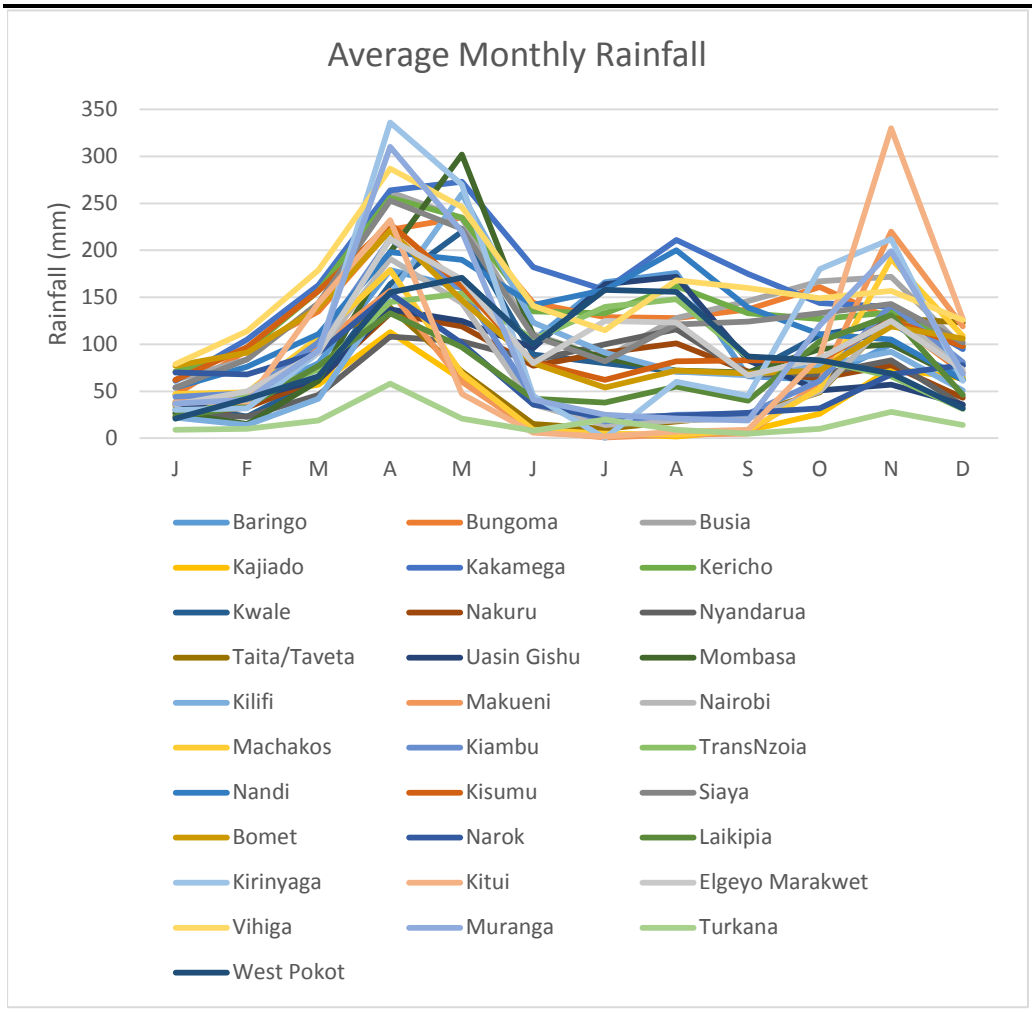
Source: ILRI, (2007)[1].

Precipitation

Kenya mostly experiences a warm climate throughout the year whereas 80% of the country is considered to be Arid and Semi-Arid Lands (ASALs). Average monthly rainfall in the NEC ranges from 42 mm to 302 mm during the long rains and 26 mm to 220 mm during the short rains. This study calculated the mean of average monthly rainfall received in the headquarters of the NEC Counties. It elucidated that Kakamega County with a mean of 164 mm of rainfall per month is the wettest county whilst Kajiado is the driest with a mean of 42 mm per month. *Figure 5.2* illustrates the trend in average monthly rainfall amongst the NEC Counties.

[1] ILRI, (2007). Agro-Climatic Zones of Kenya. ESRI ArcGIS Shapefile. Adopted from Sombroek at al. (1982).

Figure 5.2 Average Monthly Rainfall (mm) in the NEC Counties

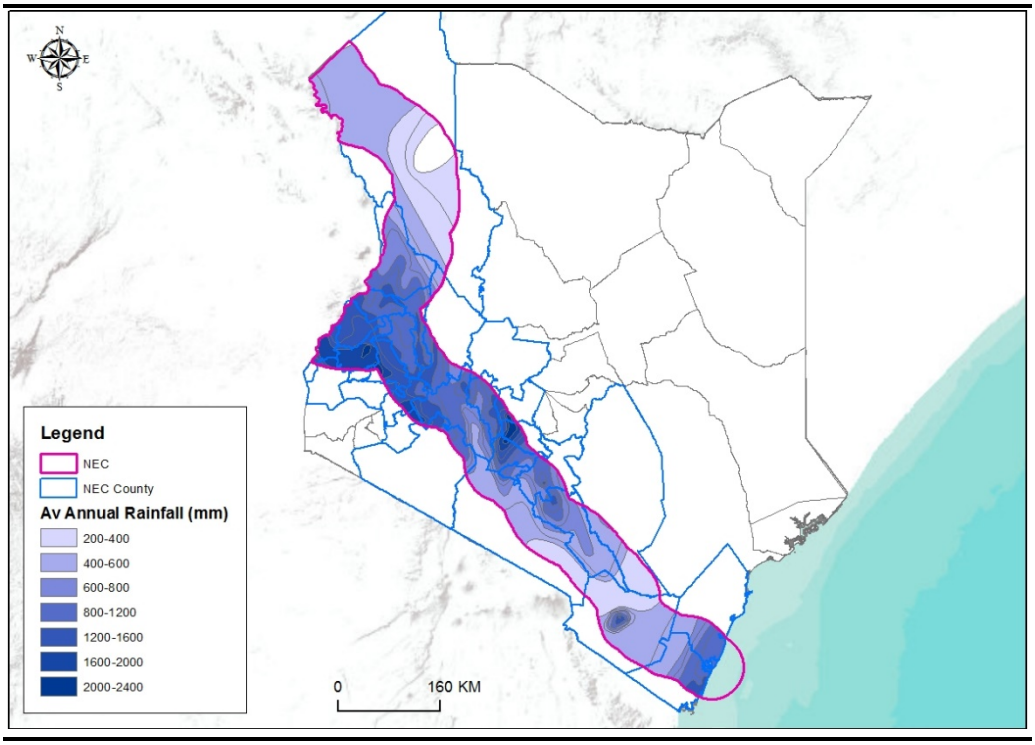


Source: www.clima-temps.org, (2016)[1].

The spatial distribution of average annual rainfall further confirms the trends amongst the counties in *Figure 5.3*. It is seen that the counties in the highlands and western region receive the most rainfall in the NEC.

[1] www.clima-temps.org, (2016). Rainfall Data on Kenya Cities.

Figure 5.3 Average Annual Rainfall (mm) in the NEC

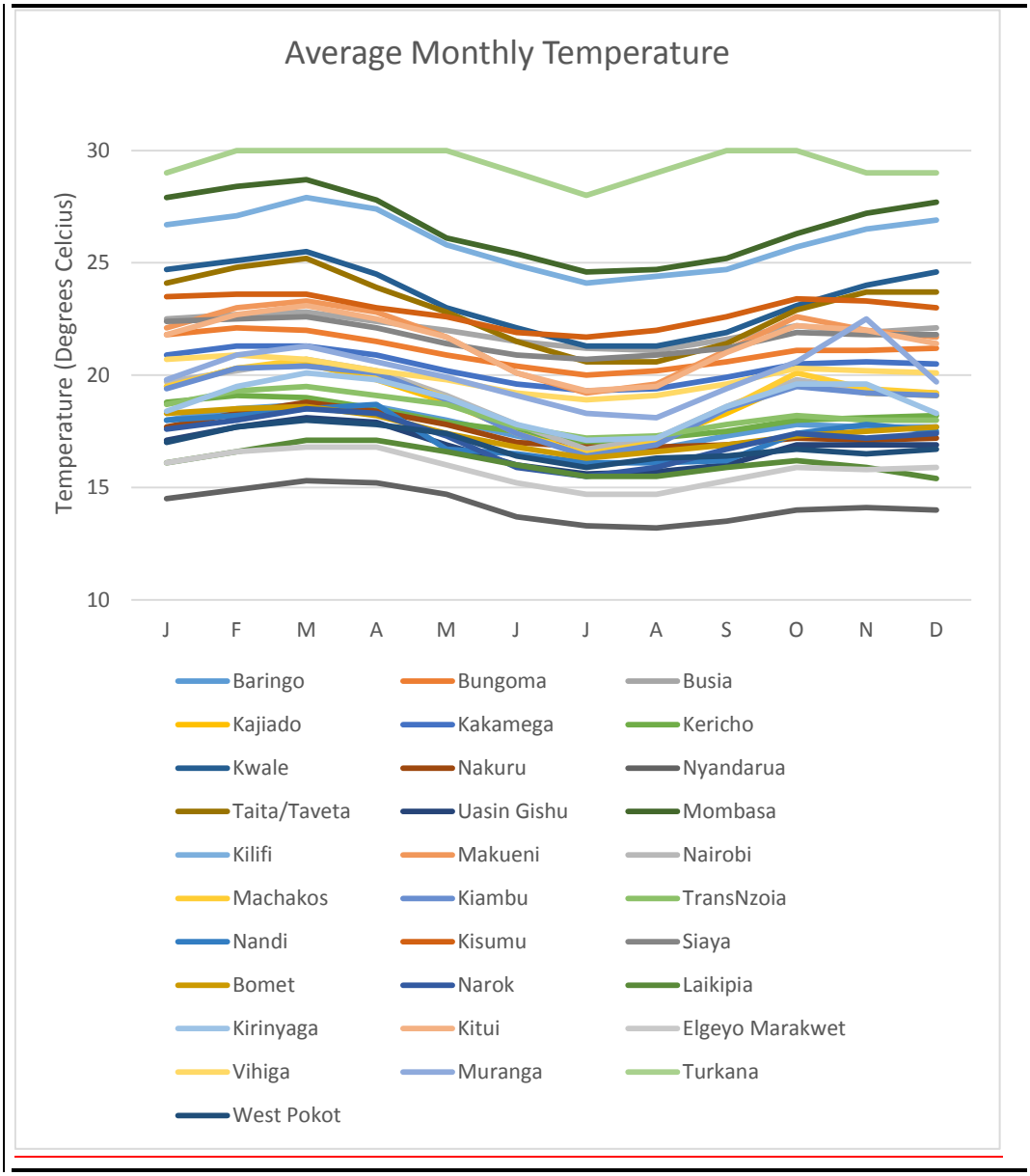


Temperature

Temperature is similarly influenced by the bi-modal system of rainfall in Kenya (NEC included). The hottest month is February, with temperatures ranging between 13 °C and 28 °C, and the coolest is July, with temperatures between 11 °C and 23 °C. Kenya experiences a tropical climate that is hot and humid at the coast, temperate inland and very dry in the north and northeast regions of the country.

Based on calculated means of monthly average temperatures, Mombasa is identified to be the hottest county amongst the NEC Counties experiencing an average monthly temperature of 27 ºC per month whilst Nyandarua is the coolest experiencing 14 ºC on average per month. This is attributed to topographic nature whereby Mombasa is a low-lying (almost entirely at sea-level) and coastal whilst Nyandarua is located within the central highlands. Trends in average monthly temperatures in the NEC Counties are illustrated in *Figure 5.4.*

Figure 5.4 Average Monthly Temperature in the NEC Counties



Source: clima-temps.org, (2016)[1].

Air Quality

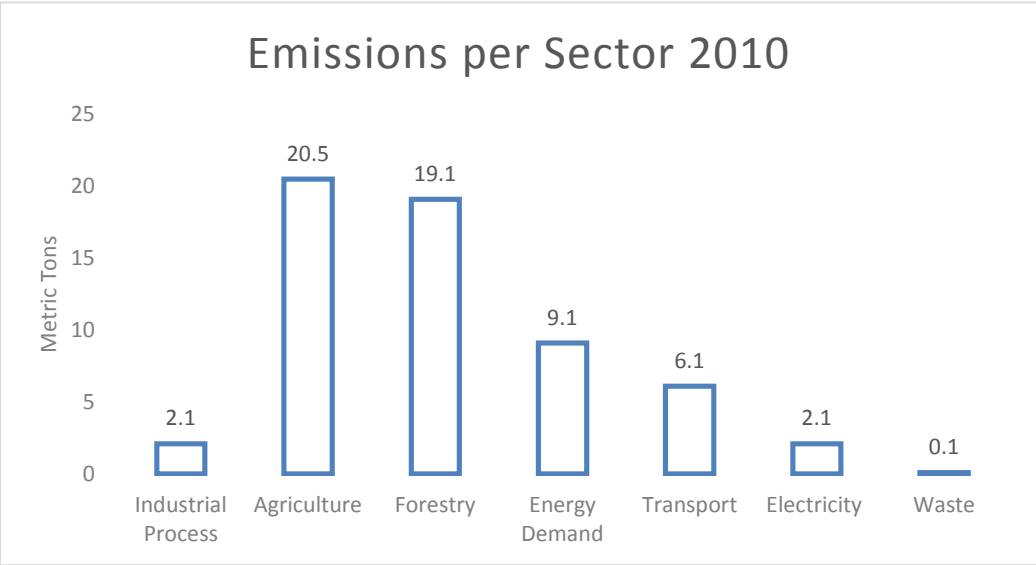
Kenya is yet to establish a central national baseline of air quality and this study observes that most air quality studies in the country have, at best, been local in scope. Majority of these studies focus on urban areas which tend to have poorer air quality as compared to rural areas since they are often population and economic centres. Moreover, within urban areas it has been documented that low income areas and informal settlements often have lower air quality than their higher income counterparts. This can be attributed to poor planning, high population densities, poverty, poor energy diet (dependence on

[1] www.clima-temps.org, (2016). Temperature Data on Kenya Cities.

firewood and charcoal), and lack of services and adequate infrastructure.

Common sources of air pollutants in Kenya include: industrial activities (manufacturing, construction and processing industries), fossil fuel engines (including vehicles), land use changes, improper waste disposal and use of fuelwood and charcoal. The NEC links Kenya's economic belt thus it has majority of the country's population and industries. It was estimated that Kenya produced at least 59.1 metric tons of emissions in 2010. Agriculture, forestry, energy demand and transportation were the main sources of these emissions as shown in *Figure 5.5.*

Figure 5.5 Emissions per Sector in Kenya 2010

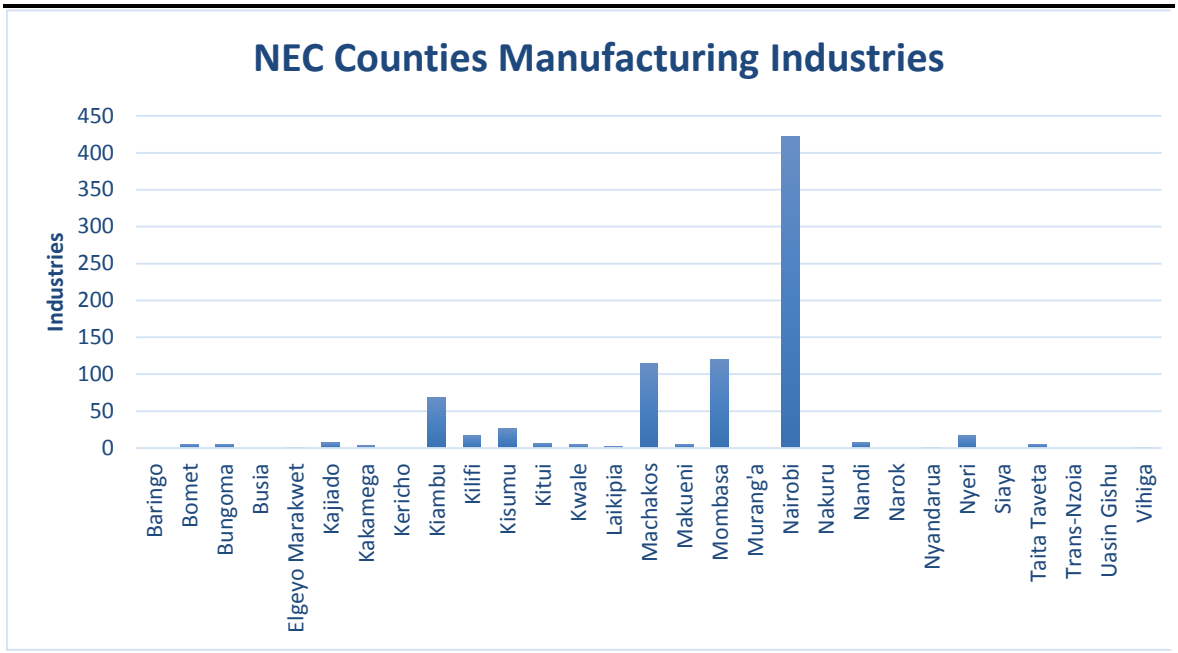


Source: NEMA, (2014)[1].

The NEC intersects several industries and industrial zones which are potential point sources of air pollution. There is an average of 28 manufacturing industries per county amongst the NEC Counties. Those counties with large urban areas such as Nairobi, Mombasa, Uasin Gishu and Nakuru host majority of industries as shown in *Figure 5.4.* Other point sources include fossil fuel generators and land use changes (land conversion). Mobile sources include motor vehicles, trains and aero planes.

[1] NEMA, (2014). Improving Ambient Air Quality in Urban Centers of Kenya. Presentation by Dr Geoffrey Wahungu.

Figure 5.6 Manufacturing Industries in the NEC Counties



Source: KNBS, (2013).

Air pollution studies in different areas in the NEC, biased on criteria pollutants, have in some cases found prevailing levels higher than recommended levels according to WHO's standards. Studies which have documented levels of air pollutants in some of the nodes of the NEC are discussed below. Whilst this discussion is not extensive it seeks to give an indication of documented levels and/or impacts of air pollution and quality in the NEC:

- **Nakuru:** Wangari S. et al (2014) sampled rooftops in 34 locations in the Lake Nakuru Basin for heavy metals (Pb, Ni, Zn, Fe and Cr). The study reveals that distribution of these pollutants is similar within the entire basin and Fe was the most deposited heavy metal followed by Zn, Cr and Pb. Ni concentration were lower than detection limits. The study points that the levels detected were not at alarming levels[1].

- **Nairobi:** Galcano C. and Kariuki L. (2001) sampled TSP in Nairobi from 11 locations (industrial, commercial and residential areas) to create an air quality map using Thiessen Polygons. The study identifies that most regions in its study area have higher TSP concentrations than WHO recommendations[2].

[1] Wangari S. (2014). Assessment of Heavy Metals in Rooftop dust around Lake Nakuru Basin, Kenya. Research Journal of Chemical Sciences. Vol. 4(11), 13-17, November (2014).
[2] Galcano C and Kariuki L (2001). Mapping and Analysis of Air Pollution in Nairobi, Kenya. International Conference on Spatial Information for Sustainable Development Nairobi, Kenya 2–5 October 2001.

Patrick L et al., (2011) found that mean daytime concentrations of $PM_{2.5}$ from traffic in Nairobi ranged from 10.7 in the rural background areas to 98.1 $\mu g/m^3$ on the sidewalks of the central business district (CBD)[1]. These values exceed the WHO recommendation of 25 $\mu g/m^3$. This can be expected at other urban areas in the NEC.

- **Eldoret:** Donna A et al. (2015) reported that rapid urbanization in Eldoret town has contributed to increased air pollution. They attribute this to increased population and economic activity which leads to increased vehicular traffic, land use changes and expansion of manufacturing activities. The authors indicate that the town has also experienced increases in respiratory and cardiovascular diseases as well as childhood asthma[2]. Apart from vehicular traffic and dust during the dry season smoke (emissions) from industries have been identified as a key source of air pollution in Eldoret[3].

- **Webuye (Bungoma County):** During Webuye Pan Paper mill's operational period, it was considered to be one of Kenya's largest air polluters. The mill emitted significant quantities of SOx creating persistent nuisances and acid rain which damaged neighbouring properties simultaneously affecting farming activities in its neighbourhood. Annual losses caused by air pollution from the mill were estimated to a value of USD 38 million by one study[4]. However, the closure of the mill also had socioeconomic impacts to the town[5].

- **Athi River (Kajiado County):** Zablon W. et al (2015) collected air samples from three sites in Athi River township over a one-week period using gas samplers and analysers in a Mobile Air Laboratory. In their findings they elucidate that the PMx concentration was generally high in the morning and late evening. Furthermore, the mean 24-hour concentration of $PM_{2.5}$ was 30.74 $\mu g/m^3$ which is excess of WHO's recommendation of 25 $\mu g/m^3$. On the other hand,

[1] Patrick K. et al (2011). Traffic Impacts on $PM_{2.5}$ Air Quality in Nairobi, Kenya. Elsevier. Environmental Science and Policy. 2011 June; 14(4): 369–378.
[2] Donna A et al (2015). Air Quality and Health Impacts: A novel approach to an international cooperative monitoring project in Uasin Gishu County, Kenya. American Meteorological Society.
[3] Job K. et al (2014). Urban Environmental Planning and Development Control of Medium Sized Towns in Kenya. A Case of Eldoret Municipality. Journal of Emerging Trends in Economics and Management Sciences (JETEMS) 5(3):351-363.
[4] CPK (2000) Pollution from Panpaper factory, A research report by the Church of the Province of Kenya.
[5] Eunice O. et al (2014). Industrial Air Pollution in Rural Kenya: Community Awareness, Risk Perception and Associations Between Risk Variables. BMC Public Health 2014, 14:377.

they found the concentration of Black Carbon to range from medium to extremely high whereas the concentrations of N, S and H were generally low. These findings are attributed to industrial activities in the Athi River region[1].

- **Mombasa (Mombasa County):** AfDB (2014) investigated air quality in a 40 km long corridor along the Mombasa-Mariakani A109 road. The study noted that while PMx concentrations were below WHO recommended limits, sections with high population densities and economic activities registered high concentrations. A maximum concentration of 7.3 mg/m3 was registered in the Miritini area. Concentrations of CO_2 (the dominant pollutant) followed the same trend with a maximum value of 200 mg/l observed in Kokotoni. SO_2 concentrations were low in the study area, ranging between 0.01 and 0.14 mg/l. CO, VOCs and NOx were all below detection limits[2].

  It is reported that residents in Changamwe suffer from dust stirred up by container trucks and local emission sources include the refinery, oil-fired power plant and fires at the landfill site[3].

- **Bamburi (Kilifi County):** Mining of limestone and manufacture of cement are the major source of air pollutants (PMx, NOx, CO_2 and SOx) in this region. It has been estimated the production standards in this area emit 650g of CO_2, 1,566 g of N_2 and 262g of O_2 per kg of cement produced[4].

- **Olkaria (Nakuru County):** Kenya's geothermal power plants are located in this region. Such power plants are known to be sources of H_2S which WHO recommends should not exceed 0.1 ppm in a 24-hour average concentration. Cornelius J. (2015) modelled H_2S dispersion from three development scenarios/stages at Olkaria using the CALMET/CALPUFF model. The study postulates that an odour detectable concentration can be expected up to 10 km from the source from a 1-hour average concentration. For the 24-hour average concentration, the study postulates that only 0.03 ppm can

[1] Zablon W. et al (2015). Ambient Air Quality Monitoring and Audit over Athi River Township, Kenya. International Journal of Scientific Research in Environmental Sciences, 3(8), pp. 0291-0301, 2015.
[2] AfDB (2014). Mombasa–Mariakani Road Upgrading Project Environmental and Social Impact Assessment (ESIA) Summary.
[3] JICA (n.d). Summary of the Preliminary Study for Grant Aid Project (draft). Retrieved February 22, 2016 from http://www.jica.go.jp/english/our_work/social_environmental/archive/grantaid/pdf/kenya4_01.pdf
[4] LaFarge (2008). Managing Emissions from industrial and Mining Sources Dust Emissions from Cement Manufacturing Plant. Presentation by Alfred Wafua.

be expected in the residential and commercial areas in the neighbourhood of Olkaria[1].

Currently, Kenya is still in the process of establishing regulations in air quality management. Prevailing regulations (EMCA) propose the adoption of WHO standards. However, this situation is deemed as a gap in view of the presence of numerous potential sources of air pollution in the NEC. In addition, some emissions have global warming potentials. Key regulations which seek to limit emissions include: Waste Management Regulations (2006), Waste Tyre Regulations (2014), OSHA, EMCA, Climate Change Act (2014) and Vehicular Emission Standards (KS 1515).

Box 5.1 Constraints – Climate and Air Quality

Under this topic, this study identifies constraints to include areas that are prone to hydrometeorological hazards. These are discussed in *Section 5.3.6*

5.3.2 Topography

Volcanic activity and the Great Rift Valley system shaped Kenya's topography. The country's highlands are located to the west of the Rift Valley with their highest point being Mt Kenya's summit at 5,199 m asl. In the eastern region are the lowlands whose altitude decreases to sea level at the coast. The country has the following six distinct physiographic regions which are traversed by the NEC:

1. Coastal belt and plains;
2. Coastal Hinterlands;
3. Foreland Plateau;
4. Highlands includes Rift Valley;
5. Nyanza Low Plateau, and
6. Northern Plain Lands.

On an E-W profile the MR commences in Mombasa at an altitude of approx. 21 m asl in region #1 above. It steadily rises 173 km to altitude of 693 m asl in Taita Taveta County as it traverses the Coastal Hinterlands. From here its next 24 km drops gently to an altitude of 466 m before rising gradually to an eventual altitude of 1,649 m over a distance of 202 km through the counties of Makueni and Kajiado in the

[1] Cornelius J. (2015). Air Quality Assessment for Development Options at Olkaria Geothermal Field in Kenya. Proceedings World Geothermal Congress 2015. Melbourne, Australia, 19-25 April 2015.

Foreland Plateau. In the western region of Makueni County the altitude generally plateaus over a distance about 30 km prior to dropping to gently to 1,507 m asl within 19 km. The elevation then rises as the MR crosses into Machakos, Nairobi and Kiambu Counties where it crosses the Kikuyu escarpment to reach 2,685 m.

As the MR traverses the Rift Valley its altitude reduces steeply to 1,498 m at the floor of the graben. The altitude oscillates between 2,028 and 1,901 m asl over a distance of 92 km within the floor of the graben in Nakuru and Nyandarua Counties. The MR the crosses the Mau escarpment where it rises to highest altitude of 2,685 m at 703 km from its starting point in Mombasa. The remaining 195 km of the MR descends gradually to an eventual altitude of 1,153 m at the Kenya-Uganda border as the route traverses from Nakuru through Kericho, Uasin Gishu, Kakamega, Bungoma and eventually Busia. *Figure 5.8* illustrates this East to West (E-W) elevation profile based on a Digital Elevation Model (DEM) with a resolution of 30 m, while Figure 5.8 displays that of the Eldoret-Nadapal-Juba Sub-Route on a South to North (S-N) profile.

Figure 5.7 MR E-W Elevation Profile along the Main Route of the NEC

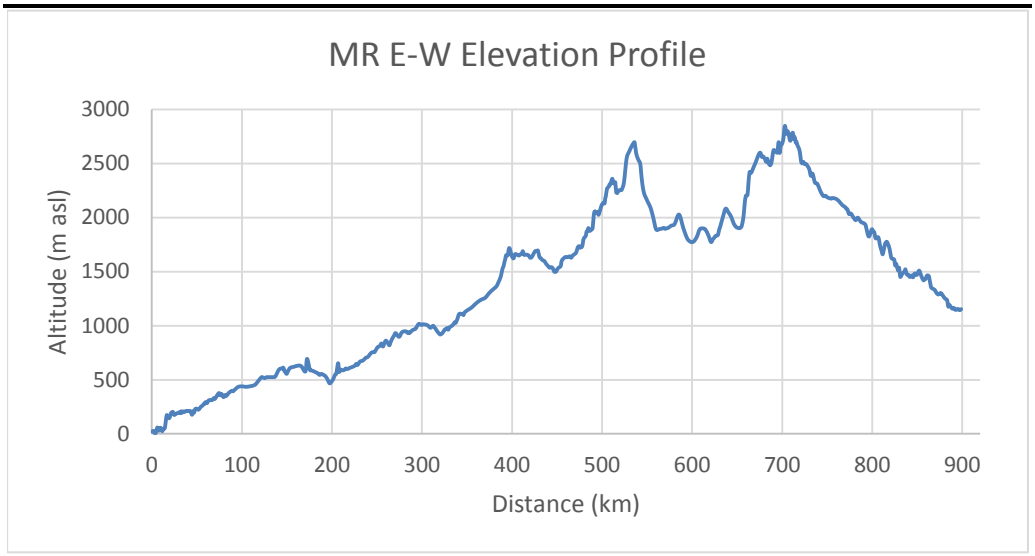


Figure 5.8 Eldoret-Nadapal-Juba Sub-Route S-N Elevation Profile

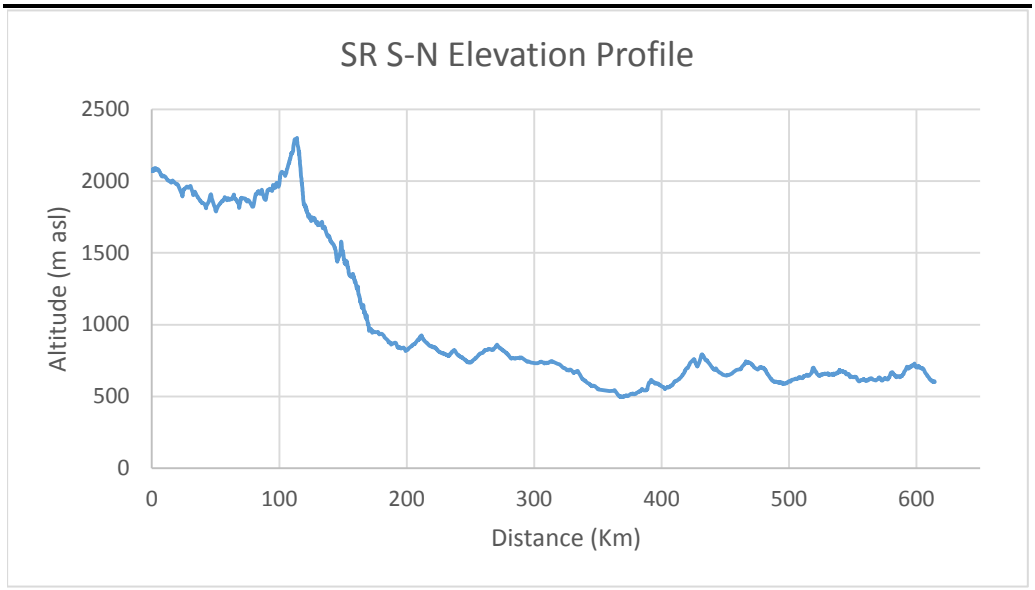
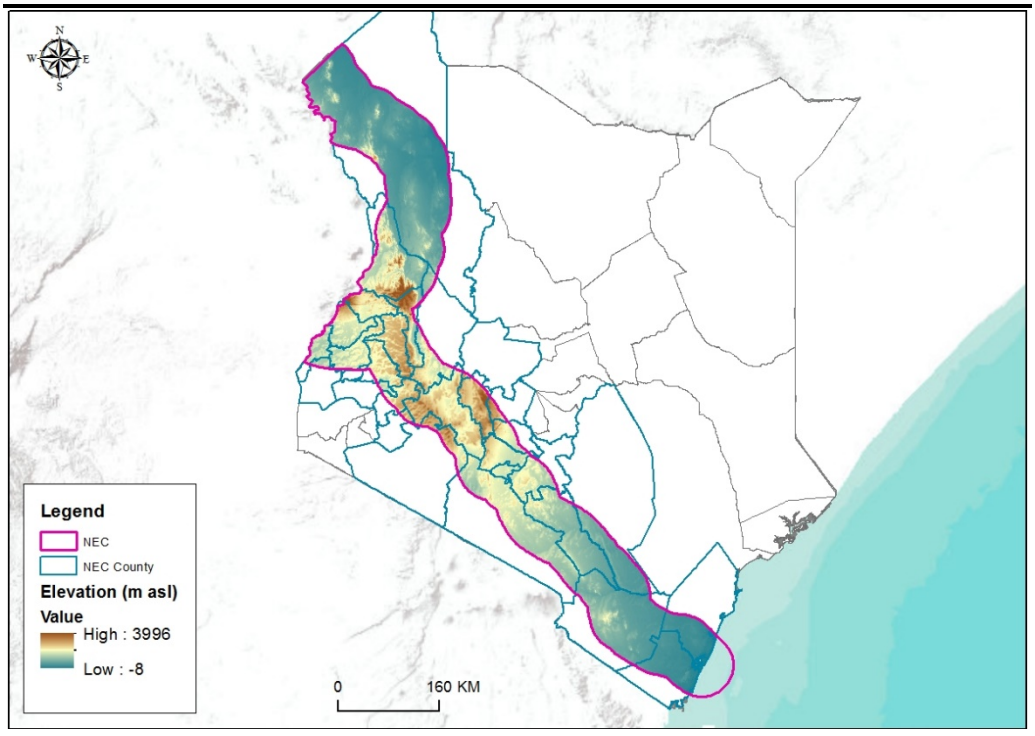


Figure 5.9 shows the elevation of the NEC through a DEM developed with data from the SRTM satellite instrument.

Figure 5.9 NEC Elevation



Source: NASA LP DAAC, (2016)[1].

[1] NASA Land Processes Distributed Active Archive Center (LP DAAC), (2016). SRTM. USGS/Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota.

Box 5.2 Constraints – Topography

Constraints identified in topography include steep slopes and high peaks (See *Figure 5.12*). These areas are construction constraints in which the constructability of any infrastructure is low or accessibility to those areas is poor. Volcanic peaks are identified and discussed further in *Section 5.3.3* under volcanism.

5.3.3 Geological Characterisations

Geomorphology

The geomorphology of the NEC is similar to the rest of country which has been part of the African continent since Mesozoic times during which the processes that occurred shaped the country's geology. As a result of those processes, marine transgressions formed during the Jurassic and Cretaceous periods can be found up to 150 km inland (Taita Taveta County). Regional uplift of up to 600 m in Central Kenya is associated with the Tertiary period that followed and marked the beginning of the present Cenozoic era. Great volcanic activities then followed and continued into the Quaternary period. This resulted in the volcanic rocks, widely found in the country, covering one third of the country's surface.

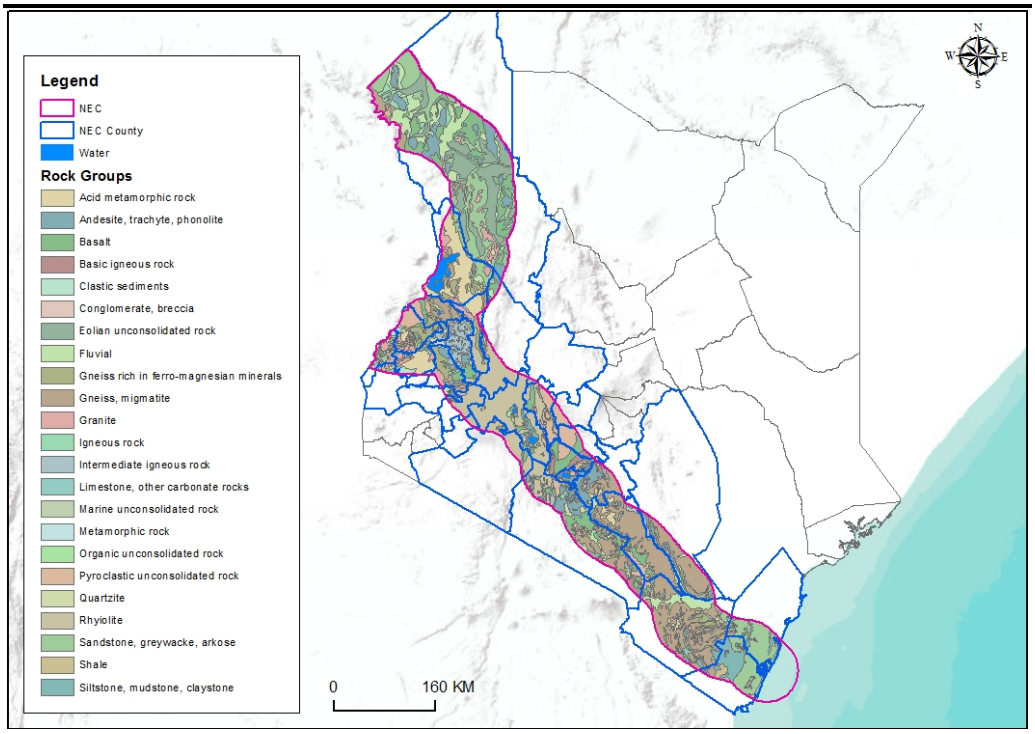
Extensive areas of the Pre-Cambrian shield were overlaid by lava and Quaternary sediments as the Rift Valley formed. In the Pleistocene period (earlier stages of the Quaternary period) the immediate forebear of other modern undulates were developed. Many landscapes were borne over these millions of years. The Nyanzian system is where the Pre-Cambrian geological formations fall. The Nyanzian shield and the metamorphism involved are found in the early Pre-Cambrian formation which date back about 3 trillion years ago. The associated rocks are well-developed around Lake Victoria where they are associated with intrusive gold-bearing granites.

Banded ironstones with quartzite, which are mainly developed east of Lake Victoria, are from the Nyanzian system. These have undergone slight metamorphism as a result of intense folding and granitic batholithic intrusions. Rocks of the Karroo system noted for their fossil beds and coal-bearing strata are the record of Paleozoic and lower Mesozoic times in Kenya. Lake and river deposits from Pleistocene times and more recent alluvial and swamp deposits are the Quaternary sediments which are mostly of terrestrial origin. These are distributed in the low lands of Eastern Kenya. Large sectors of Northern and Central Kenya, extending into Tanzania are covered by Tertiary to

Recent volcanic rocks which were products of some of the tectonic disturbances that include the Great Rift Valley.

In terms of percentage area, the NEC main route is covered with the following rock classes: metamorphic rocks 25.8%, igneous rocks 34.6%, sedimentary rocks 13.8% and unconsolidated rocks 25.4%. The remaining 0.3% are water bodies. The remaining 0.3% are water bodies. *Figure 5.10* shows the spatial distribution of the rock groups in the NEC.

Figure 5.10 Lithological Groups of the NEC



Intersection of the NEC with the Great Rift Valley is the major factor behind the presence of faults in the NEC. These faults were caused due to the formation of the grabens (including Kavirondo) on whose escarpments they are predominantly located (see *Box 5.3* for the constraints).

Soils

Soil Characteristics

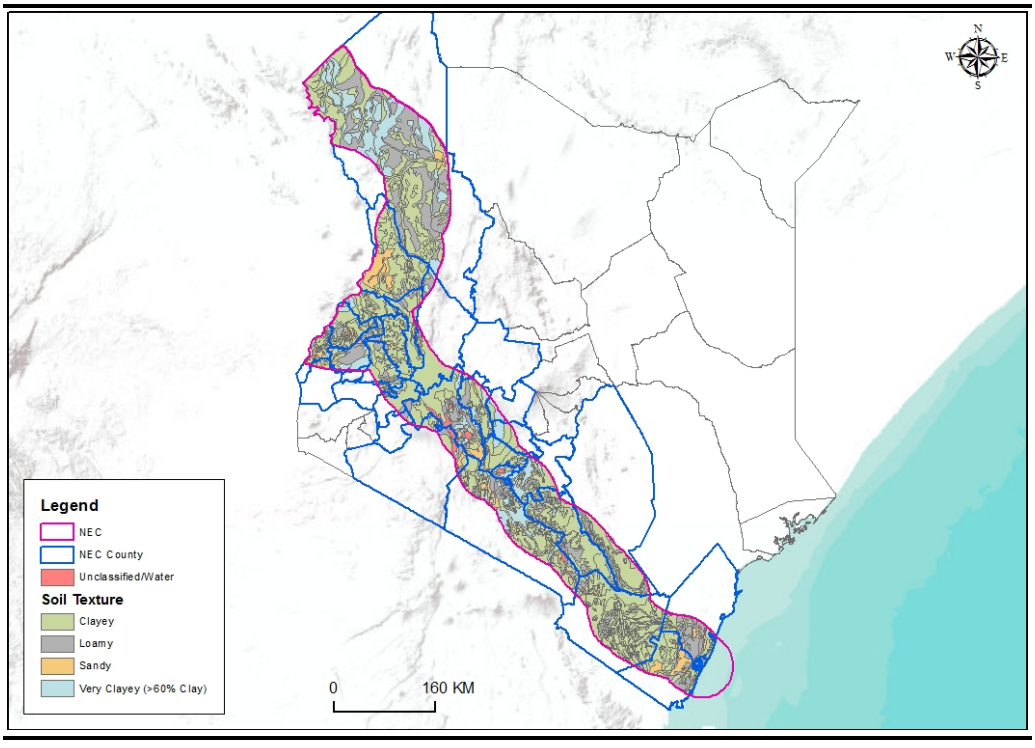
Soils vary in Kenya due to topography, amount of rainfall and parent material. Certain distinctions can however be made within the NEC. Acrisols and cambisols, and their mixtures are found in the western region of Kenya which includes the counties of Busia, Vihiga, Siaya, Uasin Gishu, Kakamega, Nandi and Kericho. Highly weathered and leached sils with accumulations of iron and aluminium oxides are

exhibited in this western region. Andisols characterize the Rift Valley region which includes Nakuru, Kericho, Uasin Gishu and Baringo.

On the other hand, Central Kenya (Nyandarua, Kiambu, Nairobi and part of Kajiado) is overlain with nitosols and andosols which are young and of volcanic origin. Soils in the ASALs (Machakos, Makueni, Kajiado and Taita Taveta) include the vertisols, gleysols and phaeozems. They are characterized with pockets of sodicity and salinity, low fertility and vulnerability to erosion. Mombasa, Kilifi and Kwale counties exhibit coastal soils which are coarse textured and ow in organic matter. The common types of these coastal soils are arenosols, luvisols and acrisols. Whilst soil salinity is widespread in the country it is found in pockets in Taita Taveta.

With respect to soil textures, the NEC main route is overlain by clays, loams and sandy soils mainly at the coast. Sandy soils create a constructability challenge of water ingress and erosion requiring soil management mitigation measures. On the other hand, clay soils expand on infiltration of water and also require to be accommodated on construction. 74.4% of the NEC is covered by clay soils, 5.4% by sandy soils and 19.3% by loams. The remaining 0.9% is unclassified or water. *Figure 5.11* shows the distribution of these soils textures in the NEC.

Figure 5.11 Soil Textures of the NEC



Tectonic Setting

Most of the NEC is located within the Kenya Dome which overlies the Nubian (African) Plate covering an area of about 1,000 km wide. The NEC traverses the Eastern Branch of the Rift Valley in the region where the Somalia Plate is pulling away from the Nubian and Arabian plate. This branch bisects the country north to south and splits further into three rift arms. The main rift is formed by two of these arms whilst the third (Kavirondo) is a subdued graben west of the dome in Nandi, Kericho and Nakuru[1]. The eastern section of the plate forms a smaller segment underlying the NEC in the South East (Mombasa, Taita Taveta, Kwale and Kilifi Counties). This region lies in the Somalia plate.

Volcanism

Kenya's volcanic activity is associated with the East African Rift System (EARS) which covers an area extending up to 200 km on each of its flanks concentrated around the Kenya Dome. Two volcanism regions are distinguished in Kenya as follows: the northern half of the Kenya Rift Valley which began at 30 Million years ago (Ma), and the southern half which began at 15 Ma. Volcanic rock in the country range from acidic to basic with the majority being alkaline (mildly alkaline, alkali basalt-trachyte series to strongly alkaline) under saturated nephelinites and phonolites[2].

Kenya has five volcanic provinces within the two aforementioned regions. These include: Northern Rift (Turkana), Central Rift Valley, West of Rift Valley, Southern Rift (Kenya Dome) and east of Rift Valley. These regions contain 24 volcanoes (volcanic peaks) and those located within the NEC are identified in *Table 5.3*. This study considers these peaks as constraints since they lower constructability of infrastructure whilst posing access challenges due to steep and or rugged slopes. They also have a low risk of eruption since most are extinct.

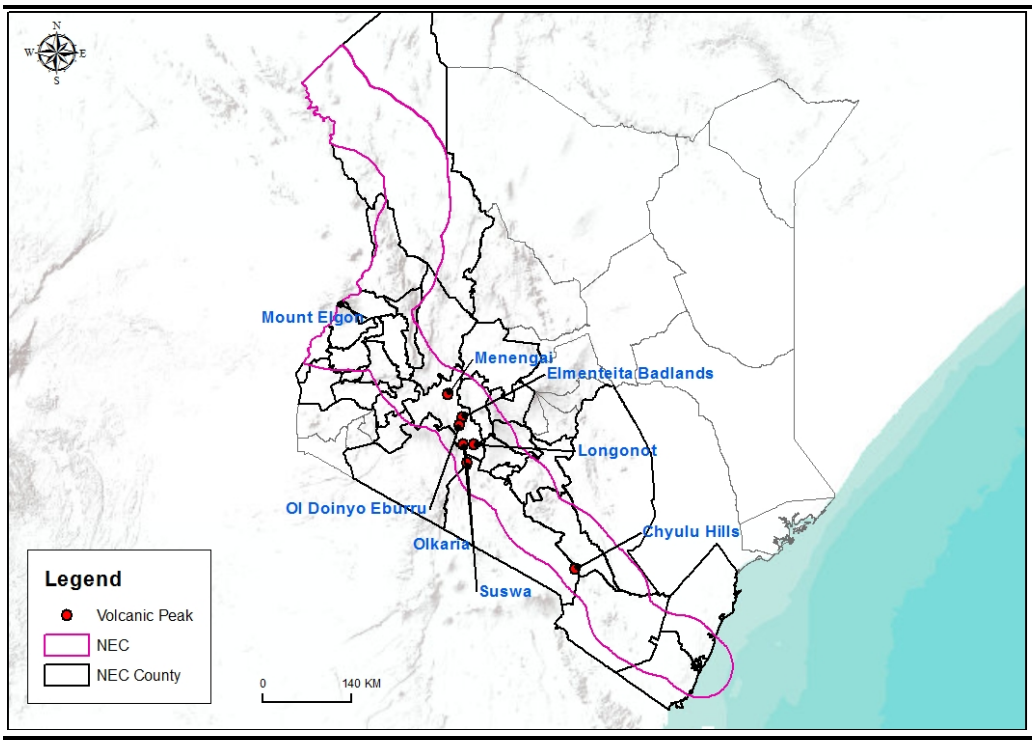
[1] Alex G. and James W., (n.d). East Africa's Great Rift Valley: A Complex Rift System.
[2] Kristján S., (2008). East African Rift System - An Overview. Presented at Short Course III on Exploration for Geothermal Resources, organized by UNU-GTP and KenGen, at Lake Naivasha, Kenya, October 24 - November 17, 2008.

Table 5.3 Volcanic Peaks in the NEC

Name	Altitude (m asl)	Last Eruption[1]	County
Olkaria	2,434	1770	Nakuru, Narok
Chyulu Hills	2,188	1855	Makueni, Kajiado, Taita Taveta
Longonot	2,776	1863	Nakuru
Menengai	2,278	6050 BC	Nakuru
Elementaita Badlands	2,126	Holocene	Nakuru
Ol Doinyo Eburru	2,856	Not known	Nakuru
Suswa	2,356	Not known	Kajiado, Narok
Mt Elgon	4,321	Not known	Bungoma, Trans Nzoia

Out of the eight volcanic peaks identified within the NEC, only Mt Elgon and Chyulu Hills are not located along the Rift Valley. This confirms the influence of the Rift on volcanism in the NEC. The location of these peaks is shown in *Figure 5.12* below.

Figure 5.12 Volcanic Peaks in the NEC



Source: Volcanoes Live, (2008).

[1] Volcanoes Live, (2008). Volcanoes of Kenya. Retrieved November 18, 2014 from www.volcanoeslive.com.

Seismicity

Whilst Kenya experiences low seismic activity, it remains vulnerable due to the EARS which runs through the West of the country and through the Davie fracture zone. The Great Rift Valley is considered to be one of the most quake prone areas in the world which consequently makes areas in Kenya such as the Nyanza basin prone to earthquakes. Low magnitude earthquake events are common along the Kenya Rift Valley due to the rift's slow divergent movements and hydrothermal processes within the geothermal fields (Olkaria – Nakuru). This implies slow but continuous radiation of seismic energy which relieves stress in the subsurface plates[3,1].

In general, Kenya's seismicity is characterized by high-frequency low-magnitude events concentrated along the rift axes which intersect the NEC. The country's seismic character is typical for magmatically active continental rifts, where igneous material at a shallow depth causes extensive grid faulting and geothermal activity. The build-up of large elastic strains is prohibited by thermal overprinting and dike intrusion, therefore prohibiting the generation of large-magnitude earthquake.

Seismic data suggest that the EARS is a zone of shallow earthquakes (average focal depth 20 km). The epicentres are shallowest in afar, deepest in the southern part of the rift system. Focal mechanism studies show dominantly normal faulting (Kebede and Kulhanek (1991) as cited in Kristján S., (2008); Stamps et al. (2008) Kristján S., (2008)). The Eastern Rift is less active seismically than the Western Rift where they run parallel. In the Eastern Rift seismic activity seems to be more concentrated in swarms.

This study considers faults and past earthquake epicentres as constraints due to them being geologically active and their movement can damage infrastructure. Earthquakes are discussed in *Section 5.3.6* of this *Chapter* under natural hazards.

[1] Robert L. et al, (1993). The distribution of earthquakes and volcanoes along the East African Rift system.

Box 5.3 Constraints - Geological Characterisations

Constraints identified in this topic include the following features:

- Fault movement can damage infrastructure such as roads, railways, water conveyance infrastructure and pipelines. Engineering mitigation measures will be required where they can't be avoided.
- Volcanic peaks lower infrastructure constructability and provide access challenges where they are located. Although most are extinct, their presence creates a low risk of eruption.
- Areas prone to soil erosion will require soil management measures during construction and operation of infrastructure to prevent soil erosion. These areas are identified in Section *5.3.6*.

5.3.4 Hydrology and Hydrogeology

Surface Hydrology

The Great Rift Valley bisects Kenya on a N-S axis into two regions thereby influencing the extent of the country's drainage basins. The NEC intersects all of the country's five drainage basins which are described herein:

- **Lake (L) Victoria Basin:** Covers ~8% of Kenya land area but provides up to 54% of the country's freshwater. The main outflow from the basin is through River (R) Nile to its north in Uganda. Its inflows from the Kenyan catchment include Rivers Sio, Nzoia, Yala, Nyando, Sondu Miriu, North Awach, South Awach and Gucha-Migori. Other inflows outside of Kenya's catchment is R Akagera whose source is in Rwanda[1].

- **Rift Valley Basin:** Covers an area of approx. 130,452 km^2 comprising of a number of closed basins. It includes the basins which discharge into L Turkana in the north through Rivers Turkwel and Kerio as well as basins draining into L Natron in the south through R Ewaso Ng'iro South. Almost all major lakes in Kenya are located in this basin such as Baringo, Bogoria, Nakuru, Elementaita, Naivasha, Ol Bolossat and Magadi. These lakes form individual basins and the Nakuru, Elementaita and Naivasha are located within the NEC.

- **Athi River and Coast Basin:** Stretches over an area of about 67,000 km^2 and comprises the southern part of Kenya east of the Rift

[1] NEMA (2011). State of the Environment and Outlook Report.

Valley. It includes the rivers which drain into the Indian Ocean through R Athi from the southern slopes of the Aberdares Range, flanks of the Rift Valley and north eastern slopes of Mt Kilimanjaro. This basin provides water for some of the highly populated urban areas of the country including Mombasa and Nairobi.

- **Tana River Basin:** Measures about 127,000 km^2 and drains into the Indian Ocean from the eastern slopes of the Aberdares range, the southern slopes of Mt Kenya and the Nyambene hills. This basin also provides water for populated regions of the country in Central Kenya and despite 80% of it being located within ASALs it is a major source of hydropower.

- **Ewaso Ng'iro Basin:** Expands over an area of approx. 209,00 km^2 in the northern region of Kenya. It drains the northern slopes of the Aberdares and Mt Kenya. Rivers in this basin drain into the Lorian Swamp but on occasion they flow into Somalia.

Figure 5.13 displays the extent of each of these basins. This study identifies that the area of the NEC is comprised 16.0% Lake Victoria Basin, 46.0% Rift Valley Basin, 34.1% Athi River and Coast Basin, 3.4% Tana River Basin and 0.6% Ewaso Ng'iro Basin.

Figure 5.13 Hydrological Features in the NEC

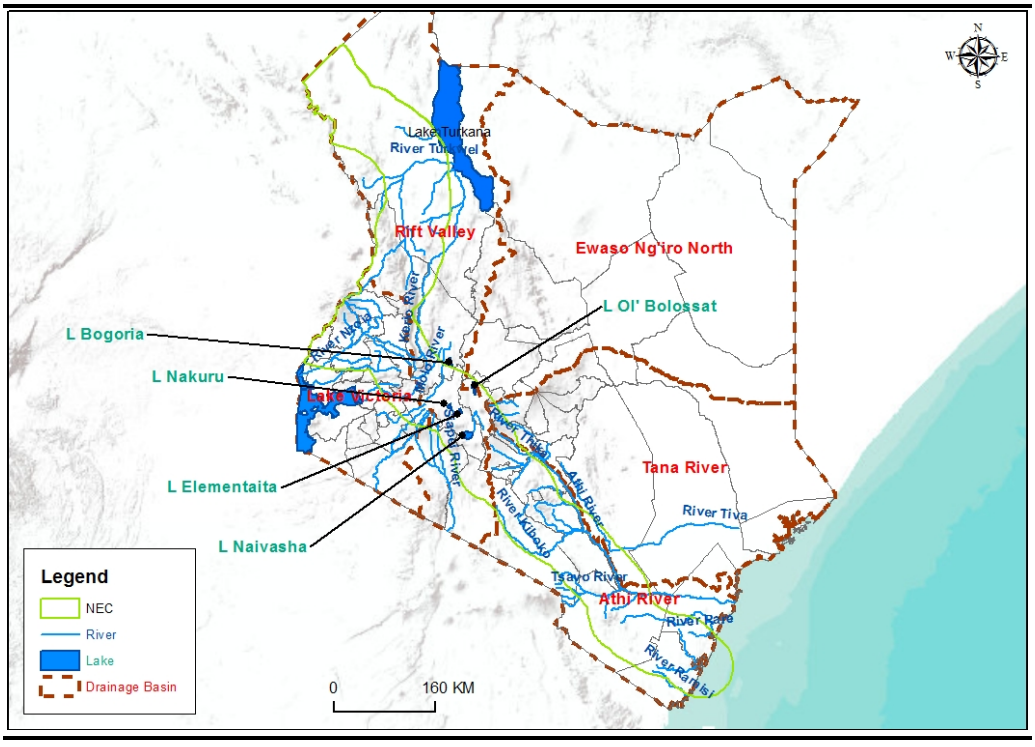


Table 5.4 further provides summary characteristics of these drainage basins whilst also identifying the NEC Counties overlapped by each of them.

Table 5.4 Summary Characteristics of Kenya's Drainage Basins

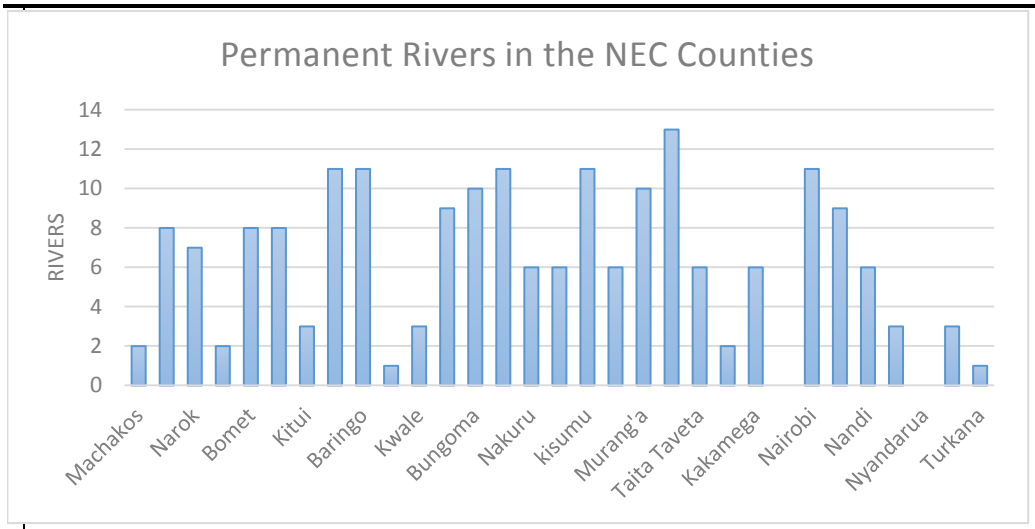
Basin	Area (Km^2)	Annual Rainfall	Surface Water (10^6 m^3)	Surface Water Abstraction		Groundwater (10^6 m^3)	Total water (10^6 m^3)	% of total water resources potential	NEC Counties	NEC Area (Km^2)	Major Rivers	Lakes within the NEC
				10^6 m^3	%							
L Victoria	46, 229	1,368	11,672	254.3	2.2	116	11,788	54.1	Trans Nzoia, Bungoma, Busia, Kakamega, Siaya, Kisumu, Vihiga, Kericho, Bomet, Narok, Nakuru, Nandi, Uasin Gishu and Elgeyo Marakwet	21,287	Sio, Nzoia, Yala, Nyando, Sondu-Miriu, North Awach, South Awach and Gucha-Migori	Victoria
Rift Valley	130,452	562	2,784	46.8	1.7	126	2,910	3.4	Elgeyo Marakwet, Baringo, West Pokot, Turkana,	61,245	Kerio, Turkwell	Nakuru, Elementaita, Naivasha, Ol Bolossat

Basin	Area (Km²)	Annual Rainfall	Surface Water (10^6 m^3)	Surface Water Abstraction		Groundwater (10^6 m^3)	Total water (10^6 m^3)	% of total water resources potential	NEC Counties	NEC Area (Km²)	Major Rivers	Lakes within the NEC
				10^6 m^3	%							
									Nakuru, Kajiado, Narok, Laikipia, Nyandarua, Kiambu and Nyeri			
Athi River	66,837	739	1,152	133.1	11.6	87	1,239	4.3	Murang'a, Nyandarua, Kiambu, Nairobi, Kajiado, Machakos, Makueni, Taita Taveta, Kitui, Kilifi, Mombasa and Kwale	45,367	Athi	None
Tana River	126,026	697	3,744	595.4	15.9	147	3,891	32.3	Nyeri, Murang'a and Nyandarua	4,571	Tana	None
Ewaso Ng'iro	210,226	411	339	42.1	12.4	142	481	5.8	Laikipia, Nyandarua	755	Ewaso Ng'iro	-

Basin	Area (Km^2)	Annual Rainfall	Surface Water (10^6 m^3)	Surface Water Abstraction		Groundwater (10^6 m^3)	Total water (10^6 m^3)	% of total water resources potential	NEC Counties	NEC Area (Km^2)	Major Rivers	Lakes within the NEC
				10^6 m^3	%							
North									and Nyeri		North	
Total	579,770	621	19,691	1,071.7	5.44	618	20,309	99.9				

Rivers in each of these basins are a source of water for domestic, industrial/commercial and environmental demand. They're vital to the socioeconomic wellbeing of the population especially since Kenya is considered to be water scarce. This study observes that in 2013 Nyeri had the most permanent rivers amongst the NEC Counties whilst Kilifi and Mombasa had the least with one and none respectively[1,2]. The distribution of permanent rivers in the NEC Counties is shown in *Figure 5.14.* This data shows that there are an average of 7 permanent rivers per county amongst these counties.

Figure 5.14 Permanent Rivers in the NEC Counties



Source: KNBS (2013).

In each of the five drainage basins are Kenya's water towers which are mountains and highlands which provide lowlands with essential freshwater for different demands. There are five main water towers in Kenya namely: Aberdares, Cherangani Hills, Mau Complex, Mt Elgon and Mt Kenya. Of these five water towers only Mt Kenya is not intersected by the NEC. Jointly, these five water towers provide up to 75% of the country's renewable water resources[3]. In addition to these five water towers there are 24 other smaller water towers spread across the country. Those which intersect the NEC as shown in *Figure 5.15*.

[1] KNBS (2013). County Profiles Data.
[2] Data was not available for Nyandarua County.
[3] KWTA (2015). Kenya Water Towers Status Report.

Figure 5.15 Water Towers in the NEC

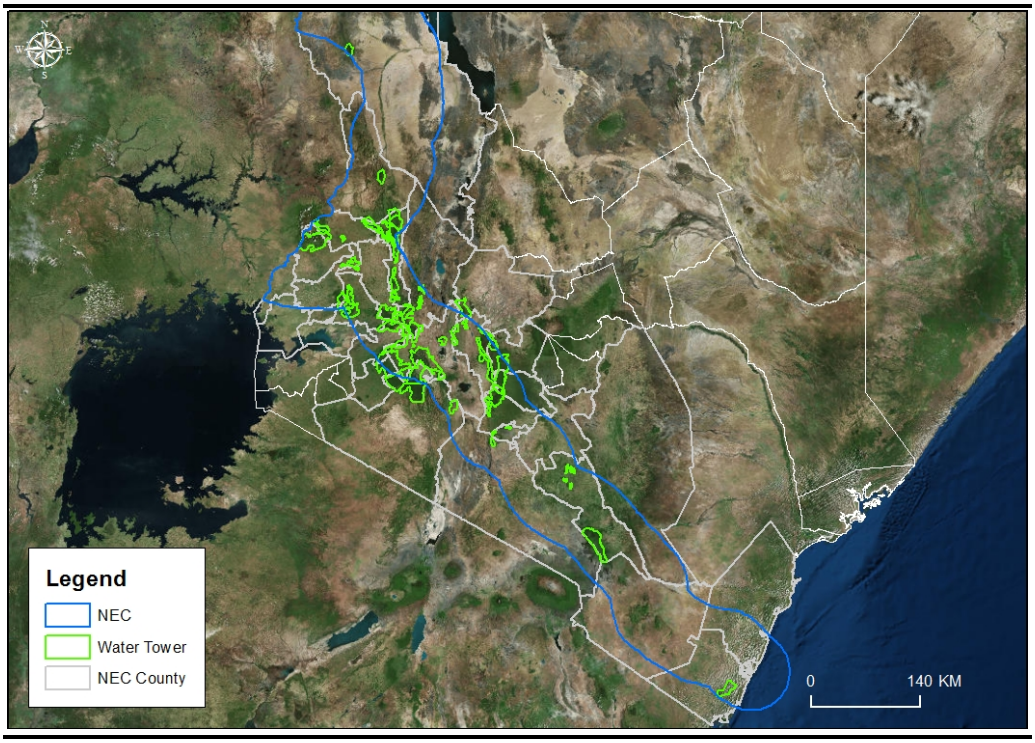


Table 5.5 identifies the water towers which intersected by the NEC, and the drainage basins and counties in which they're located.

Table 5.5 Water Towers in the NEC

Water Towers	Drainage Basin	County
Aberdares	Athi, Tana River, Ewaso Ng'iro North and Rift Valley	Nyeri, Kiambu, Murang'a and Nyandarua
Shimba Hills	Athi River	Kwale
Chyulu	Athi River	Taita Taveta, Kajiado and Makueni
Kikuyu Escarpment	Athi River and Rift Valley	Kiambu, Nyandarua and Nakuru
Enoosupukia	Rift Valley	Narok, Nakuru
Kipipiri	Rift Valley	Nyandarua
Nandi	Lake Victoria	Nandi and Kakamega
Cherangani	Lake Victoria and Rift Valley	Uasin Gishu and Elgeyo Marakwet
Mt Elgon	Lake Victoria	Bungoma and Trans Nzoia
Marmanet	Rift Valley and Ewaso Ng'iro North	Laikipia, Nakuru and Nyandarua
Mau Forest Complex	Rift Valley and Lake Victoria	Uasin Gishu, Nandi, Baringo, Nakuru, Kericho, Bomet and Narok

Water Towers	Drainage Basin	County
Loima	Rift Valley	Turkana

Source: KWTA, (2015) [3].

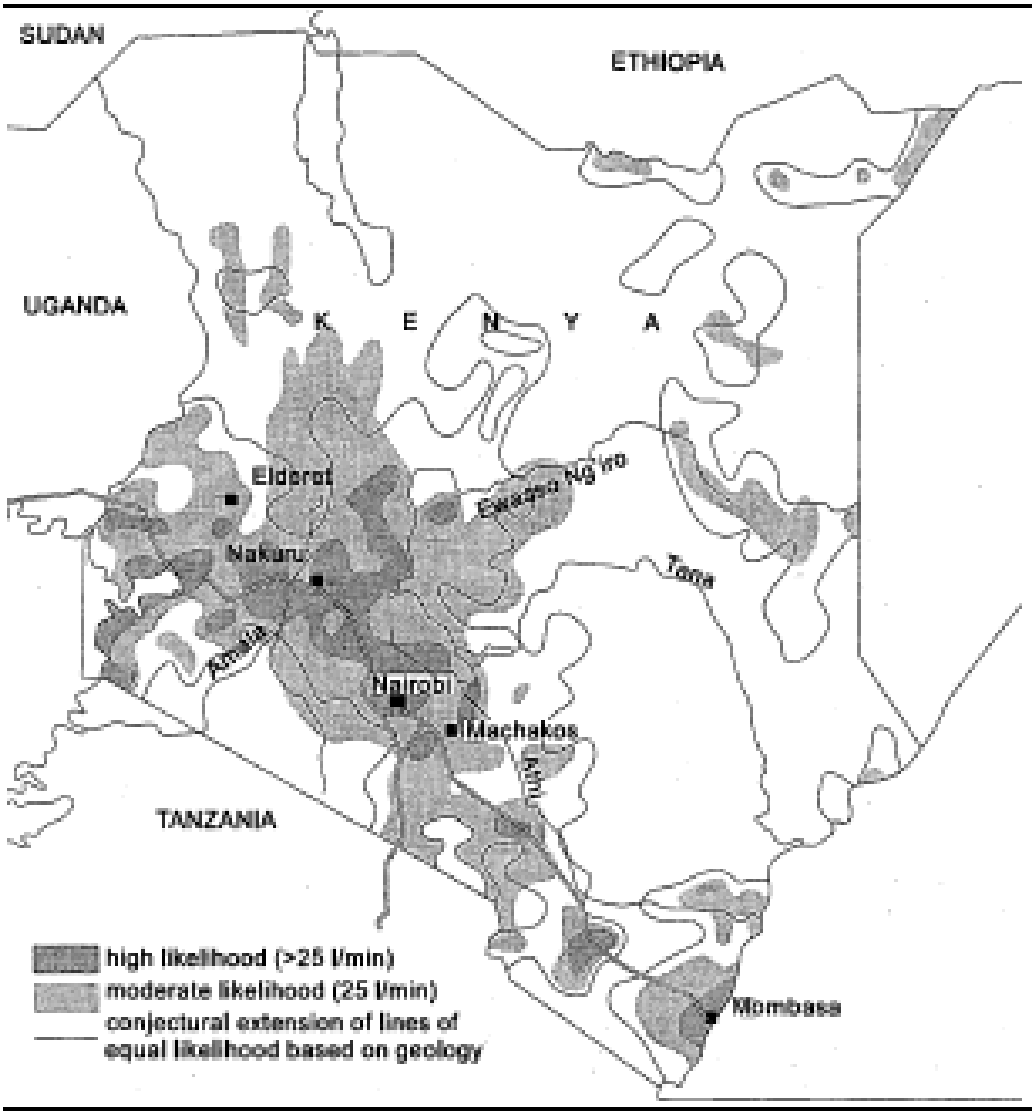
Being forests in nature these water towers are threatened by a combination of anthropogenic factors including encroachment, climate change, degradation, unplanned dams and irrigation projects. These threats pose a threat to the country's water security, stability and surfeit. They are therefore considered constraints by this study.

Hydrogeology

Aquifers in Kenya are linked with the three major rock formations: the basement metamorphic, intrusive igneous and the quaternary sedimentary rocks. Volcanic and quaternary formations are particularly rich in groundwater. However, groundwater potential in the country is extremely variable, spatially and temporally, in terms of quality and quantity and in the level of the water table and depth. Recharge rates vary from as high as 30% of annual rainfall in areas of deep sandy soils, coral limestone and unconsolidated rock where evapotranspiration losses are low, to 5% in the ASALs where evapotranspiration losses are high. Moreover, humid and semi-humid regions exhibit higher recharge rates.

The NEC crosses through regions with high and moderate likelihood of groundwater in its central and western sections as deduced from *Figure 5.16.* The northern and eastern sections of the corridor interest regions with less production potential which have fewer areas of moderate or high likelihood of groundwater production.

Figure 5.16 Groundwater Production Areas of Kenya



Source: ILRI (n.d).[1]

The NEC traverses the following groundwater basins or regions:

- **Nairobi Aquifer Suite (NAS):** NAS is a series of multi-layered aquifers in the volcanic flows rising from the southern Aberdares, the Kikuyu Escarpment and Ngong Hills and dipping gently eastward into the pre-Tertiary Athi Lake Basin, terminating at the Mozambican Basement System. The groundwater basin extends from the zone of north-south rift faulting west of the city (with an elevation of about 2,400 m asl) towards the Athi river floodplain (with an elevation of 1,500 m asl) east of the city centre[2,3,4]. NAS

[1]ILRI, (n.d). Workshop Paper presented at the ILRI Workshop: Groundwater Management: Sharing Responsibility for an Open Access Resource.
[2] Gulf Power Ltd., (2010). Geology and Hydrogeology Report.
[3] Stephen F. and Albert T., (2005). The Role of Groundwater in the Water-Supply of Greater Nairobi, Kenya.
[4] WRMA, (2010). Nairobi Water Allocation Plan.

intersects and provides water for Nairobi, Kiambu, Machakos and Kajiado. NAS features the only Groundwater Conservation Area (GCA) in Kenya, which was established as part of the strategies aimed at protecting its sustainability. However, this GCA is poorly enforced as NAS is the most abstracted aquifer with the most boreholes amongst all aquifers in the country.

- **Mount Elgon Aquifer:** This transboundary aquifer between Uganda and Kenya is a volcanic formation. In this aquifer volcanic rocks are found in high relief areas and groundwater often occurs in the form of springs[1].

- **Kilimanjaro Aquifer:** Kilimanjaro Aquifer is the general name given to various volcanic aquifers, which have Mount Kilimanjaro at their centre and extend over an area of approx. 15,000 km^2 [2]. The aquifer encompasses Chyulu Hills which is located within the NEC.

- **Coastal Sedimentary Basin:** This spans the coastal area between Tanzania and Kenya. It is a transboundary aquifer spanning an area of 16,800 km^2 and composed of quaternary and consolidated sedimentary rocks[3].

- **Baricho Aquifer:** This is a strategic alluvial aquifer because of its importance in public water supply to the Coastal Strip. Baricho aquifer extends over approx. 2 km^2 from Malindi to the north of Mombasa mainland. The aquifer does not face risks of depletion due to abstraction levels being within sustainable levels, however it remains vulnerable to pollution.

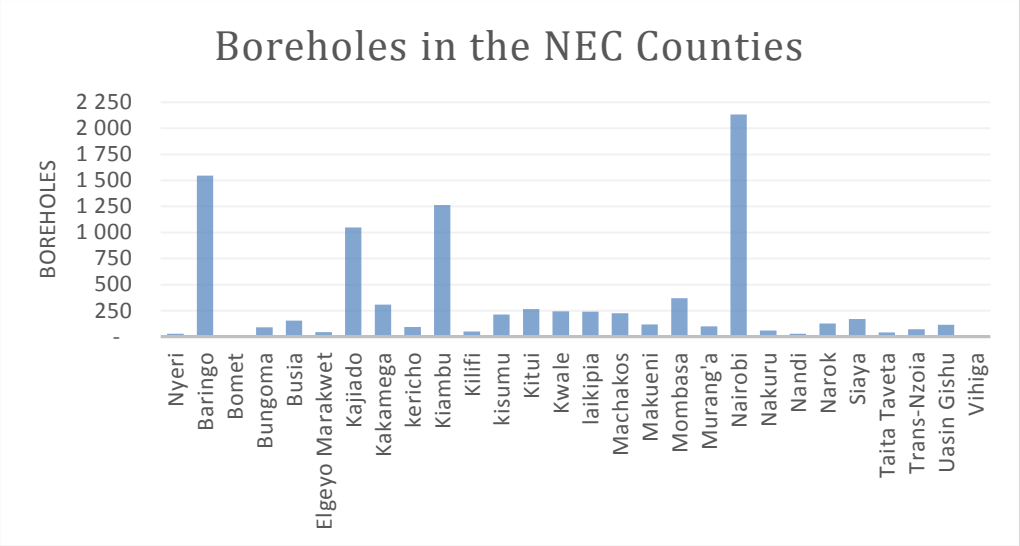
- **Tiwi Aquifer:** This aquifer is strategic to the water supply of the southern coast of Kenya. The aquifer spans 147 km^2 between the Mwachema River to the south and a point between Matuga and Ngombeni in the north; its eastern boundary is the contact with the Pleistocene coral limestone, and its western boundary is approximately 2,000 m west of the Likoni-Ukunda road.

In 2009, 43% of the urban population and 23% of the rural population accessed water mainly through groundwater underpinning its

[1] Appelgren B. (2004). Managing Shared Aquifer Resources in Africa. UNESCO. IHP-VI, Series on Groundwater No. 8.
[2] Malte G. (2008). The Kilimanjaro Aquifer A case study for the research project "Transboundary groundwater management in Africa". German Development Institute.
[3] International Water Management Institute (2014). Transboundary Aquifer Mapping and Management in Africa. CGIAR.

importance in water supply[1]. Amongst the NEC Counties, an average of 26% of the households per county access water through groundwater sources (boreholes and wells) . *Figure 5.17* illustrates the distribution of boreholes amongst the NEC Counties. It is observed that Nairobi has the most boreholes whilst Bomet has the least. Based on this data there are at least 327 boreholes per county amongst the NEC Counties.

Figure 5.17 Boreholes in the NEC Counties



Sources: KNBS, (2013) and WRMA (2011)[2].

Groundwater remains important to environmental water demands in Kenya. This is underpinned by the existence of several specific Groundwater Dependent Ecosystems (GDEs) in the country including, Mzima Springs, Njoro Kubwa, Lari Swamp in Limuru, the Kibwezi "groundwater forest" and Ondiri Swamp, and Kikuyu Springs[3].

[1] Mumma A., Lane M., Kairu E., Tuinhof A., and Hirji R., (2011). Kenya Groundwater Governance Case Study.
[2] WRMA (2011). Nairobi Metropolitan Borehole Inventory Study.
[3] MoWI (2013). The National Policy Groundwater Resources Development and Management. June 2013 Draft. Department of Water and Irrigation.

Box 5.4 Constraints - Hydrology and Hydrogeology

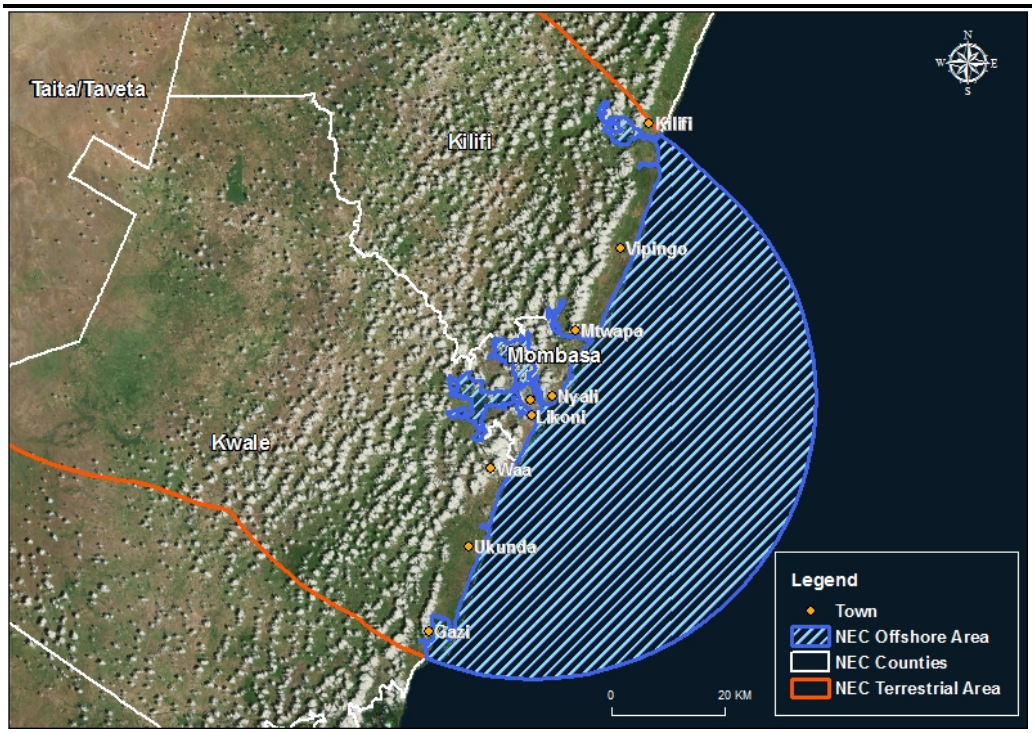
Hydrological constraints identified include:

- Rivers, lakes and other water bodies intersected by the NEC. These features provide water for human and ecological needs in a water scarce country. National regulations also protect these water bodies from pollution or unsustainable consumption. Moreover, some of them are designated as Ramsar Wetlands and or their linked ecosystems are national PAs.
- Water towers which are the source of the rivers mentioned above in addition to being ecosystems that support a variety of species some of which are at risk. They also provide other ecosystem goods and services that are important to human wellbeing. These water towers are protected by national regulations and some of them are also national PAs.
- The GCA in the NAS since the abstraction of water from within it will contribute to the challenge of over-abstraction in the NAS. Any water demands of NEC in the NAS will have to be supplied in accordance to the management strategies implemented by regulatory authorities such as WRMA.

5.3.5 Oceanography

The NEC extends up to approx. 47 km off the coast of Mombasa, Kilifi and Kwale creating an offshore area measuring 3,684 km^2. This area stretches from Gazi to Kilifi town along the coast as shown in *Figure 5.18* and this subsection describes the oceanographic conditions associated with it.

Figure 5.18 NEC Offshore Area



Bathymetry

Kenya has a narrow continental shelf with depths dropping below 200 m within less than 4 km of the coastline in most regions. In front of the mouths of rivers Tana and Sabaki, the shelf however widens significantly exceeding 15 km off the northern end of Ungwana Bay. Fringing reefs protect the shoreline by running along the coast with gaps at the areas adjacent to the mouths of the main rivers. Slope of gentle gradients of about 1:20 to the shelf edge generally characterize the continental slope and dissected appearance occurs probably due to previous fluvial action.

The development of this shelf is connected with glacio-eustatic event and tectonic episodes since Permo-triassic times. The shelf has been classified as an Afro-trailing edge type by Hove A.R.T (1980)[1]. The shelf is markedly absent along certain straight segments of the coast suggesting a fault origin. The sudden drop of the sea-floor topography which is attributed to the postulated Ruvu-Mombasa fault supports this occurrence[2]. This fault apparently maintains a north-northeast to south-southwest orientation throughout. Examination of bathymetric charts

[1] Hove A.R.T, (1980). Some Aspects of Current Sedimentation, Depositional Environments and Submarine Geomorphology of Kenya's Submerged Continental Margins. University of Nairobi, IDS/OP 28, pp. 127–144.
[2] Abuodha J.O.Z, (1989). Morphodynamics and sedimentology of the Malindi-Fundisa coastal area associated with the heavy mineral deposition. Unpubl. M.Sc. thesis, Univ. Nairobi, 258p.

for the Kenyan coast indicate that indentations along the coast such as around the Ungwana Bay area are related to widening of the shelf, whereas narrow zones are generally associated with headlands and islands, for example in the vicinity of Mombasa Island.

Tides

The Kenyan coast is characterized by semi-diurnal tides which except for limited periods in the year, the levels of high and low water of each successive tide differ from the corresponding tide before and after. The tides are therefore designated as mixed semi-diurnal tides.

According to tidal observations at the Kilindini and Lamu port, Kilindini has a maximum tidal range which usually does not exceed 3.8 m but on occasion it may go beyond this. On the other hand, Lamu port has a maximum tidal range of 4.0 m at spring tide and 2.5 m at neap tides[1]. Malindi has a tidal range of 2 m for neap tie and 2.9 m for spring tide. A lag in the tidal state exists along the Kenyan coast and it increases with distance northwards. Malindi is typically 5 minutes after Kilindini while Lamu is about 40 minutes behind[2].

The semi-diurnal tidal regime varies from 1.5 m to 4 m amplitude from neap to spring tides, creating extensive inter-tidal platforms and rocky-shore communities exposed twice-daily during low tides. Fringing reef crests dominate the whole southern coast and parts of the northern coast towards Somalia, forming a natural barrier to the wave energy from the ocean.

Currents

There are four oceanic currents experienced in the Kenyan coast, namely:

- South Equatorial Current (SEC),
- East African Coastal Current (EACC),
- Equatorial Counter Current (ECC), and
- Somali Current (SC).

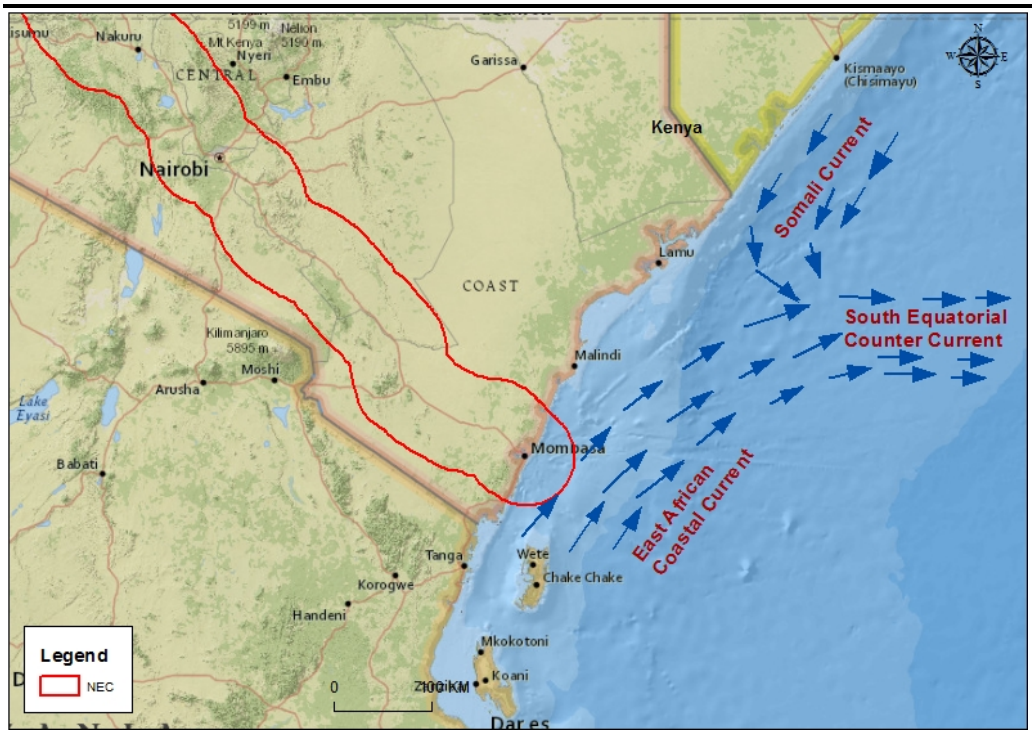
[1] KPA, (2013). Kenya Tidal Observations.

[2] A form number, F, has been defined as the ratio of the sum of amplitudes of diurnal tidal species over semi diurnal species. According to Defant (1958), a simplified definition for F, F = (k1+O1)/ (M2+S2), can be used to characterize tidal types. If F is less than 0.25, the tide is referred to as semi-diurnal, and if F is greater than 3.0, the tide is diurnal. Value of F between 0.25 and 3.0 are considered as mixed tides.

The SEC moves westward dividing into two branches as it reaches Cape Delgado on the Eastern coast of Africa. It produces both the southward flowing Mozambique Current and the northward flowing East African Coastal Current, which parallel to the coast[1].

The EACC flows northward at least as far as Malindi all year round. It continues beyond Malindi during the Southeast Monsoon, joining the SC to continue north to the Horn of Africa. The northward extent of the EACC is restricted during the Northeast Monsoon when it meets and joins the southward flowing SC (which changes direction under the influence of the monsoon). The currents converge between Malindi and north of Lamu depending on the monsoon's strength in any particular year. The resultant stream turns eastwards flowing offshore as the ECC[1] (*Figure 5.19*).

Figure 5.19 Northeast Monsoon Currents

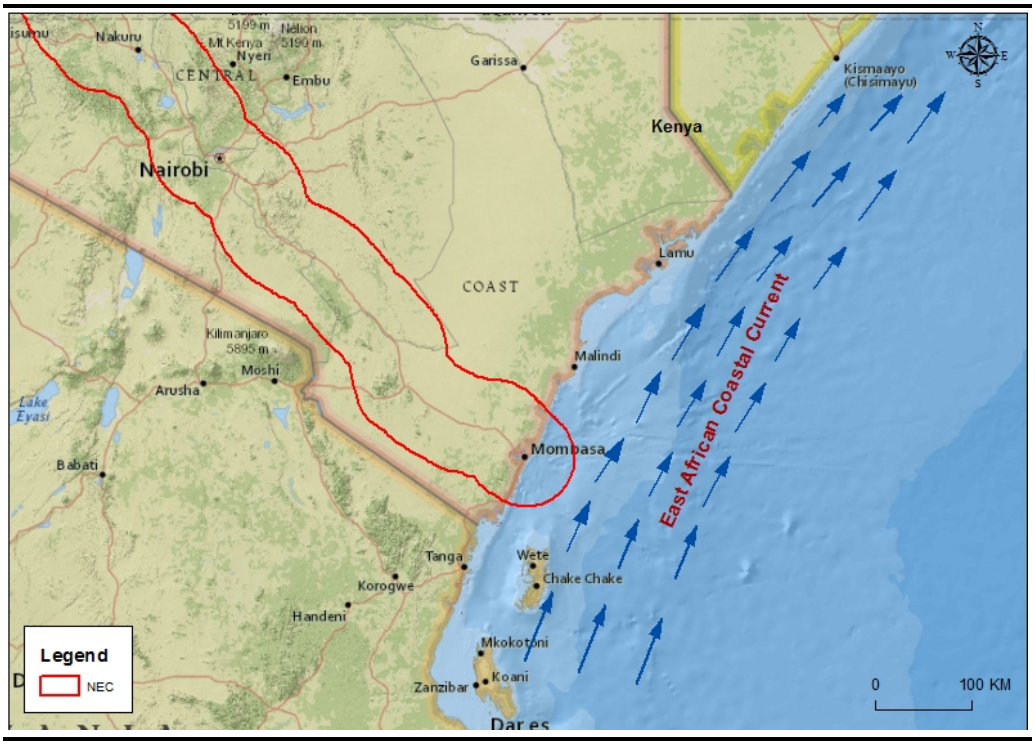


The SC reverses its flow under the monsoon's influence and flows south westerly at about 1.5 to 2.0 knots with the Northeast monsoon. However, during the Southeast monsoon the flow reverts and increases its velocity to around 2.0 to 2.5 knots. During this period, it appears as the northward extension of the EACC, which still arises from the onshore SEC (*Figure 5.20*). At this time of the year, the ECC is not very

[1] NEMA, (2009). Kenya State of the Coast Report. Towards Integrated Management of Kenya's Coastal Marine Resources.

distinct from the general Southwest monsoon drift at the lower northern latitude of the Indian Ocean. The seaward flowing ECC originates from where the reversing SC and northward flowing EACC meet, at approx. 2 to 3° S and at a depth of about 40 m [1].

Figure 5.20 Southeast Monsoon Currents



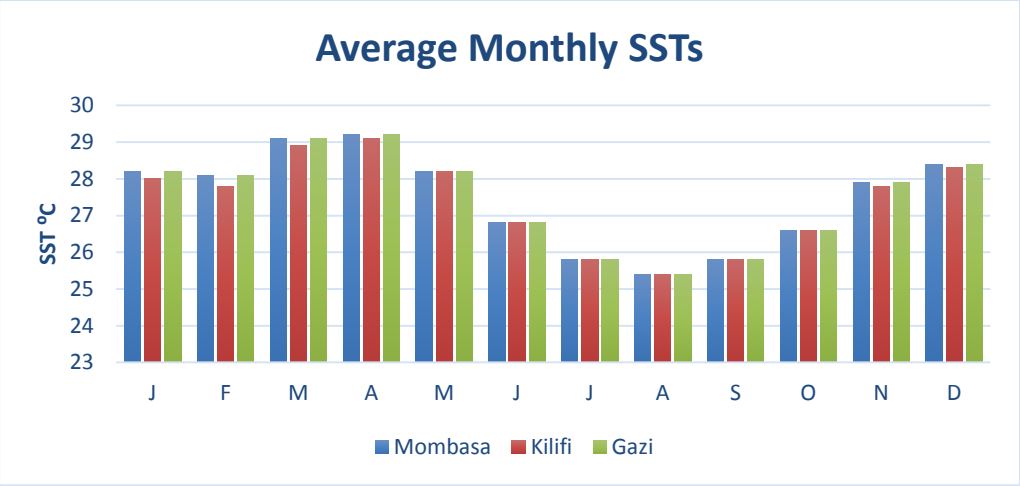
The net onshore current results in the sinking of surface waters along most of the coast. During the Northeast monsoon, Kiunga is the exception where some mild upwelling is considered to occur. Switching of winds and currents is not exactly synchronous as some research has shown. Closer to the shore off Malindi Bay (at depths of less than 40 m) the current direction remains variable throughout the year, with a dominant southerly flow tendency. Research has shown that monsoon winds do not seem to influence the current direction at the shallow part of the shelf where water movement is most likely a mixture of the 'escaping waters' out of Ungwana Bay, tidal current and the flow of R Sabaki.

Sea Surface Temperatures and Salinity

The monsoon season influences sea surface temperature (SST) and salinity. The highest SSTs of 28 °C – 29 °C occur during the Northeast Monsoon (March – April). On the contrary, the lowest SSTs occur between August and September with an average minimum of around 24 °C. Mombasa, Gazi and Kilifi have an average monthly sea

temperature ranging between 27.4 ^{0}C and 27.5 ^{0}C. Monthly average SSTs at Mombasa, Gazi and Kilifi are illustrated by *Figure 5.21.*

Figure 5.21 Monthly Average SSTs at Mombasa, Gazi and Kilifi



Source: World Sea Temperatures (2016)[1].

During the Southeast Monsoon, the shifting of ocean current brings Pacific Ocean water of high salinity into the South Equatorial Current. During the Northeast Monsoon season, the South Equatorial Current draws water of low salinity from the Malay Archipelago. These changes in turn result in higher and lower salinities of the East African Counter Current waters. A further influence on salinity is the incidence of rainfall, especially during the heavy rains of March to June when the discharges from all major and minor seasonal river systems are at their maximum. The salinity varies from a minimum of 34.5 parts per thousand (ppt) to a maximum of 35 ppt [2]. This salinity is linked to the corrosion risk posed by ocean water to infrastructure components made of brick, concrete or metals. Evaporation of this water also causes deposition of salts in water conduits which can result in reduced capacity or in extreme cases blockages. Salinity also reduces the utilitarian value of the water for human and animal consumption as well as for agriculture.

5.3.6 Natural Hazards

In this section natural hazards which occur in Kenya and the NEC are discussed. Hazard prone areas are also identified as constraints. The International Disaster Database (EM-DAT) shows hydrometeorological

[1] World Sea Temperatures, (2016). Average Sea Surface Temperature Data. Retrieved February 27, 2016 from www.seatemperature.org

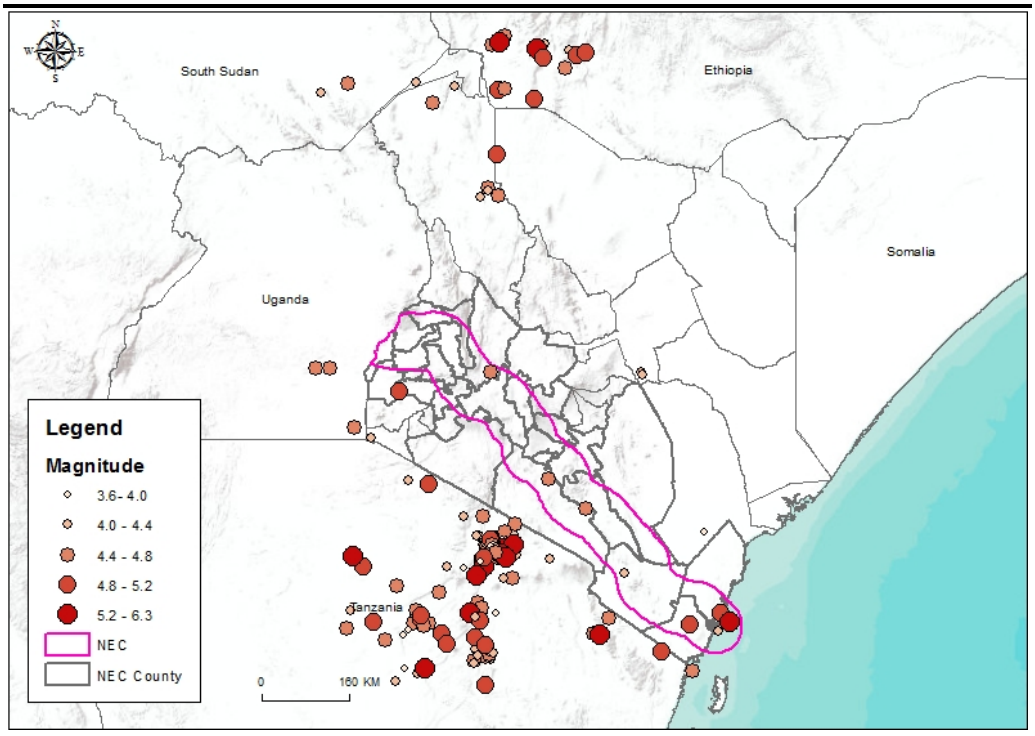
hazards to be the most common hazards in Kenya[1]. Prevailing poverty levels predispose the country's population to vulnerability. The Index for Risk Management (INFORM) assesses Kenya's humanitarian and disaster risk profile to a value of 6.2, ranking the country 16 out of 191 countries. This rank is inversely proportional to the magnitude and severity of the risk. The assessment value is calculated as an average of the values of hazard and exposure (5.8), vulnerability (6.1) and lack of coping capacity (6.6) [2].

Earthquakes

In Kenya and the NEC, seismic activity is related to the fracture zones and volcanic activity associated with the EARS. Resultantly majority of the seismic activity in Kenya is observed along the rift, and the south west and north-west borders[3]. The southern region of the Lamu basin (sedimentary basin) is also considered to be a seismic active area. This region intersects Mombasa, Kilifi and Kwale. In general, Kenya faces low seismic risks or activity as compared to Northern Tanzania and the Western Rift Valley regions along the border of Uganda and Tanzania, and Burundi and Rwanda. *Figure 5.22* displays the recorded earthquakes of magnitude greater than 2.5 on the Richter Scale in Kenya, and the country's neighbourhood, in relation to the NEC in the period between 1st January 1973 and 29th February 2016. It is observed that most events occurred around Mt Ol Doiny and Meru in Tanzania whereas in Kenya most events occurred along the Rift Valley.

[1] Guha-Sapir D., Below R. and Hoyois Ph., (2015). EM-DAT: The CRED/OFDA International Disaster Database. Université Catholique de Louvain – Brussels – Belgium.
[2] European Commission Joint Research Centre, (2016). Index for Risk Management (INFORM) 2016 Results. Institute for the Protection and Security of the Citizen.
[3]Sumedh R., (2013). Assessing Seismic Risk in Kenya.

Figure 5.22 Earthquake Events in Kenya 1973-2016



Source: USGS, (2016)[1].

In the region shown in *Figure 5.22* a total 193 earthquake events occurred during the aforementioned period. Of these events only 12 earthquakes occurred in the NEC. These earthquakes are listed in *Table 5.6* with their magnitudes, depth, year and the county in which they occurred. This study observes that these events were shallow and majorly low magnitude events with the highest magnitude event registering 5.5 on the Richter Scale. The latest event also occurred in 2015.

Table 5.6 Past Earthquakes in the NEC

Year	Magnitude	Depth (Km)	County
2015	4.2	10	Turkana
2012	4.5	10	Kajiado
2007	4.9	10	Kwale
2006	4.2	10	Offshore (Mombasa)
2001	4.7	10	Baringo
1998	3.9	10	Turkana
1996	4.5	10	Turkana

[1] USGS, (2016). Earthquake Hazards Program. Data on Earthquakes with magnitude greater than 2.5 that occurred between 1st January 1973 and 29th February 2016, in the area between Longitudes 32.959 and 42.715 and Latitude -5.091 and 5.703.

Year	Magnitude	Depth (Km)	County
1996	4.3	10	Turkana
1995	4.9	33	Kilifi
1991	4.2	10	Taita Taveta
1990	5.5	10	Offshore (Mombasa and Kilifi)
1978	4.7	25	Kajiado

Floods

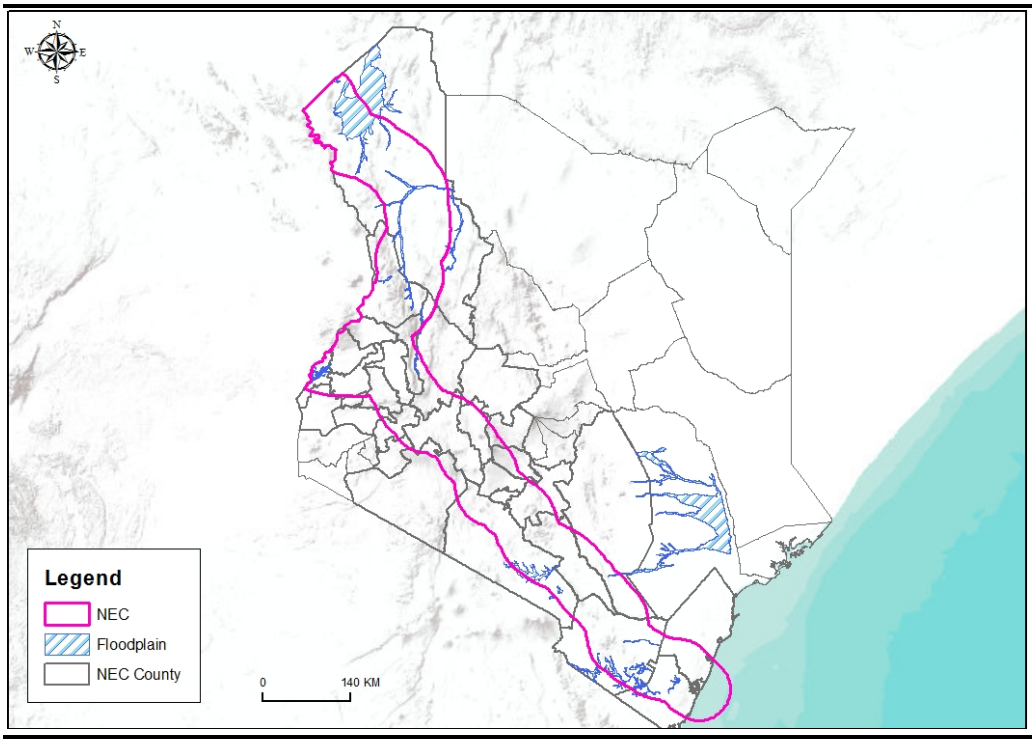
Floods are amongst the most frequent natural hazards that occur in Kenya. They typically occur in areas with flat terrain such as river basins, lake basins and urban centres in the country. The country's bi-modal system of rainfall dictates that they mostly occur during the long and short rains. Other phenomena such as *El Nino*, storms and heavy rains have also caused flood events (including flash floods), and several studies also point out that human manipulation of watersheds has also contributed to their occurrence[1,2]. Flood prone areas in the country have been identified to include:

1. Nyanza Province – Kano plains, Nyakach area, Rachuonyo and Migori
2. Western Province – Budalangi
3. Rift Valley Province – Baringo and Marigat
4. Coast Province – Kilifi, Kwale and the Tana River Basin
5. North Eastern Province – Garissa, Wajir, and Ijara
6. Urban Centres – Nairobi, Nakuru, Mombasa, Kisumu.
7. Tana River district (the Lower parts)

Figure 5.23 shows the floodplains in relation to the NEC Counties. Apart from urban flood prone areas in Nairobi, Nakuru and Mombasa, 22 alluvial floodplains are located in the NEC as shown in *Figure 5.23.* They are located in Kwale, Taita Taveta, Kajiado, Kitui, Makueni, Busia, Bungoma, Elgeyo Marakwet and Baringo.

[1] UNDP, (n.d). Kenya Disaster Profile. United Nations Development Program. Enhanced Security Unit.
[2] The Earth Institute, (n.d). Kenya Disaster Profile.

Figure 5.23 Floodplains in the NEC



Drought

Drought is common in Kenya due to the fact that 80% of the country's land mass is ASALs. In these areas annual rainfall ranges between 200 and 500 mm [1]. Moreover, these areas have the highest levels of poverty creating vulnerable populations predisposed to drought disaster on exposure. The impact of drought is experienced in the whole country in all economic sectors since it causes:

- Reduced water supply in both rural and urban areas,
- Reduced hydropower generation leading to power rationing,
- Crop failures and reduced food security,
- Deaths of humans, livestock and wildlife,
- Loss of employment when industries shut down as resources get depleted,
- Deterioration of human health due to malnutrition and poor access to quality water, and
- Conflicts between communities and wildlife[2].

[1] Kandji T. (2006). Drought in Kenya: Climatic, Economic and Socio-Political Factors. New Standpoints November-December 2006.
[2] Mbogo E., Inganga F. and Maina J., (n.d). Drought conditions and management strategies in Kenya.

Drought is also a co-factor amongst the causes of environmental degradation and desertification. Areas prone to drought are the ASALs which coincide with ACZs with a value greater than 40 (See Section 5.3.1). The NEC Counties intersected by these regions are Kilifi, Kwale, Kitui, Makueni, Kajiado, Narok, Machakos, Nakuru, Kiambu, Nyeri, Baringo, Bomet, Elgeyo Marakwet and Laikipia[1].

Figure 5.23 identifies past drought events in the country between 1883 and 2011. A total of 26 events are identified in this time period.

Table 5.7 Historical Drought Events in Kenya

Period or Year	Areas Affected
1883	Coast
1889-1890	Coast
1894-1895	Coast
1896-1900	Countrywide
1907-1911	Lake Victoria, Machakos, Kitui and Coastal areas
1913-1919	Eastern and coastal provinces
1921	Rift valley Central and Coast
1925	Northern Rift Valley and central provinces
1938-1939	Countrywide
1942-1944	Central and Coast Provinces
1947-1950	Eastern, central, Coast, Nyanza, western and rift valley provinces
1952-1955	Eastern, south/north rift Valley
1960-1961	Widespread
1972	Most of Kenya
1973-1974	Eastern Central, northern provinces
1974-1976	Central, Eastern, Western, coast
1980	Eastern province
1981	Countrywide
1983	Countrywide
1984	Central, Rift Valley, Eastern and North Eastern
1987	Eastern and Central
1992-1994	Northern, Central, Eastern Provinces
1999-2000	Countrywide except west and coastal belt
2003-2004	Countrywide
2005-2006	Countrywide
2008-2011	Countrywide

[1] Republic of Kenya (2015). National Policy for the Sustainable Development of Northern Kenya and other Arid Lands. The Presidency. Ministry of Devolution and Planning. July 2015 Draft.

Sources: NDMA, (2012)[1] and UNDP, (n.d)[1].

Landslides

Landslides and other forms of mass wasting generally occur on hillsides and slopes. They are often caused by a combination of one or more of geological, morphological and anthropogenic factors listed in *Table 5.8*.

Table 5.8 Landslide Causes

Geologic Causes	Morphological Causes	Human Causes
• Weak or sensitive materials • Weathered materials • Sheared, jointed, or fissured materials • Adversely oriented discontinuity (bedding, schistosity, fault, unconformity, and contact) • Contrast in permeability and/or stiffness of materials	• Tectonic or volcanic uplift • Glacial rebound • Fluvial, wave, or glacial erosion of slope toe or lateral margins • Subterranean erosion (solution and piping) • Deposition loading slope or its crest • Vegetation removal (by fire and drought) • Thawing • Freeze-and-thaw weathering • Shrink-and-swell weathering	• Excavation of slope or its toe • Loading of slope or its crest • Drawdown (of reservoirs) • Deforestation • Irrigation • Mining • Artificial vibration • Water leakage from utilities

Source: Gichaba M. et al, (2013)[2].

Excessive rainfall, earth movements and human manipulation of landscapes are the most common triggers of landslides. On the other hand, floods accelerate the occurrence of mass wasting, particularly mudslides since the resulting inundation increases the water content in soil.

Mass wasting often occurs in areas which receive high rainfall (over 1,200 mm annual rainfall) and have steep (over 80º) or exposed slopes. Such areas where landslides have occurred in the past have included, Mombasa, Rift Valley, Nairobi, Central Kenya and Western. The former

[1] NDMA, (2012). Kenya Post-Disaster Needs Assessment (PDNA) 2008-2011 Drought.
[2] Gichaba M., Kipseba K. and Masibo M., (2013). Overview of Landslide Occurrences in Kenya, Causes, Mitigation, and Challenges Developments in Earth Surface Processes, Vol. 16. Elsevier.

Central Province is particularly susceptible since it has permeable soils and receives high rainfall and has steep slopes (highlands). The NEC Counties with a risk of landslides, based on past events between 1974 and 2009, are Kiambu, Murang'a, Nyandarua, Nairobi, Busia, Narok, Bungoma, Taita Taveta, Nyeri and Nandi[2,1].

[1] Ministry of Special Programmes, (2009). National Policy for Disaster Management in Kenya. Office of the President. Government of Kenya.

Storms

Tropical Storms

In the NEC, and Kenya in general, tropical cyclones are rare and almost unknown since the country intersects the equator. They are however more common between November and April in the Mozambique Channel, south of the NEC. They are associated with a fresh westerly wind in southern Tanzania when they occur. Tropical cyclones predominantly occur in the south Indian Ocean and pass farther south of the NEC but may, however, at times affect winds along the Kenyan coast.

Kenya's coast is located in the southwest Indian Ocean basin in which cyclones affect Kenya, Tanzania, Comoros, Réunion, Madagascar, Mozambique and Mauritius. In this basin an average of about ten tropical cyclones form per year[1].

El Niño

El Niño refers to the periodic build-up of a large pool of unusually warm water in large parts of the eastern and central equatorial Pacific Ocean. Conversely, the opposite condition, known as *La Niña*, describes the periodic build-up of unusually cold waters in large parts of the same ocean basin. During both periods extreme weather events occur worldwide such as droughts, floods, cold/hot spells, tropical cyclones.

Kenya experienced *El Niño* in 1997/98, 2002/03, 2006/07, 2009/10 and 2014/15[2]. Effects of these events included floods, storms and deposition of excessive sediments along the coast due to exceptional run-off from the storms. The excessive sedimentation of the 1997/98 event caused coral bleaching of up to 90% of corals along the coast. This event has been recognized as the most severe since it triggered landslides, damaged property and led to loss of human lives. The floods resulting from the 1997/98 *El Niño* were considered to be most intense since the 1961/62 floods[3].

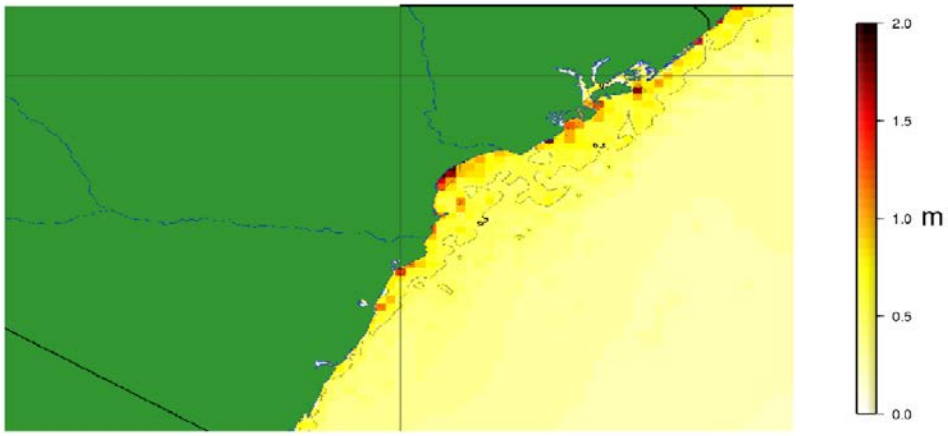
[1] World Meteorological Organization, (2006). Tropical Cyclones in the Western Indian Ocean.
[2] Ministry of Environment and Natural Resources, (2015). *El Niño*. Retrieved March 01, 2016 from http://www.environment.go.ke/?p=1337
[3]Ngecu M. and Mathu E., (1999). The El Nino Triggered Landslides and Their Socioeconomic Impacts on Kenya. Episodes, Vol. 22, No. 4.

Tsunami

Kenya is amongst the western Indian Ocean states that were affected by the Boxing Day Tsunami (December 26, 2004) albeit with low magnitude effects. Not much damage was caused by the Tsunami because extensive reaches of the coast are protected by fringing reefs.

It took nine hours for the Boxing Day Tsunami to impact the northern part of the Kenyan coast. In contrast to the southern coast, the northern coast registered higher tsunami heights. Higher magnitude damage was observed in Lamu and Malindi towns compared to Kilifi and Mombasa towns. A simulation of the Tsunami with Padang (Sumatra) as the epicentre postulated wave heights as high as 1.5 m in areas such as Ungwana Bay and Lamu, and 0.5 m around Mombasa's coastline[1] (*Figure 5.24*).

Figure 5.24 Tsunami Wave Heights along the Kenyan Coast



Source: Ngunjiru M., (2006)[2].

Tsunamis triggered by earthquakes of different magnitudes resulting from the fracture of the Davie Ridge[3] have been simulated in one study. The study used near-field earthquake source models for earthquakes with Moment Magnitude (M_w) 7.2, 8.0 and 9.0. For M_w 7.2 earthquake, the study estimated a seafloor deformation of about 0.5 m resulting wave heights of 1 m along the Kenyan coast. The M_w 8.0 and 9.0 resulted in deformations of 3 m and 10 m respectively with wave heights of less than 1 m and 10.5 m respectively. Thus, a M_w 9.0

2 Ngunjiri M., (2006). Tsunami and Seismic Activities in Kenya

3 The Davie Ridge is located off the Eastern Africa Coast in the Western Indian Ocean.

earthquake along the Davie Ridge will have the most devastating effects[1].

Soil Erosion

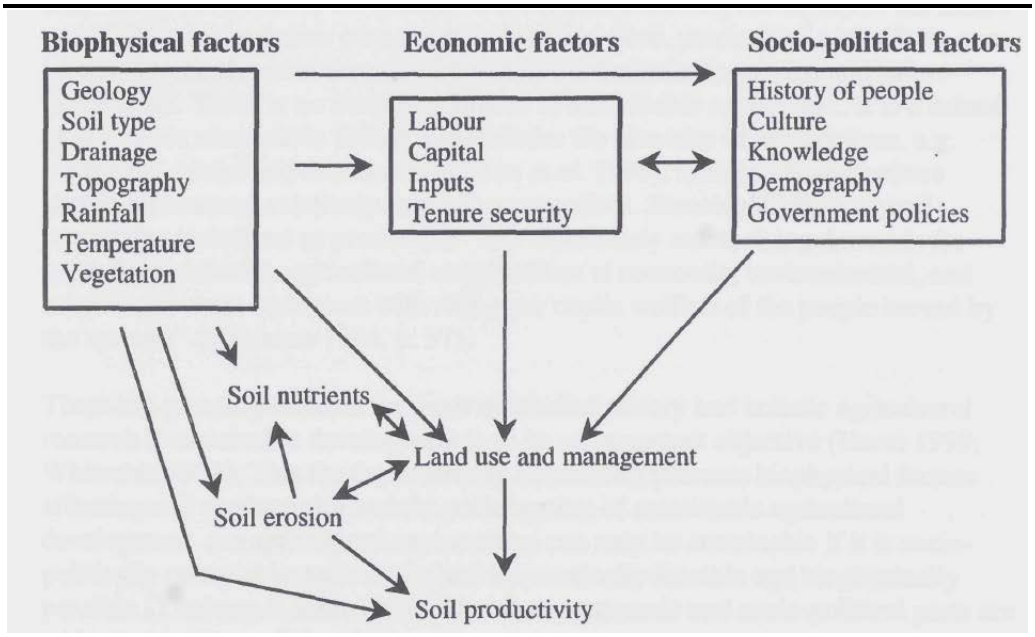
Soil erosion is a globally recognized problem, which leads to losses of up to 5 Mg/Ha of fertile top soil in Africa annually[2]. In Kenya, it presents a challenge to agriculture which contributed 30.3% of the country's GDP in 2014 [3]. The main agents of soil erosion in Kenya and the NEC are wind and water. Erosion is influenced by a combination of factors including, soil structure and texture, amount of vegetative cover, land management practices (land use changes), slope of land, amount of rainfall and wind intensity. The impacts of soil erosion vary amongst others:

- Loss of nutrients,
- Loss of land fertility and productivity,
- Increased sedimentation in water bodies,
- Loss of biodiversity,
- Increase of greenhouse emission from soil carbon losses,
- Reduced livestock carrying capacity,
- Reduced water quantity and quality, and
- Reduced wood availability.

Soil erosion is amongst the co-factors that drive land degradation whilst posing a threat to sustainable agriculture. Moreover, land and environmental degradation, and soil erosion are reinforcing in an interlinked network of factors and drivers as shown by *Figure 5.25* on their relationship with soil and land productivity in Kenya.

[1] Josphat K., Fumiaki K. and Nguyen A., (2013). Seismic Hazards. Developments in Earth Surface Processes, Vol. 16. Elsevier.
[2] Angima S., Stott D., O'Neill M., Ong C. and Weesies G., (2002). Soil Erosion Prediction Using RUSLE for Central Kenyan Highland Conditions. Agriculture, Ecosystems and Environment 97 (2003) 295–308. Elsevier.
[3] World Bank, (2016). Agriculture, value added (% of GDP). Retrieved March 03, 2016 from http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS

Figure 5.25 Factors Affecting Soil Productivity in Kenya

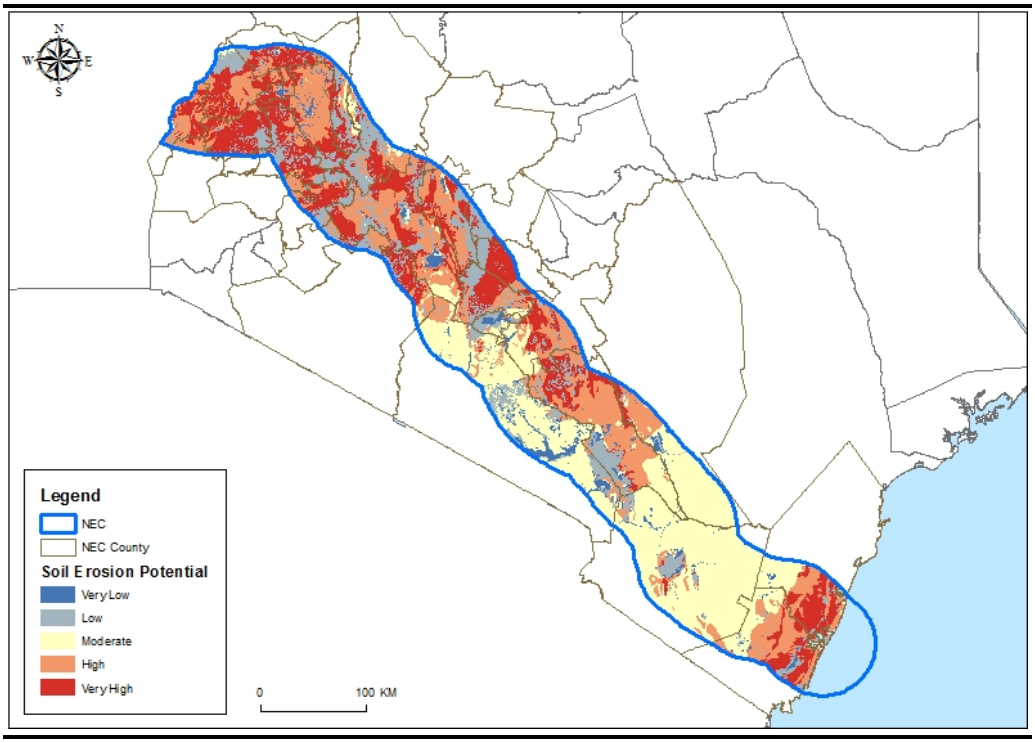


Source: Ovuka M., (2000)[1].

This study identifies only one study, Lieven C. et al, (2008)[2], that has calculated soil erosion potential in a study area that includes the whole of Kenya's land mass using the Revised Universal Soil Loss Equation (RUSLE) model. On the other hand, other studies have focus on regional subsets such as the Kenyan Highlands (Angima S.D. et al (2003)[3]), Ewaso Ngiro Basin (Mati M., (2000)[4]) and Embu (Sara R., (2009)[5]) to mention a few. This study therefore estimates the erosion potential of the NEC using an index calculated using the parameters of rainfall, land uses, slope, soil texture, bedrock depth and landforms. All these parameters were assigned representative values which are as added and multiplied by the land use value. The resulting values, ranging between 0 (waterbodies) and 92, are divided into 5 equal interval classes namely, Very Low, Low, Moderate, High and Very High. This is done through GIS using overlays and the results are shown in *Figure 5.26* (6) .

[1] Ovuka M., (2000). Effects of Soil Erosion on Nutrient Status and Soil Productivity in The Central Highlands of Kenya. Göteborg University, Department of Earth Sciences.
[2] Lieven C., Paulo V.B., Notenbaert A., Mario H., Jeanette V.D.S, (2008). Mapping potential soil erosion in East Africa using the Universal Soil Loss Equation and secondary data. Sediment Dynamics in Changing Environments (Proceedings of a symposium held in Christchurch, New Zealand, December 2008). IAHS Publ. 325, 2008.
[3] Angima S.D., Stott D.E., O'Neill M.K., Ong C.K. and Weesies G.A, (2003). Soil erosion prediction using RUSLE for central Kenyan highland conditions. Agriculture, Ecosystems and Environment 97 (2003) 295–308. Elsevier.
[4] Mati M., (2000). Assessment of erosion hazard with USLE and GIS—a case study of the upper Ewaso Ngiro basin of Kenya. Int. J. Appl. Earth Observ. Geoinform. 2, 78–86.
[5] Sara R., (2008). Soil physical properties and erosion risks at smallholder farms in Embu, Kenya. Swedish University of Agricultural sciences. Department of Soil and Environment.
(6) Data for the sub-route was unavailable

Figure 5.26 Soil Erosion Potential along the Main Route of the NEC



This erosion potential analysis identified high potential areas along the coastal area, the central highlands, rift valley and western region. The high potential in the coastal region is largely attributed to the high annual rainfall received. The central highlands, rift valley and western regions have high potential due high annual rainfall, steep slopes and predominance of agricultural practices. The location of these high potential areas coincides with the findings of Lieven C. et al, (2008).

Box 5.5 Constraints - Natural Hazards

All hazard prone areas in the NEC are classed to be constraints particularly due to the vulnerability of Kenya's population to disasters. These constraints are the following:

- **Earthquake Epicentres (Seismic Zones):** These areas are geological active and any infrastructure located in their neighbourhood will require mitigation measures to make them earthquake proof. Earthquakes present a risk on the infrastructure, human life and livelihood assets.
- **Flood Prone Areas:** Floods can damage infrastructure and affect human life negatively by: increasing the risk of water-borne diseases, leading to loss of life through drowning, damaging livelihood assets and leading to displacement.
- **Soil erosion prone areas:** In these areas the development of infrastructure can lead to or increase the risk of erosion. Soil management measures will thus have to be implemented to manage this risk.
- **Landslide Prone Areas:** Landslides can lead to loss of human life and damage infrastructure. The development of infrastructure or extension of agriculture in areas prone to landslides in the NEC can increase their associated risk.
- **Tsunami:** Coastal areas and infrastructure of the NEC will be vulnerable to tsunamis which can damage infrastructure on landfall, cause flooding and subsequently loss of life.
- **Drought:** The NEC's ASALs are the most susceptible to drought. The occurrence of drought in these regions will create a challenge of acquiring resources such as water which will be required in developing any infrastructure. Additionally, these areas remain impoverished as compared to the wetter regions of the country whereas due to their prevailing conditions the interventions of the NEC will be limited.

5.4 BIOLOGICAL BASELINE

Kenya's biodiversity richness comprises over 35,000 species of flora and fauna[1]. This richness is attributed to a long evolutionary history, variable climatic conditions, and diverse habitat types and ecosystems. Several of these biological resources face risks of extinction (species)

[1] UNEP, (2009). Kenya: Atlas of Our Changing Environment. Division of Early Warning and Assessment (DEWA). United Nations Environment Programme (UNEP)

and degradation (habitats). This study pays particular interest and focus on the anthropogenic drivers of these risks. This is because the NEC MP has the potential of contributing to these risks since it intersects regions with valuable biological diversity.

This subsection describes the biological resources of the NEC, similarly with a purpose of identifying potential constraints to the MP. Assessment methods employed in this section for species borrow from IUCN's Red List assessment method and those used nationally for prioritization[1]. The following IUCN Red List assessment categories are considered:

- **Critically Endangered (CR):** The species is in imminent risk of extinction in the wild.
- **Endangered (EN):** The species is facing an extremely high risk of extinction in the wild.
- **Vulnerable (VU):** The species is facing a high risk of extinction in the wild.
- **Near Threatened (NT):** The species does not meet any of the criteria that would categorise it as risking extinction but it is likely to do so in the future.

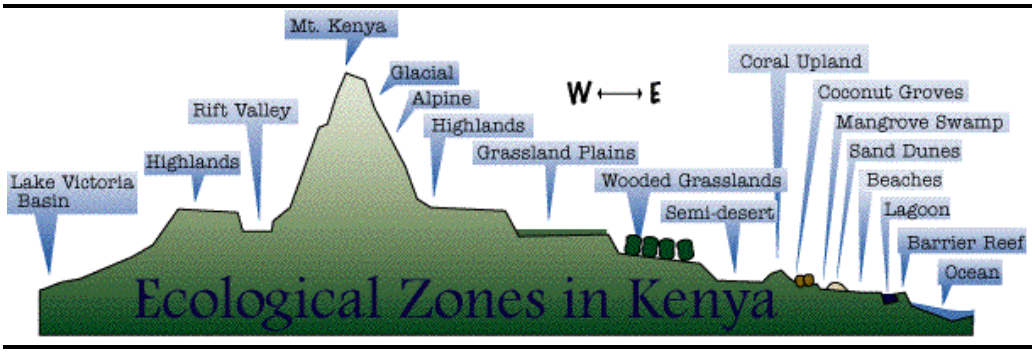
These classes are used in assessing the sensitivity of species or ecosystems and habitats of such species in this sub-section.

5.4.1 Ecosystems and Agro-ecological Zones

The NEC intersects ecosystems in both the marine and terrestrial eco-regions. Topography plays a determinant role in the ecosystems found in a particular location in the country. The NEC intersects all the ecosystems shown in *Figure 5.27* except for Mt Kenya, and the Glacial and Alpine ecosystems.

[1] National prioritization of species and ecosystems are according to the 2nd Schedule of the Wildlife Management and Coordination Act (2013).

Figure 5.27 Ecosystems in Kenya



Source: Westview Press, (1993)[1].

Terrestrial Eco-Region

Ecosystems in Kenya's terrestrial eco-region include forests, forest ranges, savannahs, grasslands, lake ecosystems, riverine ecosystems and highlands/mountainous ecosystems. KWS has identified priority/endangered ecosystems and areas of environmental significance in the country. Those priority ecosystems and areas of environmental significance which intersect the NEC are identified in *Table 5.9.*

Table 5.9 Priority Ecosystems and Areas of Environmental Significance in the NEC

Endangered or Priority Ecosystems	Areas of Environmental Significance
• Athi-Kitengela & Kaputei Plains (Kajiado) • Eburru Forest (Narok) • Kerio valley (Baringo) • Kimana Group Ranch (Kajiado) • Kuku A and B Group Ranches (Kajiado) • Lake Elementaita and its catchment and its basin (Naivasha) • Lake Nakuru N.P and its catchment (Nakuru) • Lolorashi Group Ranch (Kajiado) • Machakos ranches (Machakos)	• Aberdare Ecosystem Ranges (Nyandarua/Nyeri) • Baringo Ecosystem (Baringo) • Lake Naivasha Ecosystem (Nakuru) • Mt. Elgon Ecosystem (Bungoma/Trans Nzoia) • Mt. Kenya Ecosystem (Meru/Tharaka/Kirinyaga/Nyeri/Laikipia) • Shimba Hills Ecosystem (Kwale) • Tsavo Ecosystem (Tana River/Taita Taveta/ Kitui)

[1] Westview Press, (1993). Ecological Zones in Kenya.

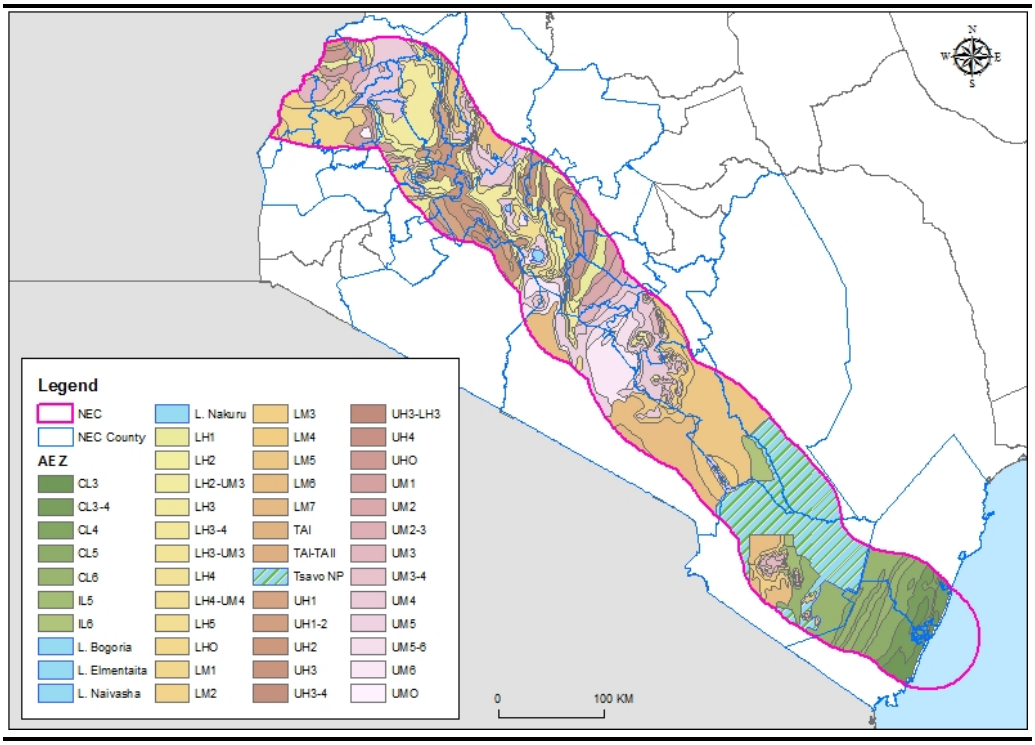
Endangered or Priority Ecosystems	Areas of Environmental Significance
• Marula Ranch (Naivasha) • Marula ranch (Nakuru) • Mashuru (Kajiado) • Mau Forest Complex (Nakuru, Bomet, Narok, Kericho) • Mbirikani Group Ranch (Kajiado) • Nairobi National park (Nairobi) • Ol Gulului (Kajiado) • Ol Gulului Trust Land (Kajiado) • Ol Pieyei (Narok) • Olare Orok Lemek (Narok) • Selengei Group Ranch (Kajiado) • Sheikh Salim Ranch (Taita Taveta) • Soysambu Ranch (Nakuru/Naivasha) • Suswa (Narok) • West Chyulu National Park (Kajiado) • Lake Turkana (Turkana) • Loima Hills (Turkana)	

Source: KWS, (2016)[1].

The country's land mass is also divided into distinct Agro-Ecological Zones (AEZs) using temperature, humidity and topography. Similarly, to the ACZ systems discussed in *Section 5.3.1*, the AEZ system assigns a designation by concatenating any of the indices of 7 humidity zones with topographical temperature belts classifications[2,3]. *Figure 5.28* below shows that the NEC traverses all the 7 humidity zones in the country (4) .

[1] KWS, (2016). Priority Ecosystems and Areas of Environmental Significance in Kenya.
[2] Ministry of Agriculture, (2006). Farm Management Handbook of Kenya.
[3] IRLI, (2007). Agro-Ecological Zones Based on Temperature and Crop Suitability.
(4) No data is available on the sub-route, i.e., north of Trans Nzoia

Figure 5.28 AEZs in the NEC Main Route



Source: ILRI, (2007).

From the map above, the topographical temperature belts intersected by the NEC are:

- Coastal Lowlands (CL),
- Inner Lowlands (IL),
- Lower Highlands (LH),
- Upper Midlands (UM),
- Lower Midlands (LM),
- Tropical Alpine (TA), and
- Upper Highlands (UH).

Marine Eco-Region

In the marine eco-region ecosystems range from mangroves and coastal wetlands to lagoons to fringing coral reefs and the open ocean. The discrete ecosystems found in the areas of this eco-region intersected by the NEC are explained in *Table 5.10.*

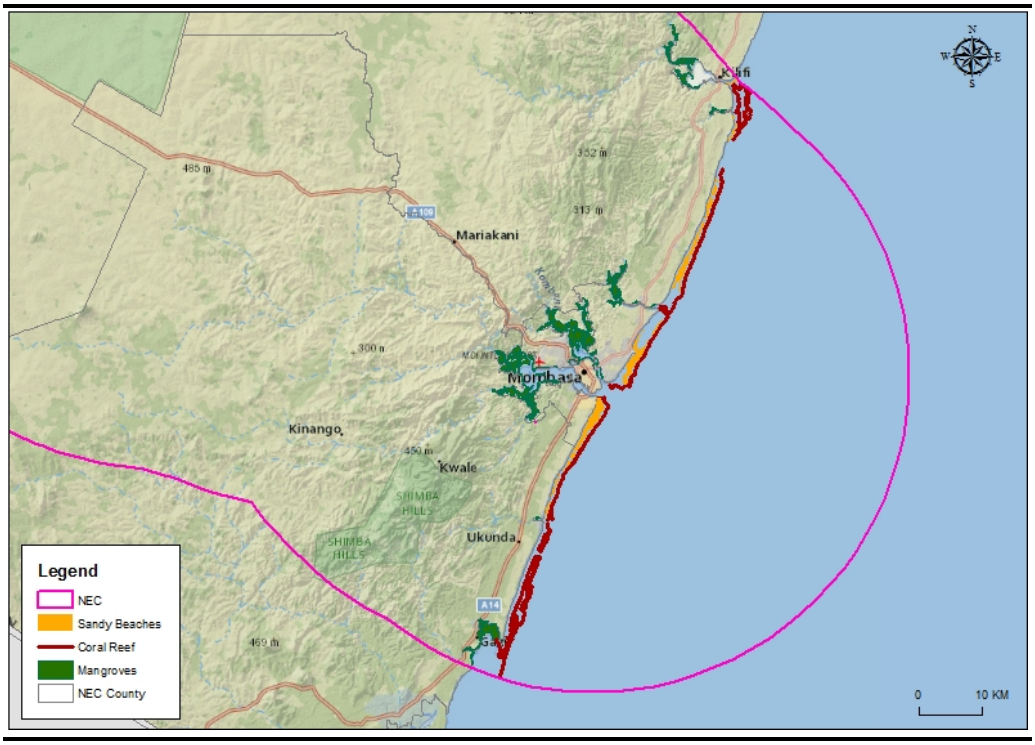
Table 5.10 Marine Ecosystems in Kenya

Ecosystem Characteristics	Description
Sheltered mangrove swamps, creeks, estuaries, marshes	Protected from wind and wave action, highly productive environments; easily damaged physically and through pollutants; mainly intertidal - regularly exposed and submerged.
Sheltered tidal flats, sea grass meadows	Mainly submerged but exposed at extreme low tides; usually subjected to medium wave energy; biological activity high.
Coral reefs	Mainly submerged and subjected to significant wave action; high productivity; very susceptible to water pollution.
Sheltered rias, sheltered rock coasts	Reduced wave action, mixture of sub-tidal, intertidal and littoral; often with extensive seaweed forests.
Exposed tidal flats exposed mud flats	Exposed to wave action; relatively high biodiversity.
Sheltered, fine-grained sand beaches	Generally sheltered beaches inside lagoons or behind the protection of a coral reef, subjected more to wind than wave action; productivity medium to high.
Exposed near-shore rocky platforms	Subjected to increasing wind and wave action; mainly sub-tidal; high productivity particularly of some algal species.
Exposed gravel, pebble, cobbles and boulder beaches	Exposed to wave action, usually with prominent storm ridges and steep profiles; productivity low.
Exposed compacted sand beaches, wind-blown sand dunes	Generally flat and very long stretches of beach without the protection of a reef; or accumulated sand dunes which are rarely behind the protection of a reef and usually open to wind and wave action; medium to low productivity.
Exposed cliffs, steep rocky coasts, manmade structures	Usually steeply dipping, near vertical walls; rocky headlands; exposed to wind and wave action; medium to high productivity.

Source: UNEP, (1998).

Figure 5.29 displays the location of mangroves, corals and sandy beaches in relation to the NEC.

Figure 5.29 Mangroves, Corals and Sandy Beaches



This study finds corals, sandy beaches, mangroves and seagrass beds to be sensitive ecosystems. This is because they provide valuable ecosystem services but are threatened by human activities. They are discussed in more detail in *Section 5.4.4*

Box 5.6 Constraints - Endangered Ecosystems and Areas of Environmental Significance

The endangered ecosystems and areas of environmental significance are recognized as constraints by this study. This is because:

- They are protected by national regulations
- They are priority areas of conservation efforts in the country.
- This study deems that these ecosystems and areas are at risk of degradation from anthropogenic pressures, and
- The NEC MP has the potential of increasing these pressures and risks.

5.4.2 Biodiversity

The diversity of flora and fauna in Kenya has led to several areas to be designated as Ramsar sites, Man and Biosphere (MAB) Reserves or World Heritage Sites. Through tourism and other environmental

services this diversity contributes to the country's economy. It is however noted that 70% of the national diversity exists outside of protected areas. This situation threatens the longevity and wellbeing of this diversity.

Fauna

Terrestrial Fauna

Kenya has over 25,000 species of fauna of which several are considered at risk by IUCN Redlist assessment method and national regulations. This study focusses on species likely to be found in the NEC which are considered to be at risk by these two regimes of assessment. Species are identified through GIS from species ranges obtained from IUCN's Redlist[1]. In the subsections herein briefs on the findings are provided:

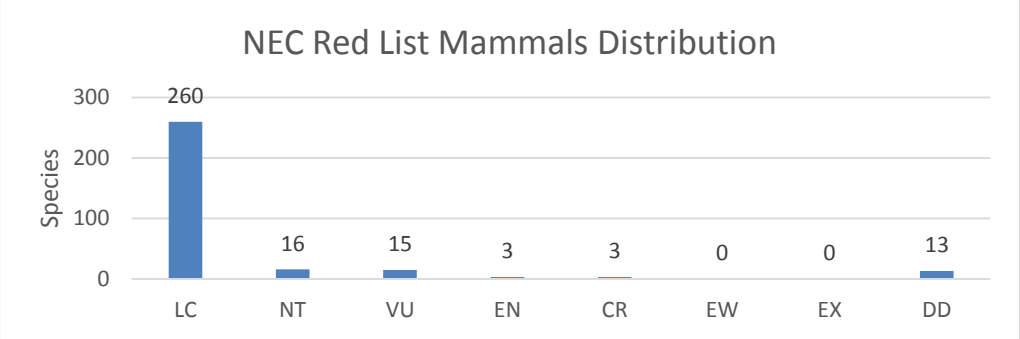
1. Mammals
   A total of 310 mammals listed in IUCN's Red List are identified to be likely to found within the NEC. *Figure 5.30* displays the distribution of these mammals according the assessment categories. Whilst most of the identified mammals are assessed to be under LC (260), 3 are EN and 3 are CE. Those under these two categories are the following:

   - Endangered
     - *Equus grevyi* (Grevy's Zebra)
     - *Lycaon pictus* (African Wild Dog)
     - *Rhynchocyon chrysopygus* (Golden-rumped Elephant Shrew)

   - Critically Endangered
     - *Beatragus hunter* (Hunter's Antelope)
     - *Diceros bicornis* (Black Rhinocerous)
     - *Suncus aequatorius* (Taita Shrew)

[1] IUCN Redlist, (2014). The IUCN Red List of Threatened Species.

Figure 5.30 Distribution of NEC Red List Mammals



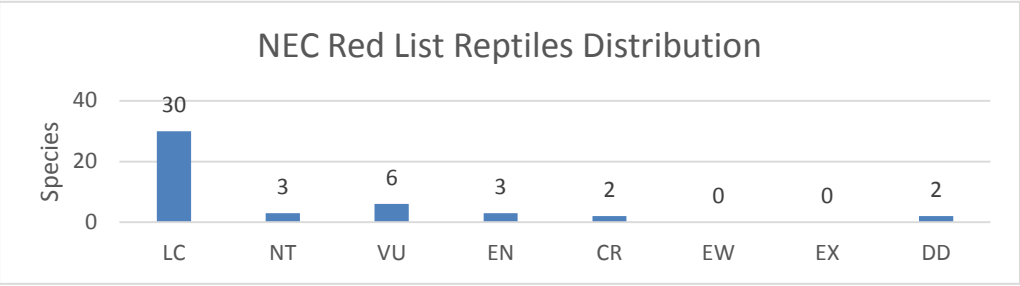
2. Reptiles

46 Red List reptilians are identified to be likely to be found in the NEC with their classifications as given in *Figure 5.31*. Of these 46 species, those that are EN and CR are the following:

- Endangered
  - Chelonia mydas (Green Turtle)
  - *Elapsoidea nigra* (Black Garter Snake / Usambara Garter Snake)
  - *Kinyongia tenuis* (Usambara Flap-nosed Chameleon, Matschie's Dwarf Chameleon)

- Critically Endangered
  - *Eretmochelys imbricate* (Hawksbill Turtle)
  - *Gastropholis prasina* (Green Keel-bellied Lizard)

Figure 5.31 Distribution of NEC Red List Reptiles



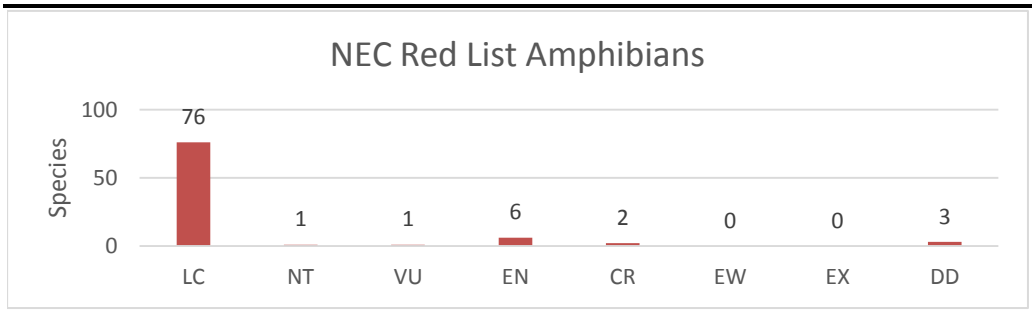
3. Amphibians

89 amphibian species in the Red List, categorized according to Figure 5.32, are likely to be found in the NEC. Six of these species are EN and two are CR and these are:

- Endangered
  - *Afrixalus sylvaticus* (Forest Banana Frog / Forest Spiny Reed Frog)
  - *Boulengerula changamwensis* (Changamwensis African Caecilian / Changamwe Lowland Caecilian / Changamwe Caecilian)
  - *Boulengerula niedeni* (Sagalla Caecilian)
  - *Boulengerula taitana* (Taita African Caecilian)
  - *Hyperolius rubrovermiculatus* (Reed Frog)
  - *Phrynobatrachus irangi* (Irangi Puddle Frog)

- Critically Endangered
  - *Arthroleptides dutoiti* (Du Toit's Torrent Frog)
  - *Callulina dawida* (Taita Hills Warty Frog)

Figure 5.32 Distribution of NEC Red List Amphibians



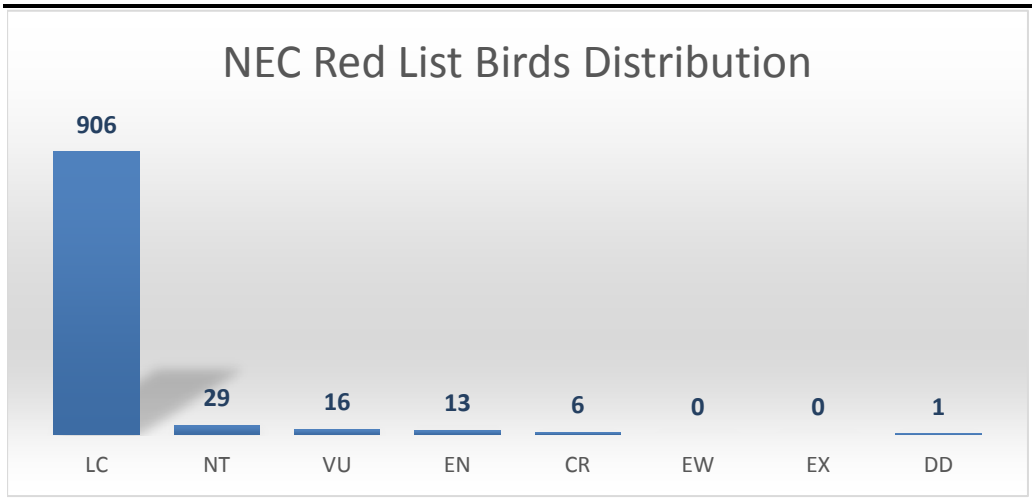
4. <u>Birds</u>
   There are 971 species of birds that are likely to be found in the NEC which are in the Red List. *Figure 5.33* illustrates the distribution of the assessment categories of these birds. Those which are EN and CR are:

   - Endangered
     - *Acrocephalus griseldis* (Basra Reed-warbler)
     - *Anthus sokokensis* (Sokoke Pipit)
     - *Aquila nipalensis* (Steppe eagle)
     - *Ardeola idae* (Madagascar Pond-heron)
     - *Balearica regulorum* (Grey crowned crane)
     - *Cisticola Aberdare* (Aberdare Cisticola)
     - *Eremomela turneri* (Turner's Eremomela)

- *Falco cherrug* (Saker Falcon)
- *Macronyx sharpei* (Sharpe's Longclaw)
- *Neophron percnopterus* (Egyptian vulture)
- *Ploceus golandi* (Clarke's Weaver)
- *Torgos tracheliotos* (Lappet-faced Vulture)
- *Zoothera guttata* (Spotted Ground-thrush)

- Critically Endangered
  - *Apalis fuscigularis* (Taita Apalis)
  - *Gyps africanus* (White backed vulture)
  - *Gyps rueppelli* (Rüppell's vulture)
  - *Necrosyrtes monachus* (Hooded Vulture)
  - *Trigonoceps occipitalis* (White-headed Vulture)
  - *Turdus helleri* (Taita Thrush)

Figure 5.33 Distribution of NEC Red List Birds



5. Aquatic (Freshwater) Species

138 aquatic fish species in the Red List are likely to be found in the rivers, wetlands and lakes in the NEC. The distribution of their assessment categories is shown in *Figure 5.34*. The freshwater fish which are EN and CR are:

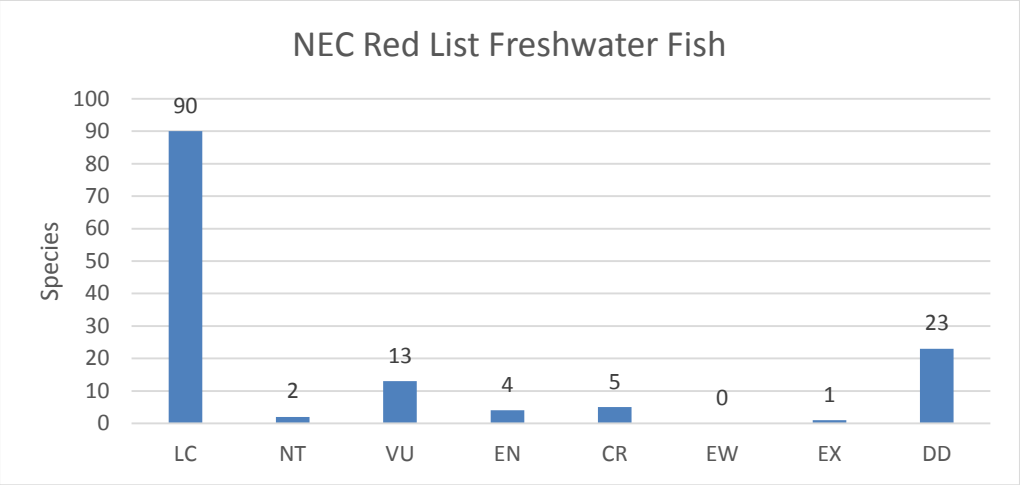
- Endangered
  - *Alcolapia alcalicus* (Soda Cichlid / Magadi Tilapia)
  - *Barbus quadralineatus* (Nelitriip-pardkala[1])

[1] Estonian common name
Source: Fishbase.org (2008). Common names of Barbus quadrilineatus. Retrieved March 03, 2016 from

- *Brycinus jacksonii* (Victoria Robber)
- *Marcusenius victoriae* (Victoria Stonebasher)

- Critically Endangered
  - *Aplocheilichthys sp. nov.* 'Baringo'
  - *Haplochromis sp. nov.* 'Amboseli'
  - *Oreochromis esculentus* (Singidia Tilapia)
  - *Oreochromis jipe* (Jipe Tilapia)
  - *Oreochromis variabilis* (Victoria Tilapia)

Figure 5.34 Distribution of NEC Red List Freshwater Fish



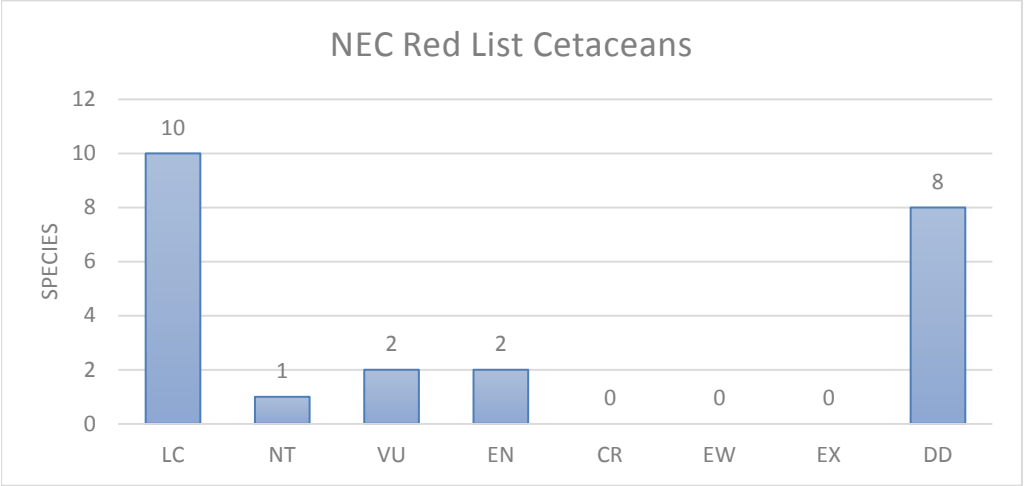
Marine Fauna

The marine zone of the NEC forms a habitat for a diverse set of species some of which are under risk from human activities. These species include cetaceans, wrasse, sea turtles and parrotfish amongst others.

1. Cetaceans
   There are 23 cetaceans in the Red List likely to be found in the NEC. The distribution of their assessment categories are given in *Figure 5.35.* None of the species are CR, however those that are EN are:
   - Balaenoptera musculus (Blue Whale), and
   - Balaenoptera borealis (Sei Whale).

http://www.fishbase.org/comnames/CommonNamesList.php?ID=62907&GenusName=Barbus&SpeciesName=quadrilineatus&StockCode=52976

Figure 5.35 Distribution of NEC Red List Cetaceans



2. Sea Turtles
   Kenya's five sea turtle species are likely to be found in the NEC. These are Chelonia mydas (Green turtle), Eretmochelys imbricate (Hawksbill turtle), Caretta caretta (Loggerhead turtle), Lepidochelys olivacea (Olive Ridley), and Dermochelys coriacea (Leatherback Turtle). The Green turtle and Hawksbill turtle are EN and CR respectively.

3. Angelfish
   In the NEC there are 12 Angelfish species in the Red List that are likely to be found. All these species are categorized as LC.

4. Groupers
   There are 46 Red List Grouper species likely to found in the NEC. Their assessment categories are distributed as shown by *Figure 5.36*

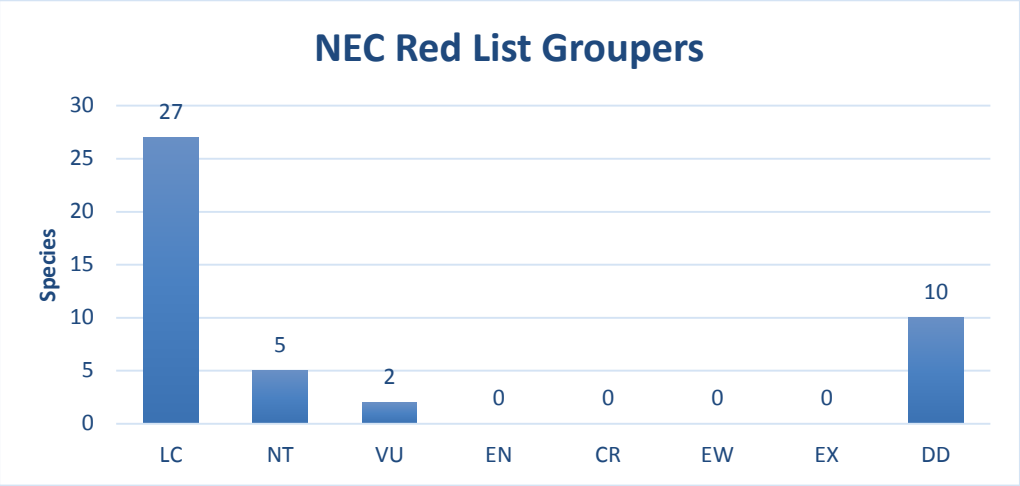
   It is observed that none of the species are CR or EN, however those that are NT and VU are the following:

   - Near Threatened
     - Epinephelus malabaricus (Malabar Grouper)
     - Plectropomus pessuliferus (Roving Coralgrouper)
     - Epinephelus fuscoguttatus (Brown-marbled Grouper)
     - Epinephelus coioides (Orange-spotted Grouper)
     - Epinephelus polyphekadion (Camouflage Grouper)

   - Vulnerable

- Plectropomus laevis (Blacksaddled Coral Grouper)
- Epinephelus lanceolatus (Queensland Groper)

Figure 5.36 Distribution of NEC Red List Groupers



5. Tunas and Billfish
   13 Red List Tunas and Billfish are likely to be found in the NEC. 7 of these are of LC category and whilst 3 are DD, the remaining 3 are NT. Those that are NT are:

   - Kajikia audax (Striped Marlin)
   - Scomberomorus commerson (Narrow-barred Spanish Mackerel)
   - Thunnus albacares (Yellowfin Tuna)

6. Wrasse
   Within the marine zones of the NEC, there are 99 Red List Wrasse species that are likely to be found. 95 of these species are categorized to be of LC, 3 are DD and Bolbometopon muricatum (Green Humphead Parrotfish) is VU.

7. Butterflyfish
   There are 26 Red List Butterflyfish species likely to be found in the NEC. 24 of these are of LC and the remaining two are categorized to be NT and DD. The two are Chaetodon trifascialis (Triangulate Butterflyfish) and Chaetodon bennetti (Bluelashed Butterflyfish) respectively.

8. Damselfish
   There are two species of Damselfish likely to be in the NEC. These are Chrysiptera unimaculata (Cape Damsel, One-spot

Damsel) and Chromis pembae (Pemba Chromis, Yellow-edge Chromis) which are both categorized to be LC.

Flora

Kenya's floral diversity comprises of over 7,000 species spread across the different ACZs, AEZs and eco-regions within the country. This section describes the diversity within the country and the NEC. It regards the diversity according to the two eco-regions intersected by the NEC.

Terrestrial Flora

As mentioned above floral species vary with AEZs. *Table 5.11* describes the common species found in the AEZs which are traversed by the NEC.

Amongst the floral species found in the country, several are classified to be at risk by KWS and IUCN. Those species include:

- Ocotea kenyensis (Camphor)
- Osyris lanceolate (East African sandalwood)
- Vitex keniensis (Meru oak)
- Polyscias kikuyuensis (Parasol tree)
- Aloe ballyi (Rat aloe)
- Prunus Africana (Red stinkwood)
- Populus ilicifolia (Tana river poplar)
- Encephalartos kisambo (Voi cycad)

Source: KWS, (2016)[1].

Table 5.11 Common Floral Species in the NEC's AEZs

Zone	Description
I	This zone is confined to mountains and immediate surrounding such as Mt Kenya and Mt Elgon.
II	This zone is generally restricted to the highlands of Kenya between 1980 and 2700 m and occurs as a forest or open grasslands. This zone is found in the surrounding of Mt Kenya (parts of Meru, Embu, Kirinyaga and Nyeri), isolated parts of the Rift Valley around Mau and Aberdares mountains (e.g. around Kericho and Nyahururu

[1] KWS, (2016). Endangered Plant Species in Kenya.

Zone	Description
	respectively) and the surrounding of Mt Elgon (e.g. around Kitale and Webuye). The main grasses are *Pennisetum clandistenum* (Kikuyu grass), *Themeda triandra* (Red oats), *Andropogon Chrysostachyus*, *Andropogon pralonsia*, *Exotheca abysinica*, *Digiteria scalaram*, *Eragrostis lascantha*, *Seteria sphacelata*, *Pennisetum catabasis* and *Sporobolus filipes*. Legumes include *Trifolium johnstoni*, *Medicago sativa* (Alfalfa or Lucerne), *Sesbania sesban* and *Leuceana leucusephala*.
III	Trees are numerous here and somewhat of shorter stature than in Zone II. This zone is the most significant for agricultural cultivation and several legume fodders are found here in crop-livestock systems. It occurs in the vast parts of Nyanza, Western and Central provinces, good proportion of Central Rift-Valley (Nandi, Nakuru, Bomet, Eldoret, Kitale) and a small strip at the Coast province. The major grasses are *Hyperenia* and *Cymbopogon*, *Themeeda triandra*, *Panicum maximum*, *Seteria Sphacelata*, *Sporobolus pyramidalis*, *Bracharia brizantha* (Congo signal), *Bricharia siluta*, *Chloris gayana* (Rhodes grass) and *Cynodon dactylon* (Star grass).
IV	This zone occupies more or less the same elevation (900-1800 m) as the previous or may be at times lower. It is typically represented in surroundings of Naivasha, vast parts of Laikipia and Machakos, vast parts of the former Central Province and vast part of the southern region of the former Coast Province. It is the home of most Acacia trees and shrubs including *Acacia seyal*, *Acasia Senegal*, *Acacia brevispica*, *Acacia drepanolobium* and *Acacia gerrardii*. Euphobia trees occur in some drier parts of this zone. *Combretum* and *Terchonanthus spp*. are also common here. Grasses found in this zone include *Themeda triandra*, *Pennisetum mezianum*, *Pennisetum straminium*, *Pennisetum massaiense*, *Eragrostis spp.*, *Hyperenia spp.*, *Seteria spp.*, *Digiteria spp.*, *Bothriochloa insculpta* and *Cenchrus ciliaris*. Rare grasses include *Chloris spp.* and *Cynodon spp.* Besides Acacia, other important legumes include *Indigoferra* and *Crotolaria*.
V	This zone is much drier than Zone IV and occurs at lower elevations. This Zone is prevalent in northern Baringo, Turkana, lower Makueni and vast parts of the former North Eastern Province. Low trees and shrubs found here include *Acacia mellifera*, *Acacia tortilis*, *Acacia horrida*, *Acacia reficiens*, *Acacia nubica*, *Acaia paslii*, *Acacia Zanzibarica*, *Adansonia digitata*, *Terminalia prunioides*, *Dobea spp.*, *Dioppspyros spp*. and *Commiphora spp*. Common grasses in this zone are *Eragrostis superba*, *Cenchrus ciliaris*, *Cymbopogon spp.*, *Bothriochloa spp.* and *Heteropogon contortus*.

Zone	Description
VI	This zone is considered as semi desert and is the driest part of Kenya. Dominant in this zone are Acacia and Commiphora shrubs with scattered taller trees of *Delonix elata*, *Acacia tortilis* and *Adansonia digitata*. *Balanites eagyptica*, *Boscia coriacea*, *Salvadora persica*, *Acacia mellifera* and *Acacia reficiens* are important shrubs or low tree species. Common dwarf shrubs here are *Indigofera spinosa* and *Sansevieria spp*. Other important shrubs are *Sericocomopsis, Barberia* and *Duosperma eromophylum*. Important grasses include *Aristida adoensis*, *Stipagrostis hirtigluma*, which are very characteristic and may occur as annuals or perennials. Other grasses also found here are *Aristida mutabilis*, *Chrysopogon aucheri*, *Tetrapogon spp.*, *Enneapogon cenchroides*, *Chloris roxburghiana*.
VII	This zone is desert dominated by sparse salt bushes.

Source: Infonet-Biovision, (2016)[1].

Forestry

Kenya is classified as a country with low forest cover since less than 10% of its area covered by forests. Recent estimates calculated the country's gazetted forest cover to a value less than 3.5%. This has driven efforts of increasing the country's forest cover since forest provide diverse and valuable environmental services and goods. Kenya's Vision 2030 sets 10% as the national goal of forest cover. Climate change, encroachment, pollution, land use changes and unsustainable harvesting of forest products are amongst the pressures which prevent the attainment of this goal. Nationally, only 18 counties had a forest cover above 10% in 2015[3].

Amongst the NEC Counties, the counties which meet the 10% goal are Elgeyo Marakwet, Baringo, Bungoma, Trans Nzoia, Nandi, Kericho, Bomet, Narok, Kiambu, Nyandarua, Nyeri, Kirinyaga, Kiambu and Makueni. *Figure 5.37* illustrates the distribution of percentage forest cover amongst the NEC Counties. This study calculates that 8.93% of land area of the NEC Counties is covered by forests. This translates to 24,467.20 km^2 wherein an average of 789 km^2 of forest cover per county is observed amongst these counties.

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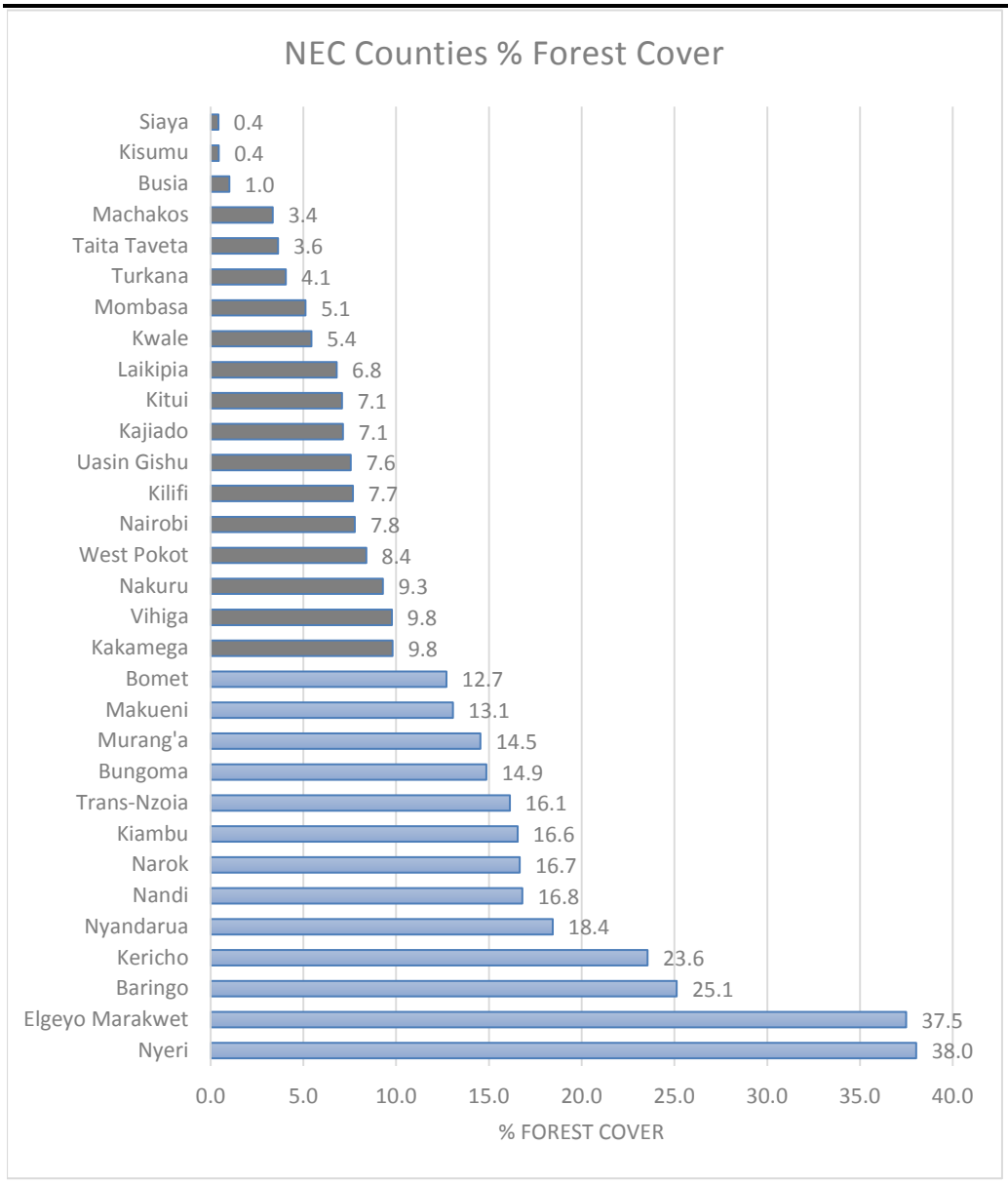
[1] Infonet-Biovision, (2016). AEZs: The Kenya System. Retrieved March 04, 2016 from http://www.infonet-biovision.org/EnvironmentalHealth/AEZs-Kenya-System

Figure 5.37 NEC Counties Distribution of Percentage Forest Cover



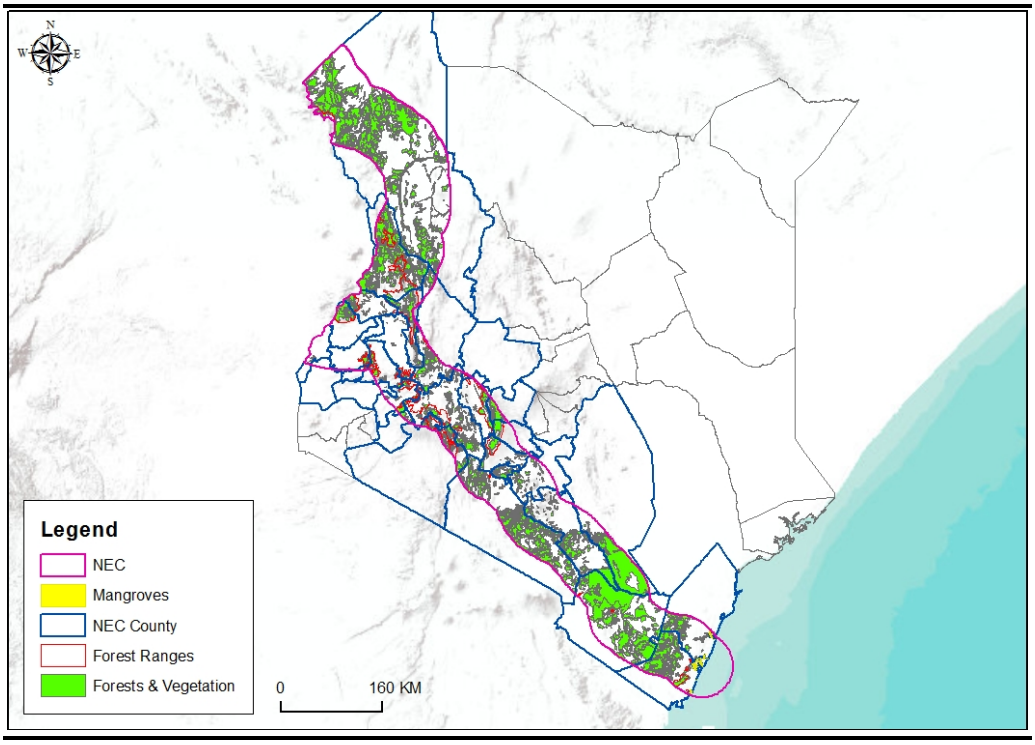
The 789 km² of forests in the NEC Counties include the different types of forests listed below alongside the specific NEC Counties where they are commonly found:

- **Mountain forests** - Aberdare Ranges, Mau and Kikuyu escarpment,
- **Dry zone forests** –Taita hills, West Pokot, Turkana,
- **Western rain forests** – Kakamega, Nandi and small patches in the western regions of the country, and
- **Coastal forests** – Shimba hills and Mkongani.

To meet the national demand for wood products in the country, plantation forests have been established to reduce pressure on indigenous forests. They are managed by public and private entities

and are distributed throughout the country. Together with indigenous forests they act as water catchments, conservations areas, and wildlife habitat and provide national heritage. The distribution of Forests (vegetation), Forest Ranges and Mangroves in the NEC is shown by *Figure 5.38.*

Figure 5.38 Forests, Forest Ranges and Mangrove Forests in the NEC



There different forest and vegetation types in the NEC covering an area of 28,756.2 km^2. The different vegetation and forest types comprise their total area in the NEC as follows:

- Closed Shrubs (3.10%)
- Closed to open woody vegetation (thicket) (9.47%)
- Closed trees (13.37%)
- Closed trees on temporarily flooded land (1.41%)
- Mangrove (Trees) (0.17%)
- Multi-layered trees (broadleaved evergreen) (0.76%)
- Open low shrubs (40-65% crown cover) (45.26%)
- Open shrubs (40-45% crown cover) (15.68%)
- Open trees (40-65% crown cover) (7.26%)
- Very open trees (15-40% crown cover) (3.53%)

Kenya has gazetted several Forest Reserves (FR) for conservation and sustainable management purposes due to the economic and ecological

significance of forests. These FRs are protected by EMCA, WMCA and the Kenya Forests Act (2005), whereas the latter places them under the management of KFS. The FRs traversed by the NEC are identified and discussed in *Section 5.4.4.*

Marine Flora

In the marine eco-region mangrove forests and seagrass beds are amongst the important floral species and ecosystems. These are discussed in the subsections herein.

1. Mangroves

Mangroves are distinctive coastal ecosystems that are highly productive areas making them important economically and socially. They are estuarine and occur in protected habitats where the seawater and freshwater mix. They provide fish habitat and are source of materials such as locally used wood. They are important nurseries and breeding sites for a variety of marine species of economic importance and other that contribute to the food chain. UNEP, (2011) calculated the value of mangroves in Gazi Bay based on the following goods and services:

- **Direct Use Values (DUV):** fishery, timber, eco-tourism, research and education, aquaculture and apiculture;
- **Indirect Use Values (IUV):** shoreline protection, carbon sequestration and biodiversity, and
- **Existence Values (EV):** which signifies the value of mangroves in an undamaged state

The study calculated a Total Economic Value (TEV) of USD 1,092/Ha. This was divided as follows: DUV = 20%; IUV = 25%; and EV = 55%. The Kenya coast has an estimated area of 530 km^2 of mangrove forests and those within the NEC are displayed in *Figure 5.29* and *Figure 5.38* . The dominant mangrove species in Kenya include among others:

- Rhizophora mucronata (Red mangrove),
- Avicennia marina (Grey or white mangrove),
- Ceriopstagal (Tagal mangrove), and
- Bruguiera gymnorrhiza (Large leafed mangrove or oriental mangrove).

2. Seagrass Beds

Seagrass beds occur along the entire coastline of Kenya, usually adjacent to or associated with coral reefs from the inter-tidal zone down to a depth of 20 m or more. They serve as an important habitat for many species and as a sediment trap thus keeping coastal beaches pristine. Seagrass beds provide a habitat for many species of fish, octopi and holothurians. Many of these species are of commercial importance. Seagrass beds are also the feeding grounds for endangered species such as the green turtle, the hawksbill turtle and the dugong. Artisanal fishing and commercial trawling activities often concentrate on seagrass beds.

Thirteen species of seagrass have been recorded in Kenya, none of which are endemic. These species are in the IUCN Red List wherein only Zostera capensis is categorized as VU and the other as LC. However, the most abundant species in Kenya are Cymodocea ciliata and Thalassia hemprichii which are found mostly on hard substrate covered to some degree by sand. They root firmly in the substrate and can withstand high wave action. C. ciliata does not do well in sheltered creeks away from the open sea. It reaches its maximum development in locations where it is never exposed by low tides. T. hemprichii does sometimes occur in sheltered places where it assumes luxuriant growth and may root to considerable depth. It becomes stunted in areas where it is uncovered by low tides.

In the reef and the lagoon environment Thalassodendron ciliatum (Cymodocea ciliata) is the predominant species, forming dense undersea meadows. Another abundant species is Thalassia hemprichii. The extensive growth of the above seagrasses constitutes a substantial part of the biomass found in lagoons, and provides food and shelter for a variety of organisms. Without the sand binding effect of these and similar plants the lagoon environment would not have been habitable for many of the organisms which now can be found there. It is possible that juveniles of spiny lobsters are among the animals benefiting from the particular habitats shaped by these plants.

Seagrass distribution along the Kenyan coast has not been mapped. UNEP, (1998) shows that seagrass beds occur throughout the 600 km-long Kenyan coastline in sheltered tidal flats, lagoons and creeks, with the exception of the coastal stretch adjoining the Tana Delta.

3. Invasive Species

According to the Global Invasive Species Database (GISD), Kenya has documented at least 61 invasive species to present day (2016). These comprise the 26 animals, 2 bacteria, 2 fungi, 30 plants and 1 virus listed in *Table 5.12*[1]. The emergence of invasive species is considered to be caused by climate change, pollution, poor agricultural practices or intentional and unintentional introduction. These invasive species have caused negative impacts on biodiversity, agriculture and human development which have included amongst others:

- Loss of capital and income including increasing agricultural costs,
- Loss and reduction of agricultural yields,
- Loss of native biodiversity,
- Creation of hazards such as birds at airports, and
- Loss of pasture.

Table 5.12 Documented Invasive Species in Kenya

<table>
<tr><th colspan="3">Fauna</th></tr>
<tr><th>Mammals</th><th>Arthropods</th><th>Coral</th></tr>
<tr><td rowspan="2">Myocastor coypus (Swamp Beaver, Coypu Rat, Coypu Rat, Nutria, Nutria Rat)</td><td rowspan="2">Cactoblastis cactorum (Cactus Moth, Prickly Pear Moth)
Ceratitis capitate (Meditarranean Fruit Fly, Medifly)
Gonipterus scutellatus (Eucalyptus Snout Beetle, Eucalyptus, Eucalyptus Weevil)
Orthezia insignis (Croton Bug, Kew Bug, Jacaranda Bug, Latana Blight)
Paratrechina longicornis (Crazy Ant)
Pheidole megacephala (Big Headed Ant, Coastal Brown Ant, Lion Ant, Brown House Ant)
Procambarus clarkia (Red Swamp Cray Fish,</td><td>Tubastraea coccinea (Colonial Cup- Coral, Orange–Cup Coral, Orange-Tube Coral)</td></tr>
<tr><td>Molluscs</td></tr>
<tr><td></td><td>Achatina fulica (Giant African Snail, Giant African Land Snail, Kalutara Snail)</td></tr>
</table>

[1] GISD, (2016). Retrieved March 08, 2016 from http://www.iucngisd.org

	Louisiana Cray Fish) • *Scyphophorus acupunctatus* (Acapiche Del Nardo, Agave Billbug, Agave Snout Weevil Agave Snout-Nosed Beetle, Agave Snout-Nosed Weevil, Agave Weevil Black Weevil, Sisal Bore, Sisal Weevil) • *Tapinoma melanocephalum* (The Ghost Ant) • *Trogoderma granarium* (The Khapra Beetle)	
Fish	***Birds***	***Reptiles***
• *Ctenopharyngodon idella* (White Amur) • *Cyprinus carpio* (Common carp, baby Carp, wild carp, scale carp) • *Gambusia affinis* (Western Mosquito Fish) • *Micropterus salmoides* (Large Mouth Bass) • *Oncorhynchus mykiss* (Rain Bow Trout, Steelhead, Redband Trout) • *Oreochromis mossambicus* (Mozambique Tilapia) • *Poecilia reticulate* (Guppy, Millionfish, Rainbow Fish) • *Salmo trutta* (Brown Trout, Sea Trout)	• *Corvus splendens* (House Crow, Indian House Crow, Colombo Crow) • *Myiopsitta monachus* (Monk Parakeet, quaker parrot) • *PsittaculaKramer* (Rose Ringed Parakeet, Ring Ringed Prakeet)	• *Hemidactylus frenatus* (Common House Gecko, Pacific Gecko, Medittaranean House Gecko) • *Ramphotyphlops braminus* (Flower Pot Snake, Brahminy Blind Snake)
Flora		
• *Acacia farnesiana* (Needle bush)	• *Lantana camara* (Lantana, Tick Berry) • *Leucaena leucocephala* (White Lead	

• *Acacia longifolia* (Long Weaved Battle, Acacia Trinervis, Aroma Doble, Golden Wattle, Coas, Wattle, Sallow Wattle, Sydney Golden Battle) • *Acacia melanoxylon* (Australlian Backwood, Sally Wattlr, Light Wood, Hickory) • *Acanthophora spicifera* (Red Alga, Boeloeng) • *Agave Americana* (Century plant, Maguey, American Aloe) • *Bidens pilosa* (Begger Ticks, Spanish Needle, Black Jack) • *Caesalpinia decapetala* (Shoofly, Mauritius, Mysore thorn) • *Cenchrus clandestinus* (Kikuyu Grass, West African Pennisettum) • *Cryptostegia madagascariensis* (Madagascar Rubber Vine, Indian Rubber Vine, Palay Rubber Vine, Purple Allamanda) • *Cyperus rotundus* (Java grass, nut grass, purple nut sedge, red nut sedge) • *Dalbergia sissoo* (Northern Indian Rose Wood) • *Eichhornia crassipes* (Water Hyacinth) • *Gracilaria Salicornia* (Red Algae) • *Halophila stipulacea* (Halopholla seagrass) • *Imperata cylindrical* (Blady grass, Cogon grass)	Tree) • *Macfadyena unguis-cati* (Cats Claw Vive, Funnel Creeper, Macfadyena, Cats Claw Trumpet) • *Mimosa pigra* (Giant Sensitive Tree, Mommosa, Black Mimosa, Thorny Sensitive Plant, Cat Claw Mimosa) • *Physalis peruviana* (Cape Goose Berry, African Ground Cherry) • *Prosopis* (Honey Mesquite) • *Psidium guajava* (Guava, Guiaba, Djamboe) • *Rubus niveus* (Mysore Raspberry, Hill Rasp Berry, Caylon Rasp Berry) • *Salvelinus fontinalis* (Trout, Brook trout) • *Salvinia molesta* (Kabira Weed, Giant Salivinia) • *Scaevola sericea* (Beach Naupaka, Half Flowers, Fun Flowers) • *Setaria verticillata* (Bur Grass, Brstly Foxtail, Bristle Hooked Grass, Rough Bristle Grass) • *Tradescantia fluminensis* (Small Leaf Spider Wort, Creeping Christian, Spider Wort, Inch Plant, Wandering Williwe, Wandering Trad, Water Spider Wort) • *Tradescantia spathacea* (Moses in a Basket, Moses in A Boat, Boastlilly, Oyster Plant, Three Men in a Boast) • *Verbena brasiliensis* (Bzazillian Verbena, Gin Case, Brazillian Vervain)
Bacteria	**Fungi**
• *Vibrio cholera* (Asiatic Cholera) • *Yersinia pestis (*Bubonic Plague*)*	• *Batrachochytrium dendrobatidis* (Chytrid Frog Fungi, Chytridiomycosis, Frog Chytrid Fungus) • *Phellinus noxius* (Brown Root Rot)
Virus	
West Nile Virus	

Source: GISD, (2016).

Species of Commercial Value

1. Terrestrial Species

There several species of fauna and flora that are either traded, produce goods or are part of services that are traded in the NEC, country and export markets. These are the species of commercial value in which distinctions exist within their nature since some of these species are domesticated and others are wild. In this respect, three categories of commercial species are considered with the first two categories being sector based. The two sectors are agriculture and livestock, and tourism in which this study regards the outputs achieved through the different trade sectors (goods and services) involving these species as value. It is noted that there are numerous species with commercial value in these two sectors thus the sectoral approach is preferred. The third category of species encompasses wild species identified to be exploitable by national regulations and authorities.

The agriculture sector (livestock included) is considered to be the backbone of Kenya's economy contributing 27.3% of GDP and employing about 75% of the working population in 2014. Crops contributed 19.7% of GDP and, forestry and other support services contributed 1.9% of GDP. This is the value of domesticated crops through the sector. The key commercial crops in Kenya and NEC include: tea, coffee, maize, rice, cotton, sugarcane and horticultural crops. On the other hand, livestock and inland fisheries contributed 4.46% and 0.8% of GDP in 2014 respectively. Key commercial livestock species include amongst others: cattle, goats, sheep, pig, poultry and fish[1].

Through the tourism sector wild fauna and flora species create value since they are part of the attractions in the country. These species include those within the boundaries of protected areas as well as outside. Signature species in the country include: elephant, buffalo, lion, cheetah, primate, rhino, crocodile and hippopotamus amongst others. The tourism sector yielded KES 84.1 Billion in 2014 from domestic and foreign tourists. Part of this value was generated from the 2,164,600 people who visited national parks and reserves in that

[1] MoALF, (2015). Economic Review of Agriculture 2015.

year[1]. This signifies the commercial value of the ecosystems, flora and fauna in these protected areas.

The 10th Schedule of the WCMA permits the exploitation of specific flora and fauna species in Kenya. These species are therefore regarded to be of commercial value or potential in the least. *Table 5.13* identifies the commercially exploitable species under the WCMA and KWS's recommendations. They are reared or grown for consumptive and ornamental purposes.

Other species of wild flora and fauna of commercial value or potential in the country which can be found in the NEC include, amongst others:

- *Acacia seyal* and *Acacia senegal*: The exudate of these trees is known as Gum Arabic when hardened. It is used in the food, pharmaceuticals, printing, ceramics, and textile industries where it functions as an emulsifier, stabilizer, emulsifier, flavouring agent, thickener, or coating agent[2].
- *Sclerocarya birrea* (Marula Tree): Its fruit is used in making cream liqueur, juice and cosmetics.

Table 5.13 Commercially Exploitable Wildlife Species in Kenya

Fauna		**Flora**
Terrestrial Fauna	**Avifauna**	
• Butterfly • Chameleon • Crocodile • Frog • Lizard • Reptile • Snail • Snake • Tortoise • Bees • Wild silk moths	• Ostrich • Pigeon • Doves • Ducks • Helmeted Guinea fowl • Vulturine Guinea fowl • Quelea	• Aloe • *Ocimum kilimanscharicum* (Camphor basil) • *Osyris lanceolate* (East African Sandalwood) • *Prunus Africana* (Red Stinkwood) • *Mondia whytei* (White's Ginger (mkombera))

Source: Republic of Kenya, (2013)[3] and KWS, (2016)[1].

[1] KNBS, (2015). Economic Survey 2015.
[2] Vellema W., Mujawamariya G. and D'Haese M., (2014). Gum Arabic Collection in Northern Kenya: Unexploited Resources, Underdeveloped markets. Afrika Focus - Volume 27, Nr. 1, 2014 - pp. 69-86.
[3] Republic of Kenya, (2013). The Wildlife Conservation and Management Act, 2013.

2. Marine Species

In the marine eco-region commercial valuable species include: marine fauna, mangroves and seagrass. Wild fauna in the marine environment form part of the tourist attractions in the coastal region and thus has a similar economic contribution as wild terrestrial fauna. Some of the signature species of fauna in the Kenyan marine eco-region include: Cetaceans, Sea turtles and corals amongst others.

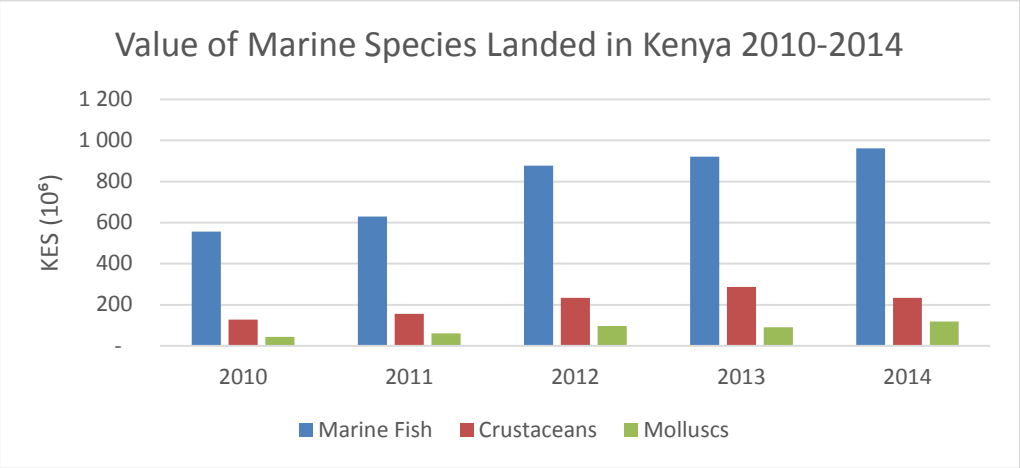
Marine fisheries play an important role to national and regional economies, and livelihoods in the coastal zone of the NEC. This is despite being overshadowed by inland fisheries. Species landed include: demersals, pelagics, crustaceans, molluscs, and sharks and rays. It is estimated that marine fisheries contributed 0.44% of Kenya's GDP in 2014 [1].

Figure 5.39 displays the trend in value earned from marine fisheries in Kenya between 2010 and 2014. In addition, ornamental or aquarium fishing is practised along the coast of Kenya. In 2009, an estimated 250,000 fish were exported through the trade, primarily from Kilifi, Shimoni, Shelly beach, Kanamai, Nyali, Diani and Kikambala. Species involved in this trade include Angelfish, Anemonefishes, Butterflyfish, Damselfish, Anthiases and Corals[2].

Mangroves and seaweed are exploited commercially in the coastal zone of the NEC. Mangroves trees provide timber used for construction as part of their DUVs. Seaweed is grown primarily in the South Coast (Kwale) targeting local and foreign markets. Dried seaweed extract, carrageenan, is used in the food, cosmetic and pharmaceutical industries[3].

[1] KWS, (2016). Wildlife species for which game farming may be allowed.
[2] Okemwa G., Kimani E., Zamu M., Waiyaki E., Muthama C., Ogutu B., Muturi J., (2011). The Marine Ornamental and Curio trades in the Western Indian Ocean – benefit or threat? KMFRI.
[3] Magangi N., Kiema A., Kimanthi A. and Nzioka A., (2011). Development of a Seaweed Nursery for Kappaphycus alvarezi (cottonii) and Eucheuma denticulatum (spinosum) in the South Coast of Kenya. KMFRI.

Figure 5.39 Value of Marine Fish Landings 2010-2014



Box 5.7 Constraints - Biodiversity and Ecosystems

Constraints under this topic include the following:

- Mangrove forests and gazetted forests including forest reserves. These provide valuable ecosystem goods and services and are protected by national regulations.
- Ecosystems classified endangered by KWS. Their designation is evidence of their sensitive nature and part of conservation strategies. Some are PAs and the implementation of the NEC can increase the threats and pressures they face.
- Protected areas which create a habitat for endangered or threatened species. These are discussed in Section 5.4.4.

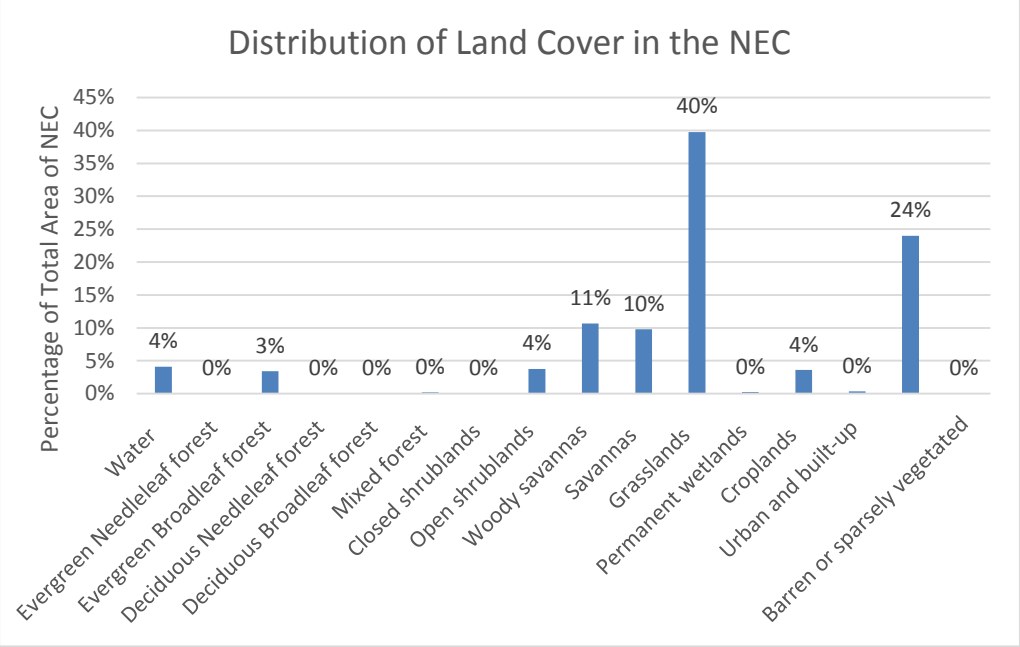
5.4.3 Land Cover

The NEC traverses diverse regions in the country including rural, peri-urban and urban areas. It intersects Kenya's primary economic belt linked by the MR and SGR through the cities and towns of Mombasa, Nairobi, Nakuru, and Kisumu amongst others. In addition, as noted in *Section 5.4.1* the corridor transects most classes of ecosystems in the country. Consequently, land cover classes/types in the corridor vary with the social, environmental and economic characteristics of the underlying regions.

This study calculates the percentage area occupied in the NEC by the typical land cover classes used for the MODIS satellite instrument. This is based on 2012 MODIS data through which it is observed that grassland, cropland/natural vegetation mosaic, woody savannas and

savannas occupied 39.77%, 23.97%, 10.67% and 9.79% of the NEC respectively. These land covers occupied the most area, together comprising 84.2% of the NEC's area. The least area was occupied by deciduous and evergreen needleleaf forests (0.0014%). Permanent wetlands, water, croplands, evergreen broadleaf forests, and urban and built up areas occupied 0.23%, 4.08%, 3.59%, 3.4% and 0.36% of the NEC's area. *Figure 5.39* compares the percentage of the total area of these land cover classes.

Figure 5.40 Land Cover Distribution in the NEC 2012

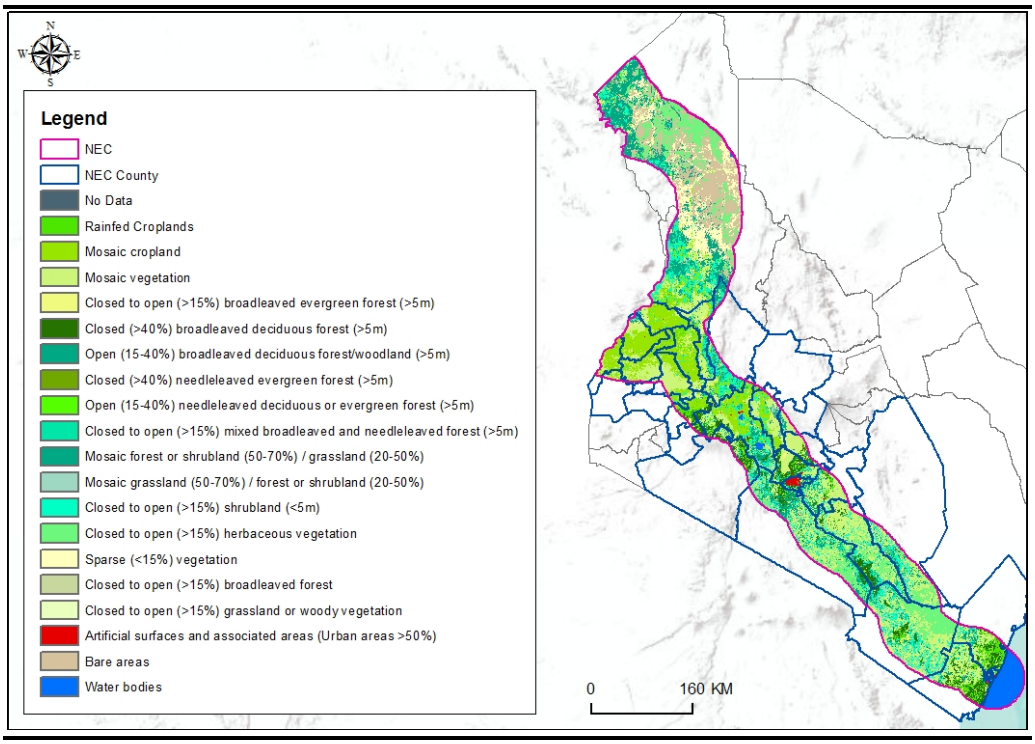


Source: NASA LP DAAC, (2014)[1]

Figure 5.41 shows the spatial distribution of land cover in 2012 using MODIS data from the Global Land Cover European Space Agency (GLCESA). It is observed that croplands and natural vegetation mosaic primarily occurs in the western and coastal regions and some smaller regions in the central. Urban and built-up areas are in the towns and cities of Nairobi, Machakos, Nakuru and Eldoret, whilst grasslands and savannas are predominantly located in the east between Nairobi and the coastal region.

[1] NASA Land Processes Distributed Active Archive Center (LP DAAC), (2014). MODIS. USGS/Earth Resources Observation and Science (EROS) Center, Sioux Falls, South Dakota.

Figure 5.41 NEC Land Cover 2012

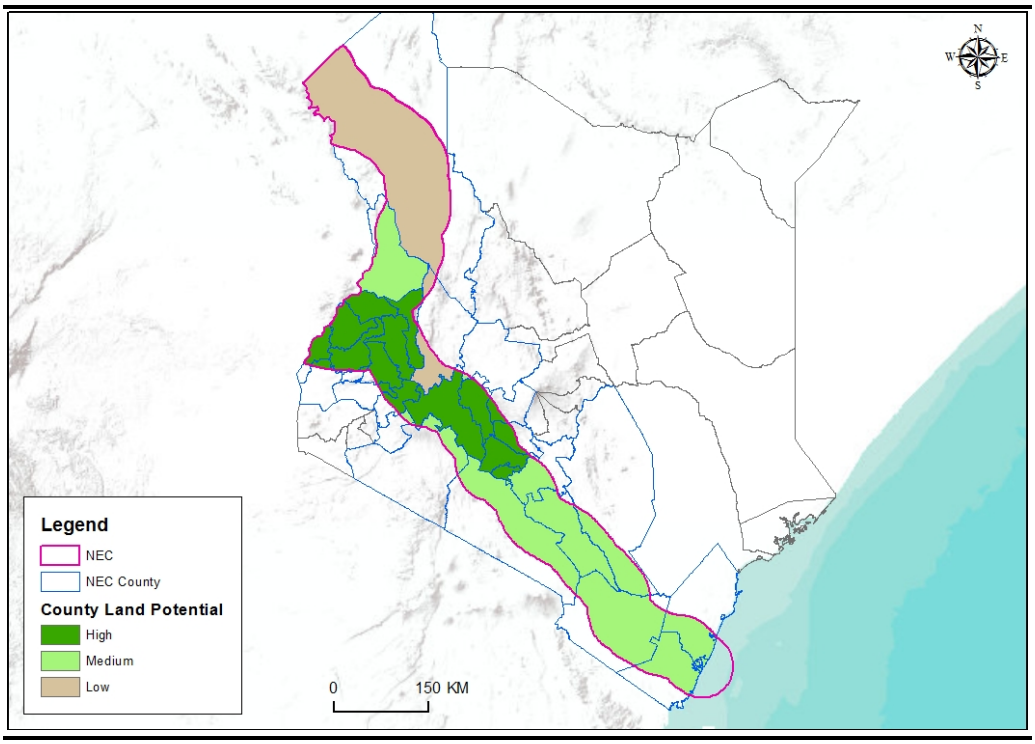


Land Suitability/Potential

Land suitability is determined by both environmental and social factors. The former category of factors limits the type of land uses that can occur at any land unit whilst the latter which includes tenure systems often influence the choice of land use. Such choices are largely based on the value that can be obtained from land with respect to the capacity of users. Agriculture remains an important land use in the country since it employs up to 75% of the population. On the contrary, land tenure systems and demand driven by population growth contributes to commoditization of land. Often competing interests exist on land units particularly in urban and high populated areas. This is observed in that 80% of Kenya's population is supported by the available arable land and the ASALs support 20% of the population, 50% of livestock and 80-90% of wildlife.

Figure 5.42 shows the land potential/suitability of the NEC Counties generalized from NEMA, (2011)[23] into three classes of potentiality. The original potentiality classes are informed by, rainfall (water availability), soil, ACZs and AEZs. According to this system, it is observed that 39% of the land area has high potential, 58% has moderate potential and 3% is low potential.

Figure 5.42 Land Potential the NEC



Source: NEMA, (2011).

5.4.4 Sensitive and Designated Features

A number of Kenya's sensitive and designated environmental features are located in the NEC. These are identified in the subsections herein through the following categories:

- Protected Areas (PAs)
- Wetlands
- Ramsar Sites
- UNESCO World Heritage Sites (WHS)
- UNESCO Man and Biosphere Reserves (MAB)
- Important Bird Areas (IBAs) and Endemic Bird Areas (EBAs)
- Alliance for Zero Extinction Sites (AZE)
- Eastern Afromontane Biodiversity Hotspot (EAM)
- Flyways
- Corals
- Sandy Beaches
- Sea Turtle Nesting Sites
- Transboundary Resources

This Study notes that several of the PAs in the NEC have multiple national and international designations. These are identified in this *Section* accordingly.

Nationally Protected Areas

Protected Areas cover 14% of Kenya's surface area and are grouped into 8 conservation areas (CAs) by KWS. The NEC intersects the 7 out of the 8 (CAs) in Kenya namely, Western, Mountain, Tsavo, Southern, Coast, Central Rift and Eastern conversation areas. These CAs include Protected Areas (PAs) of economic and ecological significance. This is because they provide a habitat to some of the species at risk in the country whilst being fundamental to the tourism sector. The ecological significance of some of these PAs is evidenced by their international recognition whereby some are classified as Ramsar Sites, World Heritage Sites, UNESCO Biosphere Reserves or form part of the EAM. Economically, these PAs contributed to revenues earned from tourism even in spite of reduced activity in the sector between 2010 and 2014 (*Figure 5.43*). A total of 1,626,300 tourists visited the PAs in the NEC in 2014.

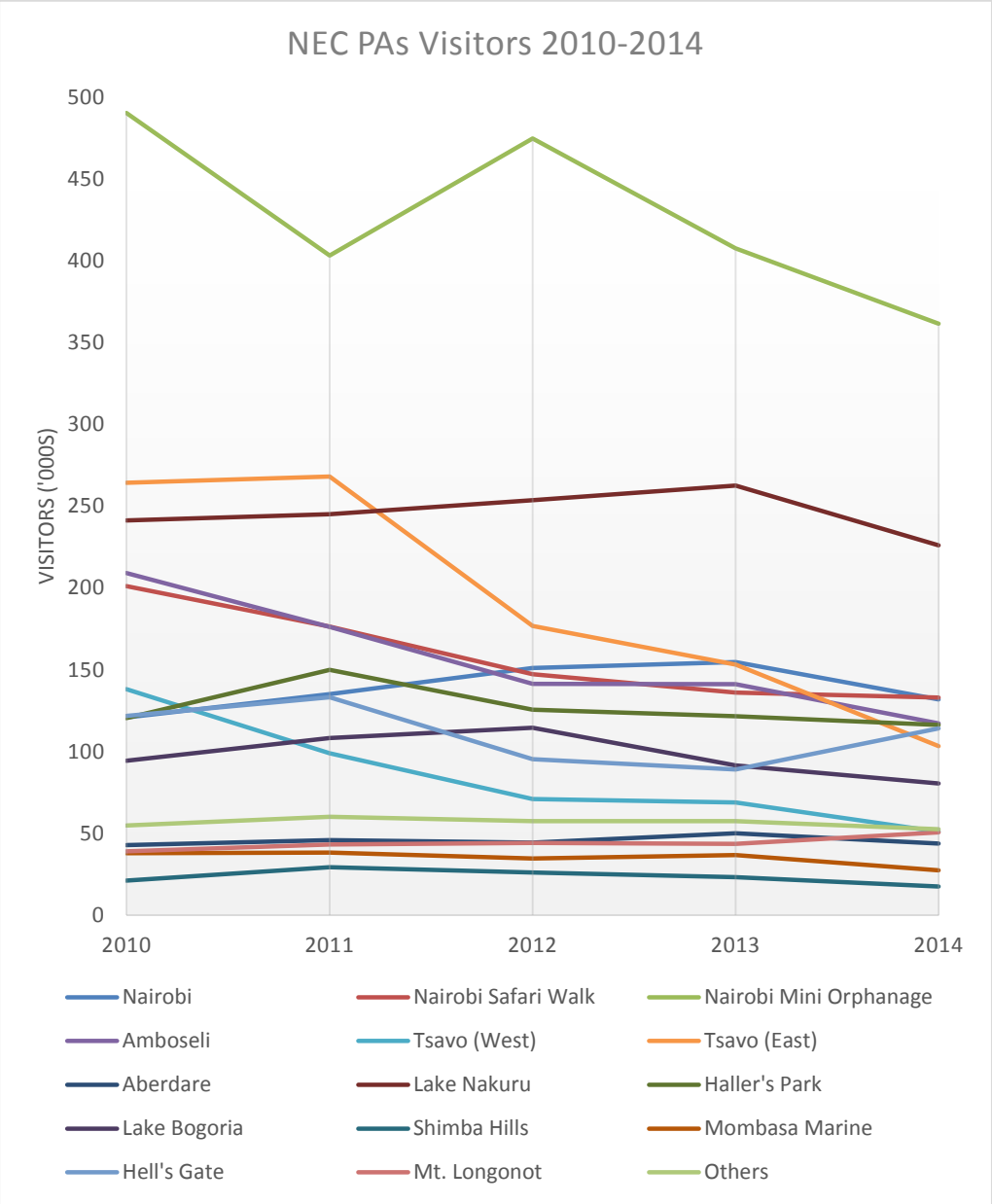
The specific nationally gazetted PAs in the NEC are identified using data from WDPA (2016)[1] and KWS, (2016). A total of 163 PAs are intersected by the NEC with their typology including:

- National Park (NP),
- National Reserve (NR),
- Marine Protected Area (MPA) (Marine National Park and Marine National Reserve),
- Wildlife Sanctuary (WS),
- Forest Reserve (FR), and
- Private Conservation Area (PCA) and Community Conservation Area (CCA) – These include Community Conservancy, Community Wildlife Sanctuary (CWS), Private Reserve (PR) and Locally Managed Marine Area.

These PAs are protected by national regulations such as EMCA, WMCA and the Forest Act. The distribution of their typologies is given in *Figure 5.44*, in which FRs are the most abundant (128) followed by NPs (10) and Private Reserves (10).

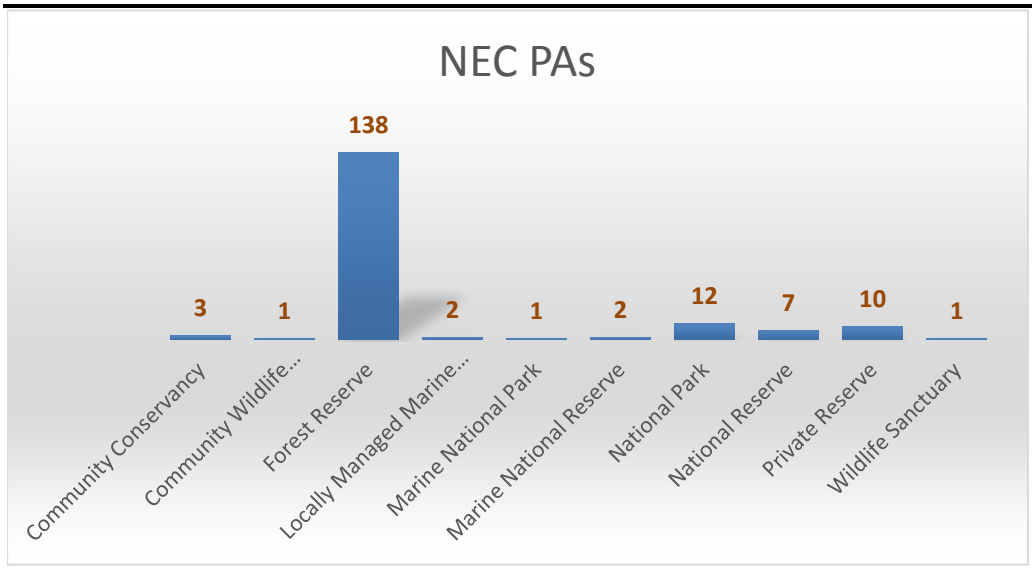
[1] UNEP-WCMC and IUCN, (2016). Protected Areas of Kenya. February 2016.

Figure 5.43 Visitors to PAs in the NEC 2010-2014 (1)



[1] Others include: Arabuko Sokoke, Ol-Donyo Sabuk, Marsabit, Saiwa swamp, Sibiloi, Bamburi, Chyulu, Ruma National Park, Mwea National Reserve, Central lsland National Park, Kiunga, Mt. Elgon, Nasolot, Ndere and Kakamega.

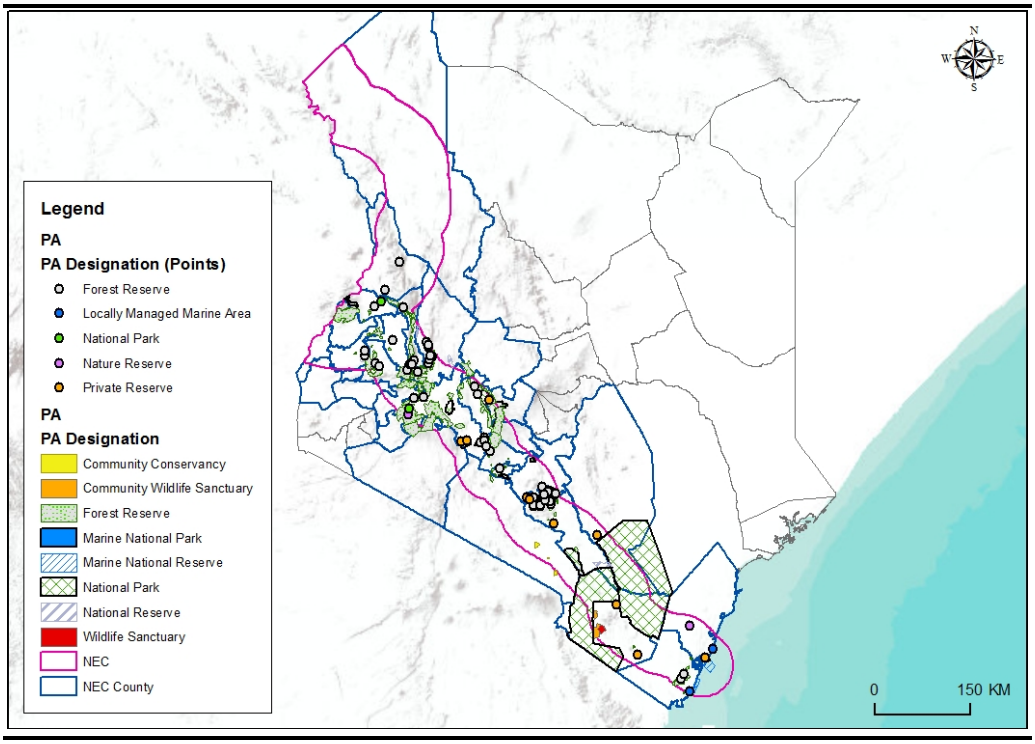
Figure 5.44 Distribution of PAs in the NEC



Source: UNEP-WCMC and IUCN, (2016).

Figure 5.45 shows the spatial distribution of these protected areas.

Figure 5.45 PAs in the NEC



Source: UNEP-WCMC and IUCN, (2016)[1,1].

[1] In the dataset used in this map some PAs did not have polygons showing their boundaries but instead had points. These points were considered in this study since they still show the location of their respective PAs in relation to the NEC.

This study is guided by IUCN's Protected Area Category System in assessing the sensitivity or significance of the PAs in the NEC. This system defines the following types to PAs:

- **Category Ia Strict Nature Reserve:** These are strictly PAs set aside to protect biodiversity and also possibly geological/geomorphic features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such PAs can serve as indispensable reference areas for scientific research and monitoring[1].

- **Category Ib Wilderness Area:** These PAs are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

- **Category II National Park:** These PAs are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.

- **Category III Natural Monument or Feature:** These are PAs set aside to protect a specific natural monument, which can be a landform, sea mount, sub-marine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small PAs and often have high visitor value.

- **Category IV Habitat/Species Management Area:** These PAs aim to protect particular species or habitats and management reflects this priority. Many Category IV PAs will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.

- **Category V Protected Landscape / Seascape:** This is a PA where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and

[1] IUCN, (2014). IUCN Protected Areas Categories System. Retrieved March 09, 2016 from http://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/

scenic value; and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

- **Category VI Protected area with sustainable use of natural resources:** These PAs conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. Most of these PAs are expansive and natural condition. A proportion of these PAs are under sustainable natural resource management, where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of these areas.

National Parks

Ten national parks (NPs) are intersected by NEC. Details of these NPs, including characteristics and number of species at risk supported, are provided in *Table 5.14* as well as *Figure 5.46.*

Table 5.14 National Parks in the NEC

Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
Tsavo East	II	1948	Kitui, Kwale, Taita Taveta, Makueni	It is part of the Tsavo Conservation Area (TCA) and together with Tsavo West NP they form one of the largest protected areas in the world. Tsavo East NP expands over an area of 13,747 km². It supports Elephant, Rhino, Buffalo, Lion, Leopard, Hippo, Crocodile, Waterbuck, Lesser Kudu, Gerenuk and Hirola. It is an IBA in which over 500 species of birds have been documented[1]. Together with Tsavo West and Chyulu Hills they form the Tsavo Parks and Chyulu Complex which are being considered for designation as a WHS.	11	16	30	41
Tsavo West	II	1948	Kajiado, Kitui, Makueni, Taita Taveta	This NP is part of TCA and covers an area of 7,065 km² which features a transboundary protected ecosystem. Species supported by this NP include: Leopard, Cheetah, Wild dog, Buffalo, Rhino, Elephant, Giraffe, Zebra, Lion, Crocodile, Mongoose, Hyrax, Dik- dik, Lesser Kudu and Nocturnal Porcupine. Tsavo West is an IBA with over 600 bird species documented within its boundaries[2]. This PA features Ngulia Ranch that supports the Black Rhino to prevent its extinction. Together with Tsavo East and Chyulu Hills they form the Tsavo Parks and Chyulu Complex which are being considered for designation as a WHS.	15	16	29	42
Chyulu	II	1983	Kajiado,	This PA is part of TCA and covers an area of 741 km²	10	12	24	39

[1] KWS, (2016). Tsavo East National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/content/tsavo-east-national-park
[2] KWS, (2016). Tsavo West National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/tsavo-west-national-park

Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
Hills			Taita Taveta, Makueni	in the eastern part of Kenya. Document faunal species in this PA include Buffalo, Bushbuck, Eland, Elephant, Leopard, Giant Forest Hogs, Bush Pig, Reedbuck, Giraffe, Black Mamba, Puff Adder, Rock Python, Gecko, Tortoise and Lizard[1]. Chyulu Hills is also an IBA and a gazetted water tower which is a Key Biodiversity Area (KBA) of the EAM. Together with the Tsavo NPs they form the Tsavo Parks and Chyulu Complex which are being considered for designation as a WHS.				
Nairobi	II	1946	Nairobi	This PA occupies an area of 117 km^2 within Kenya's capital city. An estimate 100 mammalian species have been documented in this PA including African Buffalo, Baboon, Eastern Black Rhinoceros, Bushnell Zebra, Cheetah, Coke's Hartebeest, Grant's Gazelle, Hippopotamus, African Leopard, African Lion, Thomson's Gazelle, Eland, Impala, Masai Giraffe, Ostrich, Vulture and Waterbuck among others. It is an IBA which features at least 400 bird species of which at least 20 are identified to be European migrants[2,3]. Nairobi NP supports the second largest annual migration of large herbivores (wildebeest and zebra).	9	16	19	43

[1] KWS, (2016). Chyulu Hills National Park. Retrieved March 16, 2016 http://www.kws.go.ke/content/chyulu-hills-national-park
[2] Prins H.; Grootenhuis J.G; Thomas T., (2000). Wildlife Conservation by Sustainable Use. Springer.
[3] Trzyna, T., (2014). Urban Protected Areas: Profiles and Best Practice Guidelines. Best Practice Protected Area Guidelines Series No. 22, Gland, Switzerland: IUCN. xiv + 110pp.

Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
				The PA features a Rhino sanctuary which breeds the species to restock other PAs[1]. Adjacent to the PA is Nairobi's animal orphanage and safari walk.				
Aberdare	II	1950	Murang'a, Nyeri, Nyandarua	Aberdare NP occupies 765.7 km² as part of the greater Aberdare ecosystem on the Kikuyu escarpment of the Eastern Rift Valley. It supports 56 of the 67 tropical highland species of fauna in Kenya. These include, amongst others, Elephant, Black Rhino, Leopard, Spotted Hyenas, Olive Baboon, Black and White Colobus Monkeys, Buffalo, Warthog, Bushbuck, Giant Forest Hog, Bongo, Golden Cat, Serval Cat, African Wild Cat, African Civet Cat and The Blue Duiker. It is an IBA, located within the Kenya Mountains EBA, with at least 290 bird species documented[2,3]. The montane forest within the Aberdare ecosystem is one Kenya's five important gazetted water towers. It is a KBA of the EAM which is subset of the Mt Kenya – Aberdare EAM Corridor. Aberdare is under consideration for designation as a WHS.	10	21	29	50
Mount Elgon	II	1968	Bungoma, Transzoia	169 km² of the transboundary ecosystem of Mt Elgon is gazetted as a NP in Kenya. The ecosystem, which has high floral diversity, features the gazetted Mt Elgon FR. Within the NP, key faunal species are Elephant, Buffalo, small antelopes, Duiker, Black and	22	15	20	36

[1] KWS, (2016). Nairobi National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/parks/nairobi-national-park
[2] KWS, (2016). Aberdare National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/content/aberdare-national-park
[3] UNESCO, (2010). Aberdare Mountains. World Heritage Centre. Tentative Lists.

Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
				White Colobus, Blue Monkey, and Red-tailed Monkey[1]. Mt Elgon is an IBA, located within the Kenya Mountains EBA, within which 57 bird species have been documented. The PA is the last known refuge for *Petropedetes dutoiti* (Du Toit's Torrent Frog) (CR) and *Otomys barbouri* (Barbours Vlei Rat) (EN), therefore it is a designated AZE. Moreover, the ecosystem is one of Kenya's 5 major gazetted water towers. In connection, the catchment within the ecosystem is a Freshwater KBA (FWKBA) of the EAM, whilst the montanous ecosystem is a composite KBA of the EAM. Due to its uniqueness as a water the ecosystem is also designated as a UNESCO MAB.				
Lake Nakuru	II	1967	Nakuru	This NP measures 118 km^2 and provides a habitat for about 450 species of Greater and Lesser Flamingos. At least 56 species of mammals have also been documented in the NP including White Rhino and Waterbuck. 550 species of flora are known to exist with the NP including the largest Euphorbia forest in Africa[2]. Due to its support for bird species the NP is an IBA within the Kenyan Mountains EBA. The lake supports several endangered species and for this reason it is	9	14	16	44

[1] KWS, (2016). Mount Elgon National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/content/mount-elgon-national-park
[2] KWS, (2016). Lake Nakuru National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/lake-nakuru-national-park

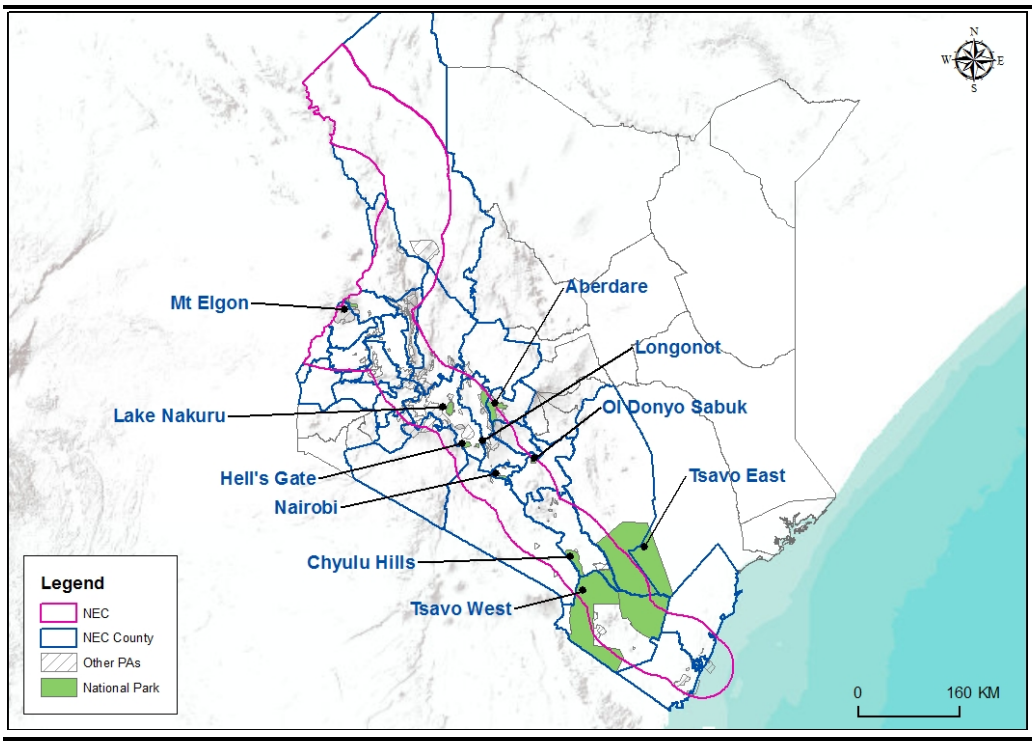
Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
				designated as a Ramsar Site, in addition to a WHS as part of the Kenya Lake System in the Rift Valley. It is also a FWKBA of the EAM.				
Ol Donyo Sabuk	II	1967	Machakos	Ol Donyo Sabuk NP covers an area of 20.7 km² which supports Buffalo, Leopard, Mongoose, Bushbuck, Olive Baboon, Colobus Monkey, Vervet Monkey, Sykes' Monkey, Kirk's Dik-Dik, Bush Pig, Common Duiker, Reedbuck, Rock Hyrax, Bushbaby, Tree and Ground Squirrel, Aardvark, Porcupine, Python and Monitor Lizard. Additionally, over 45 avifaunal species have been recorded in the NP[1].	9	16	4	30
Hell's Gate	II	1984	Nakuru, Narok	This NP measures 68 km² in an area beset with geothermal activity within the Rift Valley. It supports a range of species including: Giraffe, Eland, Hartebeest, Buffalo, Gazelles, Antelope, Lion, Leopard, Cheetah, Klipspringer, Rock Hyrax and Chanler's Mountain Reedbuck. Avifaunal diversity in the NP encompasses 103 enumerated species with notable ones including Vulture, Ragles and Augur Buzzard. Rare bird species documented in the PA are the Verreaux's Eagle and the Lammergeyer, Ruppel's Griffon and Hooded Vultures. The NP is under consideration for designation as a WHS[2].	9	16	21	34
Longonot	II	1983	Nakuru	Mt Longonot NP occupies 52 km² in the Rift Valley, featuring the extinct monolith of Mt Longonot. Common species observed in the NP are Buffalo,	9	14	16	43

[1] KWS, (2016). Ol Donyo Sabuk National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/content/ol-donyo-sabuk-national-park
[2] UNESCO, (2010). The African Great Rift Valley - Hell's Gate National Park. World Heritage Centre. Tentative Lists.

Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
				Eland, Lion, Leopard, Bushbuck, Common Zebra, Giraffe and Grant's Gazelles[1].				

[1] KWS, (2016). Mount Longonot National Park. Retrieved March 16, 2016 from http://www.kws.go.ke/content/mount-longonot-national-park

Figure 5.46 National Parks in the NEC



National Reserves

Five National Reserves, whose details are provided in *Table 5.15* and *Figure 5.47,* are traversed by the NEC.

Table 5.15 National Reserves in the NEC

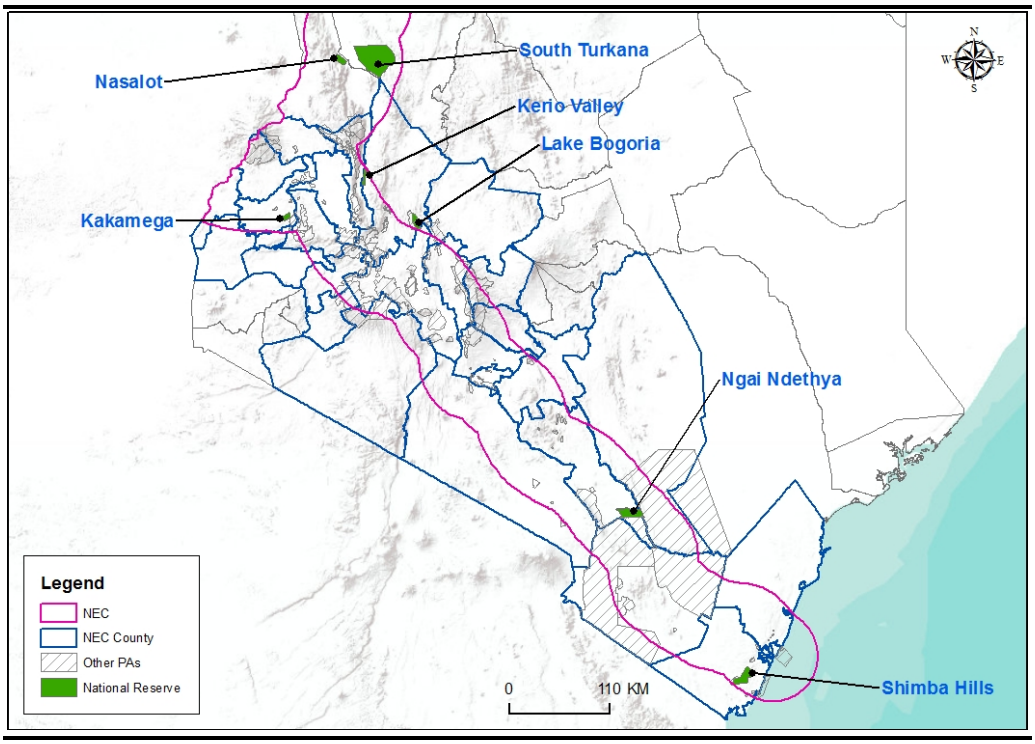
Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
Ngai Ndethya Game Reserve	VI	1976	Kitui, Makueni	This PA, which is 227 km² in size and part of TCA, features savannah grasslands ecosystems. Less than 19 large mammals have documented in this PA, and between 100 and 200 bird species[1].	9	10	20	36
Lake Bogoria	II	1970	Baringo	Lake Bogoria NR occupies 107 km² and features the highly alkaline lake. Its ecosystem supports a diverse range of species including several which are at risk. It also supports at least 373 bird species, of which 50 are migratory notably lesser flamingos, and is thus designated as an IBA within the Kenyan Mountains EBA[2]. The PA is designated as Ramsar Site and WHS due to its importance to migratory birds and support for endangered species. It is also a KBA of the EAM.	10	14	15	40
Shimba Hills	II	1968	Kwale	Shimba Hills NR covers 300 km² and supports Sable Antelope, Elephant, Giraffe, Leopard, Genet, Civet Cat, Hyena, Waterbuck, Bush Pig, Buffalo, African Bush Baby, Bushbuck, Coastal Black and White Colobus, Blue Duiker, Bush Duiker, Red Duiker, Greater Galago, Black-faced Vervet Monkey, Sykes Monkey, Serval Cat, Black and Red Shrew, and Knob-bristled Suni Shrew amongst others. It is an	12	17	14	37

[1] Moses M.O, Bobby E.W. and Avignon M.M., (2001). Importance of Conservation Areas in Kenya Based on Diverse Tourist Attractions. The Journal of Tourism Studies Vol. 12, No. 1, May '01 39.
[2] WWF EARPO, (2007). Lake Bogoria National Reserve World Ramsar Site No. 1057 Integrated Management Plan 2007-2012.

Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
				IBA, within the East Africa Coastal Forests EBA, that supports at least 111 bird species of which 22 are endemic[1]. This PA is dually gazetted as a NR and FR. It provides the last known refuge for *Hyperolius rubrovermiculatus* (EN) and is therefore an AZE. Shimba Hills is also a gazetted water tower which is a source for the several of the main rivers in Kwale and the southern regions of Mombasa County. Shimba Hills is part of the Eastern Arc Coastal Forests which are in the Tentative Lists of the WHS Programme.				
Kakamega	II	1985	Kakamega	This PA's surface area is 44.7 km² in which over 380 species of trees, 330 bird species, 27 species of snakes, 7 primates, over 400 species of butterflies and several mammals have been documented[2]. Kakamega forest is as an IBA in addition to being under consideration for a WHS designation.	9	14	20	46
Kerio Valley	VI	1983	Baringo	This NR occupies 66 km² in which common species include Crocodile (along Kerio River), Elephant and several birds[3].	9	14	20	34

[1] KWS, (2016). Shimba Hills National Reserve. Retrieved March 16, 2016 from http://www.kws.go.ke/content/shimba-hills-national-reserve
[2] KWS (2016). Kakamega Forest Reserve. Retreived March 16, 2016 from http://www.kws.go.ke/content/kakamega-forest-reserve
[3] KVDA, (2015). Wildlife Resource. Retrieved March 16, 2016 from http://www.kvda.go.ke/Wildlife.html

Figure 5.47 National Reserves in the NEC



Marine Protected Areas (MPAs)

MPAs in the NEC include Mombasa Marine National Park (MNP), its adjacent Mombasa Marine National Reserve (MNR) and Diani MNR. The details of these MPAs are provided in *Table 5.16* as well as *Figure 5.48*.

Table 5.16 MPAs in the NEC

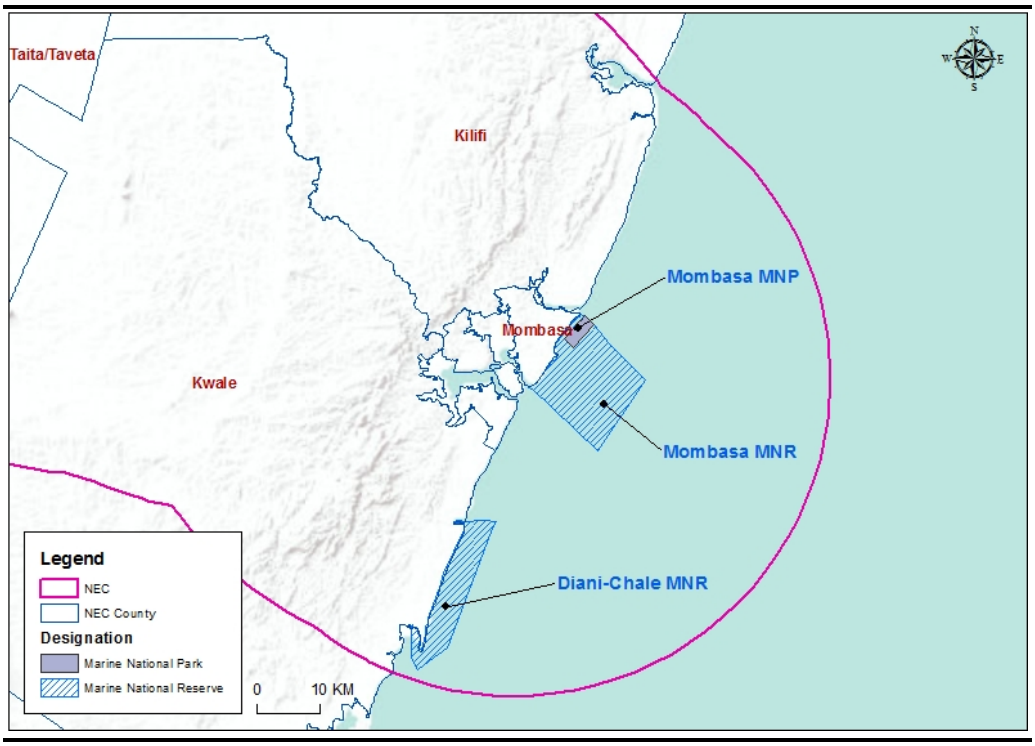
Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
Mombasa MNP	II	1986	Mombasa	This MNP occupies an area of approx. 10 km², located off the coast of Mombasa County. It features sea grasses and marine algae in terms of vegetation. Marine life includes crabs, corals, sea urchins, jellyfish, sea stars, sea cucumbers and different varieties of coral species comprising of Acropora, Turbinaria and Porites. Seabirds are also present in large nesting colonies and internationally significant number of crab plover and roseate tern[1].	9	9	46	85
Mombasa MNR	VI	1986	Mombasa	This reserve surrounds Mombasa MNP and stretches over an area of about 194 km². It shares similar characteristic vegetation, marine life and birds as Mombasa MNP described above.	3	4	44	66
Diani-Chale MNR	VI	1995	Kwale	Diani-Chale MNR covers approx. 107 km² off the coast Kwale County. It was designated as a MNR to protect its coral reef, coral gardens and fish species[2]. The diversity of the fish species comprises at least 350 species[3].	13	11	56	105

[1] KWS, (2016). Mombasa Marine National Park and Reserve. Retrieved March 16, 2016 from http://www.kws.go.ke/content/mombasa-marine-national-park-reserve

[2] Kenya County Guide, (2015). Diani/Chale Marine National Park and Reserve. Retrieved March 16, 2016 from http://kenyacountyguide.com/home/dianichale-marine-national-park-and-reserve/

[3] Muthiga N.A., Kawaka J., (2010). Progress Towards Conservation Science for Marine Protected Areas in Kenya: An Annotated Bibliography. WIOMSA Book Series No. 4, v + 171.

Figure 5.48 MPAs in the NEC



Wildlife Sanctuaries

Three wildlife sanctuaries are identified in the NEC. These are described in *Table 5.17* below.

Table 5.17 Wildlife Sanctuaries in the NEC

Name	IUCN Category	Year	County	Characteristics	Red List Species			
					CR	EN	NT	VU
Taita Hills Wildlife Sanctuary	Not Reported	1973	Taita Taveta	This sanctuary occupies 28,000 acres in the Taita Taveta County and was established in 1973. It provides a habitat for over 50 species of mammals and 300 species of birds. Notable species in the sanctuary include, Cape Buffalo, African Bush Elephant, African Leopard, Masai Lion, Tanzanian Cheetah, Masai Giraffe, Zebra, Hartebeest, Impala, Waterbuck, Thomson's Gazelle, Lesser Kudu and Dik-Dik. The greater ecosystem of Taita Hills is designated as an AZE since it supports the CR Taita Apalis.	10	13	14	32
Ngulia Rhino Sanctuary	Not Reported	1986	Taita Taveta	Ngulia Rhino Sanctuary occupies approx. 91 km^2 within Tsavo West NP and was established 1986 with a purpose of breeding the Black Rhino to restock its population in the wild and in other sanctuaries[1].	1	0	0	0
Mwaluganje Elephant Sanctuary	Not Reported	1995	Kwale	Mwaluganje Elephant Sanctuary is located north of Shimba Hills NR and measures 18 km^2 in area and was established in 1995 to create a corridor for elephants moving between Shimba Hills National Reserve and Mwaluganje FR during the mating season. It is primarily a community conservation area for elephants.	9	9	14	37

[1] AWF, (n.d). Descriptions & Plan. Black rhinos in danger of extinction. Retrieved March 16, 2016 from http://www.awf.org/projects/ngulia-rhino-sanctuary

Forest Reserves (FRs)

There are 138 FRs intersected by the NEC. *Table 5.18* and *Figure 5.49* identify them according to the regions or wider ecosystems in which they belong. They are important ecosystems which are protected by national regulations and some these FRs have globally recognized designations. The forests within their boundaries provide important ecosystem goods and services including, carbon sequestration, flood mitigation, soil erosion prevention, provision of goods (food, wood fuel, water - some of the FRs are water towers (see *Section 5.3.4*)), provision of habitat for wild fauna and avifauna and climate modulation.

Table 5.18 Forest Reserves in the NEC

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
Coastal Zone (East African Coastal Forests)	Shimba Hills, Mkongani North, Mkongani West, Gogoni, Buda and Mwachi and Mwaluganje.	Kwale	These FRs are part of the Eastern Africa Coastal Forests. Shimba Hills, Mkongani North, Mkongani West and Mwaluganje are part of the Shimba Hills water tower. The wider ecosystem of the coastal forests is part of the habitat of: *Diceros bicornis* (Black Rhino) (CR), *Loxodonta africana* (Savanna Elephant) (EN), *Lycaon pictus* (Wild dog) (EN) and *Hyperolius rubrovermiculatus* (EN)[1]. The Shimba Hills forests, including Mkongani forests, have a heterogeneous mosaic of vegetation, including grassland, scrub and exotic plantations as well as forest. Six major forest types have been documented, including tall *Milicia* forest on the deep soils on the plateau top (in Longomagandi and Makadara forests, and near Kwale town), and on the western escarpment;	12	14	14	37

[1] TFCG, (2006). Coastal Forests of Kenya and Tanzania. Retrieved March 10, 2016 from http://coastalforests.tfcg.org/index.html

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			Afzelia–Erythrophloeum forest, covering much of the eastern and southern escarpment; *Paramacrolobium* forest on particularly steep scarp slopes to both east and west; and *Manilkara–Combretum* forest in the lower, western sector of the plateau[1].				
Eastern Region	Kilungu, Momandu, Ikilisa, Kalimani, Kilala, Kiongwani, Kioo, Kithendu, Kitoo Kitumbuuni, Kiu (Ngungu), Kyai, Makongo-machakos, Mutula, Ndatai, Nduluni-kalani, Tulimani, Utangwa, Utunene, Waiya, Mbooni North, Mbooni South, Kenze, Katende, Kibwezi, Kitondu, Kyemundu, Makuli-nguuta, Nthangu, Nzaui, Kibwezi and Kasigau.	Taita Taveta, Makueni, and Machakos.	These FRs are located in arid regions of the NEC and contribute to provision water as part of local catchments. Despite their local importance and small size, they are at risk of deforestation mainly through unsustainable harvesting of forest products. Details on the flora and fauna species are limited on these FRs.	20	35	34	79
Nairobi Region	Kamiti, Kiambu, Karura, Ngong Road, Ololua, Ngong Hills, Dagoretti, Embakasi and Nairobi Arboretum.	Kajiado, Nairobi, and Kiambu.	These forests are located within the urbanscapes of Nairobi and Kiambu Counties. Two key services provided by these FRs include regulation of the urban climate and provision of	9	19	19	47

[1] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: Shimba Hills.Retrieved March 16, 2016 from www.birdlife.org

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			recreation space. They key characteristics are as follows: • **Karura FR:** Comprises of forest plantations (630 Ha) and indigenous trees (260 Ha). The forest plantations include species such as *Araucaria cunninghamii*, *Grevillea robusta*, *Eucalyptus saligna*, *E. globule*, *Cupressus torulosa* and *Cupressus lusitanica*. Indigenous trees include *Olea europeae subsp. auspidata*, *Croton megalocarpus*, *Warburgia ugandensis*, *Brachyleana huillensis*, *Uvaridendron anisatum*, *Markhamia lutea*, *Vepris nobilis*, *Juniperus procera* (Cedar), *Craebea brownii*, *Newtonia buchananii*, *Salvadora persica*, *Ficus thonningii*, *Trichilia emetica*, *Calondendrum capense* and *Dombeya goetzenii*. Shrubs such as *Strychnos henningsii* (Muteta), Erythrococca bongensis (Muharangware), Vangueria madagascariensis (Mubiro),				

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			Rhamnus prinoides (Mukarakinga), Caesalpinia volkensii (Mubuthi), Solanum incanum (Mutongu, Sodom Apple), Elaeodendron buchananii (Mutanga) and Rhus natalensis (Muthigio) are also found[1]. • **Ngong Road FR:** Occupies 1,224 Ha within which 600 Ha is the Ngong Road Forest Sanctuary. The sanctuary comprises of indigenous forest with at least 316 plant species[2]. Dominant trees include Eucalyptus, Pine, Cyprus, Croton and Cordia. • **Ololua FR:** This FR is located in the Karen suburb and covers 250 Ha with indigenous trees. Notable flora includes *Olea africana*, *Eleodendron*, *buchananii*,				

[1] Friends of Karura, (2016). Ecology: Climate & Soils, Plants & Animals. Retrieved March 16, 2016 from http://www.friendsofkarura.org/the-karura-forest-researve/ecology-climate-soils-plants-animals/

[2] Ngong Forest Sanctuary, (2016). Conservation. Retrieved March 16, 2016 from www.ngongforest.org

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			Akokanthera schimperi, *Brancylaena* species, *Croton*, *Megalocarpus*, *Carisa edual*, *Rhus natalensis*, Aloe and Acacia[1]. • **Nairobi Arboretum:** Extends over 30 Ha and holds over 350 tree species. It was established in 1907 to reduce pressure on indigenous tree species during the construction of the East Africa Railway and was later gazetted in 1937[2]. Nairobi Arboretum provides a habitat to over 100 species of resident and migrant birds. Notable mammals in the Arboretum are Vervet and Sykes monkeys.				
Kikuyu Escarpment and Aberdares Ecosystem	Nyamweru, Kingatua, Muguga, Aberdare, Kikuyu Escarpment, Magumo North, Magumo South, Kirima, Muruai, Kipipiri and Ol-bolossat.	Kiambu, Nyandarua, Murang'a, Laikipia and Nyeri.	These FRs are located within the Central Highlands along the Kikuyu Escarpment of the Eastern Rift Valley. The key characteristics of the main FRs in this region are provided below.	21	39	51	94

[1] CCN, (2007). City of Nairobi Environment Outlook.
[2] Nature Kenya, (n.d). Nairobi Arboretum. Retrieved March 16, 2016 from http://www.naturekenya.org/content/nairobi-arboretum

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			• **Aberdare FR:** This FR largely surrounds Aberadare NP and is adjacent to Kikuyu Escarpment FR (south) and Kipipiri FR (west). It measures approx. 947 km^2. Within the forest a total of 778 species, sub-species and varieties of vascular plants belonging to 421 genera and 128 families, have been documented. It has four key vegetative zones whose distribution determined by climatic conditions and altitude. These are: Sub alpine vegetation, Montane humid forest, Xeromorphic evergreen forest, and Sub-montane forest[1]. • **Kikuyu Escarpment FR:** This FR occupies an area of 413 km^2, south of Aberdare FR. The forest comprises of mixed montane forest with its major block having a closed canopy				

[1] KFS, (2010). Aberdare Forest Reserve Management Plan.

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			whilst other habitats in the FR include forest and agro-industrial plantations, and savanna bamboo montane vegetation[1]. • **Ol-bolossat FR:** It is located to the north east of Aberdare FR and covers an area of about 32 km². Its vegetation types rage amongst natural forest, plantations, glades and bushes.				
Mau Escarpment (Mau Forest Complex) and Cherangani Hills	Eldoret I and II, Kapchorua I, Nabkoi, Kapsaret, Kijabe Hill, West Molo, Molo, Bahati, Eburu, Mau Narok, Menengai, Nakuru, Ol-pusimoru, Southern Mau, Eastern Mau, Western Mau, Londiani, Northern Tinderet, Tingwa Hill, Tumeya, Kapchorua IV, Cheboit, Chemurokoi, Kapchemutwa, Kaptagat, Kessop, Kipkabus (Uasin/Gishu), Kipkabus (Elg-Marak), Kiptaberr, Sogotio, Transmara, South-western Mau, Chebartigon, Chepkuchumo,	Uasin Gishu, Nakuru, Kericho, Elgeyo Marakwet, Bomet, and Baringo.	These FRs or forest blocks form the Mau Forest Complex and Cherangani Hills forests. These forests provide a habitat threatened species in addition to being amongst the main water towers in the country. Their characteristics are given below: • **Mau Forest Complex:** These forests cover 4,047.21 km² comprising of the following forest blocks: Chemorogok, Eastern Mau, Eburu, Kilombe hill, Lembus,	24	44	60	103

[1] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: Kikuyu Escarpment Forest. Retrieved March 16, 2016 from www.birdlife.org.

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
	Kaptimom, Kinyo, Lembus, Mtarakwa, Sanao, Sekenwo, Tarambas Hill, Mukobe, Kabarak, Chemorogok, Kilombe Hill, Kimojoch, Maji Mazuri, Marmanet, Metkei, Mount Londiani, Perkerra Catchment, Timboroa and Tinderet.		Londiani, Maji Mazuri, Western Mau, Maasai Mau, Mau Narok, Molo, Northern Tinderet, Olposimoru, Olposimoru Excision, South West Mau, South Mau, Tinderet, Transmara, West Molo, West Mau, and Nabkoi. They are the source for rivers in the Lake Victoria and Mara basins[1]. This complex forms the largest closed canopy forest in the country[2]. Vegetation patterns range amongst broad altitudinal zonation, lower montane forest, thickets of bamboo *Arundinaria alpina* mixed with forest and grassland, and finally to montane sclerophyllous forest near the escarpment crest[3]. • **Cherangani Hills:** These hills comprise 12 protected (FR)				

[1] KWTA, (2014). Status of Water Towers Volume II.
[2] UNEP, (2008). Mau Complex and Marmanet forests, Environmental and economic contributions, Current state and trends.
[3] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: Mau Forest Complex. Retrieved March 16, 2016 from www.birdlife.org

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			forest blocks namely Kapolet, Cheboyit, Chemurkoi, Embobut, Kaisungor, Kerrer, Kipkunur, Kiptaberr, Sogotio, Toropket, Kapkanyar and Lelan. Jointly they cover 2,811 km² and are amongst the country's major water towers. The main vegetative cover in the ecosystem is closed canopy forest whilst other vegetation types and land cover types are distributed amongst bamboo, scrub, rock outcrops, grassland, moorland, cultivated areas and plantations of exotic species. The ecosystem contains an IBA within the Kenyan Mountains EBA, and is also part of the EAM[1,2].				
North Rift Valley and Western Regions	Kitale Township, Kitale, Kaptaroi, Ururu, North Nandi, South Nandi, Taressia, Buyanga, Kisere, Malaba, Bunyala, Lugari, Turbo, Kakamega, Mount Elgon	Trans-Nzoia, Nandi, Kakamega and Bungoma.	These FRs contain the rainforests in Western Kenya and North Rift Valley. The characteristics of the major FRs are as follows:	23	28	40	75

[1] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: Cherangani Hills. Retrieved March 16, 2016 from www.birdlife.org
[2] KFS, (2015). Cherangani Hills Forest Strategic Ecosystem Management Plan 2015 -2040.

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
	and Sekhendu.		• **Kakamega FR:** This FR covers an area of about 181 km² and is considered to be the easternmost outlier of the Guinea-Congolian forest and the only remaining tropical rainforest in Kenya[1]. Vegetation within the FR includes closed canopy indigenous forest, grassy and bushed glades (some natural, some maintained by fire or grazing), tea, cultivation and plantations of softwoods and commercially valuable hardwoods[2,3]. • **South and North Nandi FRs:** These FRs are located on the Nandi escarpment. Covering 199 km² and 112 km² respectively. They are transitional between the lowland forests of West and				

[1] Piritta P., (2004). Forest Types of Kenya. In: Pellikka, P., J. Ylhäisi & B. Clark (eds.) Taita Hills and Kenya, 2004 – seminar, reports and journal of a field excursion to Kenya.
Expedition reports of the Department of Geography, University of Helsinki 40, 8-13. Helsinki 2004, ISBN 952-10-2077-6, 148 pp.
[2] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: Kakamega Forest. Retrieved March 16, 2016 from www.birdlife.org
[3] KFS, (2012). Kakamega Forest Ecosystem Management Plan 2012-2022.

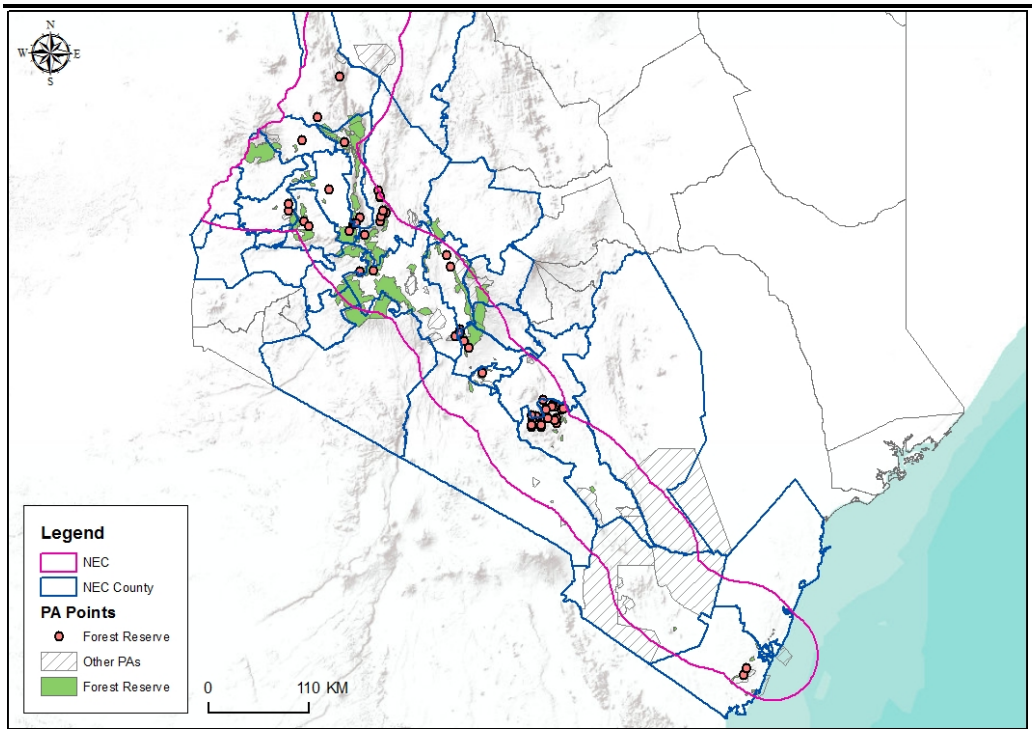
Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			Central Africa and the montane forests of the central Kenya highlands. Vegetation within these forests vary amongst tea plantations in settled areas, plantations of exotic trees, closed canopy forest (majority of their area and indigenous in North Nandi), scrub and grassland or cultivation[1,2]. • **Mt Elgon FR:** This FR covers about 607 km^2. The forest comprises of montane forest, wooded grassland, bamboo and alpine moorland on the eastern slopes of the mountain. Vegetation within the wider Mt Elgon ecosystem is determined by altitude. The wet montane forest is dominated by *Olea capensis* and *Aningeria adolfi-friedericii* grading into *Olea–Podocarpus falcatus* forest, a zone of mixed				

[1] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: South Nandi Forest. Retrieved March 16, 2016 from www.birdlife.org
[2] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: North Nandi Forest. Retrieved March 16, 2016 from www.birdlife.org

Region/Ecosystem	Forest Reserves	Counties	Characteristics	Red List Species			
				CR	EN	VU	NT
			Podocarpus and bamboo *Arundinaria alpina*, and the *Hagenia abyssinica* zone with giant heath *Erica arborea* and *E. trimera elgonensis*. Afro-alpine moorlands occupy the highest parts of the mountain, with tussock grasses. Open wooded grasslands cover part of the lower, drier north-eastern slopes. The remaining regions are forest and moorland and are part of the FR. In the north-eastern region is wooded grassland which is unprotected[1].			

[1] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: Mount Elgon (Kenya). Retrieved March 16, 2016 from www.birdlife.org

Figure 5.49 Forest Reserves in the NEC



Private Conservation Areas (PCAs) and Community Conservation Areas (CCAs)

PCAs and CCAs in the NEC are listed below and their locations are shown in *Figure 5.50.* This study notes there is limited information available from secondary sources on the sensitivities and other characteristics of these areas.

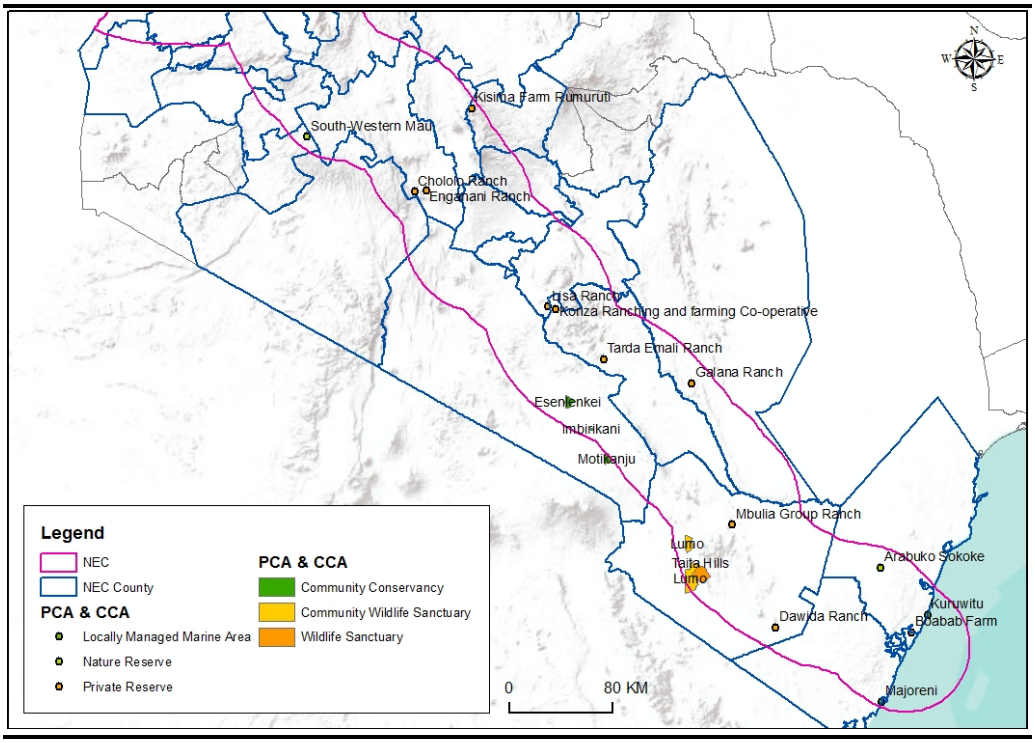
- Imbirikani Community Conservancy (Kajiado)
- Esenlenkei Community Conservancy (1983) (Kajiado)
- Motikanju Community Conservancy (2010) (Kajiado)
- Lumo Community Wildlife Sanctuary (2001) (Taita/Taveta)
- South-Western Mau Nature Reserve (1961) (Bomet)
- Boabab Farm Private Reserve (Kilifi)
- Lisa Ranch Private Reserve (Machakos)
- Konza Ranching and farming Co-operative Private Reserve (Makueni)
- Chololo Ranch Private Reserve (Nakuru)
- Enganani Ranch Private Reserve (Nakuru)
- Galana Ranch Private Reserve (Kitui)
- Mbulia Group Ranch Private Reserve (1993) (Taita Taveta)
- Kisima Farm Rumuruti Private Reserve (Nyeri)
- Dawida Ranch Private Reserve (1987) (Taita Taveta)

- Tarda Emali Ranch Private Reserve (Makueni)

There are two Locally Manage Marine Areas (LMMA) in the NEC. They are:

- Kuruwitu (2003) (Kilifi)
- Majoreni (2011) (Kwale)

Figure 5.50 PCAs and CCAs in the NEC



Wetlands

Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres[1]. They include riparian areas adjacent to the wetlands as shown by *Figure 5.51* which gives a representation of wetland vegetation types across a gradient of decreasing wetness.

Kenya has six classes of wetlands including, marine, estuarine, lacustrine, palustrine, riverine and human made wetlands. These

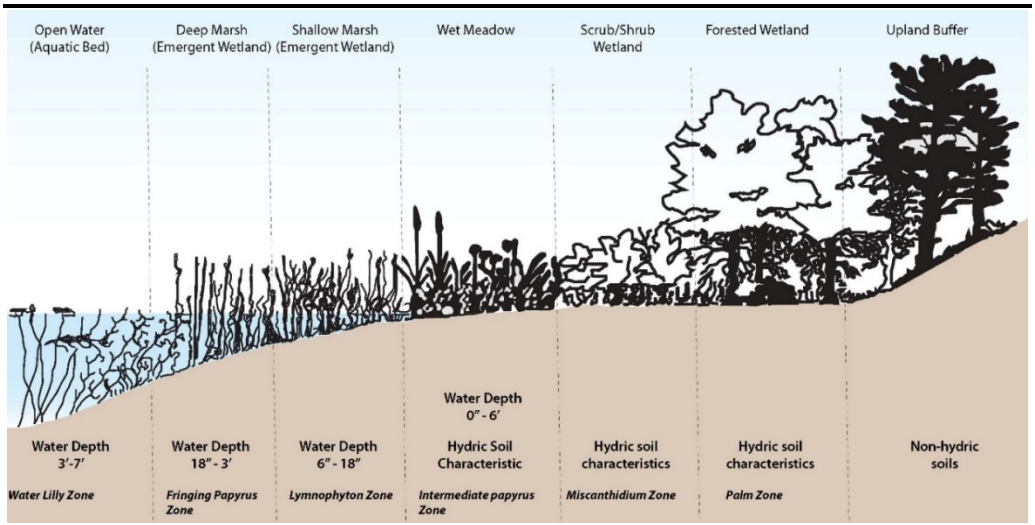
[1] Ramsar Convention Secretariat (2013). The Ramsar Convention Manual: a guide to the Convention on Wetlands (Ramsar, Iran, 1971), 6th ed. Ramsar Convention Secretariat, Gland, Switzerland.

wetlands occupy approx. 14,000 km2 of the country's land area and each of the classes of wetlands exist within the NEC.

Figure 5.52 shows those mapped within the NEC. Of these wetlands, Lakes Nakuru, Elementaita and Naivasha are considered to be wetlands of the international importance ("Ramsar Sites") under the Ramsar Convention. Ramsar sites are discussed in the next subsection.

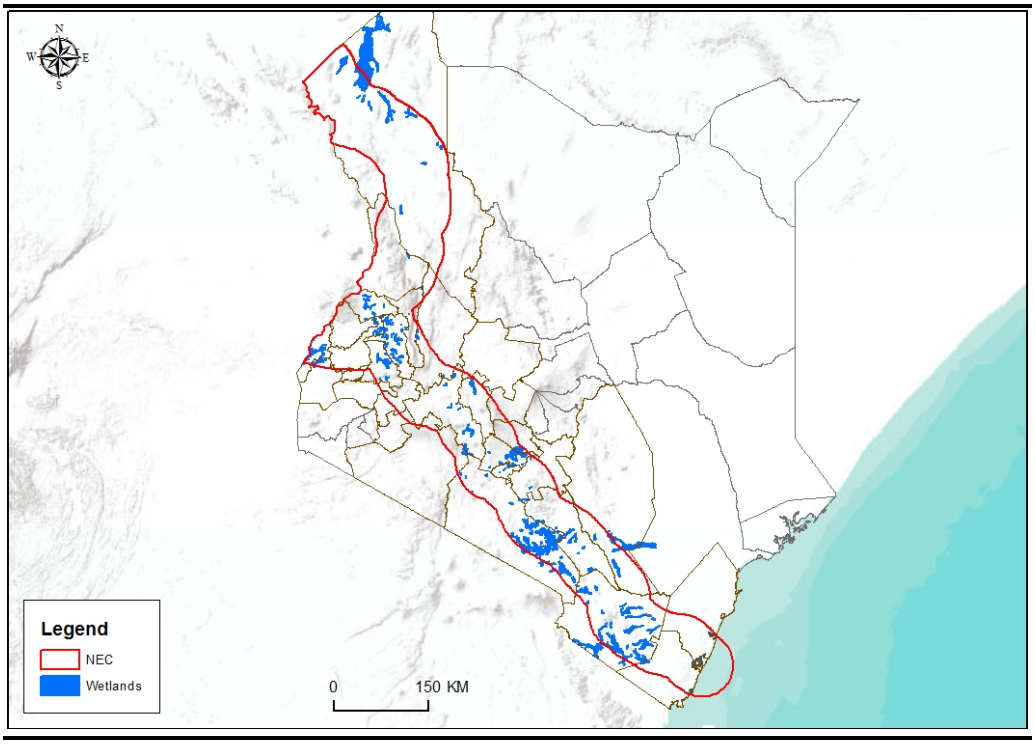
Table 5.19 identifies and describes major wetlands traversed by the NEC. The basin and sub-basin in which they are located, key land/wetland uses, pressures and impacts are identified in this table.

Figure 5.51 Wetland Vegetation in Relation to Wetness Gradient



Source: NEWP (2012) as cited in MEMR (2012)[1].

Figure 5.52 Wetlands in the NEC



[1] MEMR, (2012). Kenya Wetlands Atlas.

Table 5.19 Characteristics of Wetlands in the NEC

Basin/Sub-Basin	Major Wetlands	Land/Wetland Uses	Pressures	Impacts
L Victoria North	R Yala R Nzoia Sio-Siteko	• Fishing • Large-scale farming • Mining • Harvesting papyrus reeds • Brick making • Forestry • Conservation (Kakamega Forest) • Tourism and recreation • Irrigation • Power production • Artisanal products	• Inappropriate land use and overutilization • Conversion of wetlands to agricultural land • Unsustainable exploitation of resources • Land subdivision and fragmentation	• Pollution • Land cover loss • Invasive species • Reduced water quantity and quality • Biodiversity loss • Flooding • Reduced fisheries
L Victoria South	R Nyando	• Fishing • Large-scale farming • Mining • Harvesting papyrus reeds • Brick making • Pastoralism • Forestry • Conservation (Ruma, • Ndere island) • Energy • Water supply • Recreation • Artisanal products		

Basin/Sub-Basin	Major Wetlands	Land/Wetland Uses	Pressures	Impacts
Rift Valley	L Nakuru L Naivasha	• Conservation • Mining • Fishing • Forestry • Pastoralism • Energy - geo and hydro power • Ranching • Tourism and recreation • Irrigation	• Urbanization • Inappropriate land use • Conversion of land for • agriculture • Unsustainable exploitation of resources • Increased demand for resources • Land subdivision and fragmentation	• Pollution • Soil erosion/siltation • Loss of land/forest • cover • Overgrazing • Reduced quantity and • quality of water
Ewaso Ng'iro North	L Ol-Bolossat R Amala	• Large-scale commercial farms • Pastoralism • Ranching • Wildlife conservancies • Oil and gas exploration • Forestry • Grazing • Water supply • Fish farming • Tourism	• Inappropriate land use • Overutilization of water • Conversion of land to agriculture • Overstocking of livestock • Settlements • Loss of	• Pollution • Soil erosion / siltation • Overgrazing • Reduced water volume

Basin/Sub-Basin	Major Wetlands	Land/Wetland Uses	Pressures	Impacts
			catchment forests • Increased demand for resources • Reduced water levels • Land subdivision and fragmentation	
Tana	-	• Large-scale farming • Conservation • Irrigation • Pastoralism • Mining-sand • Fishing • Quarrying • Forestry • Hydropower generation • Recreation • Water supply	• Inappropriate land use • Overutilization of water • Conversion of land to • agriculture • Overstocking of livestock • Conversion of land to settlements • Loss of catchment forests • Increased	• Pollution • Soil erosion/siltation • Overgrazing • Reduced water volume • Loss of critical habitats and species • Reduced hydrological capacity

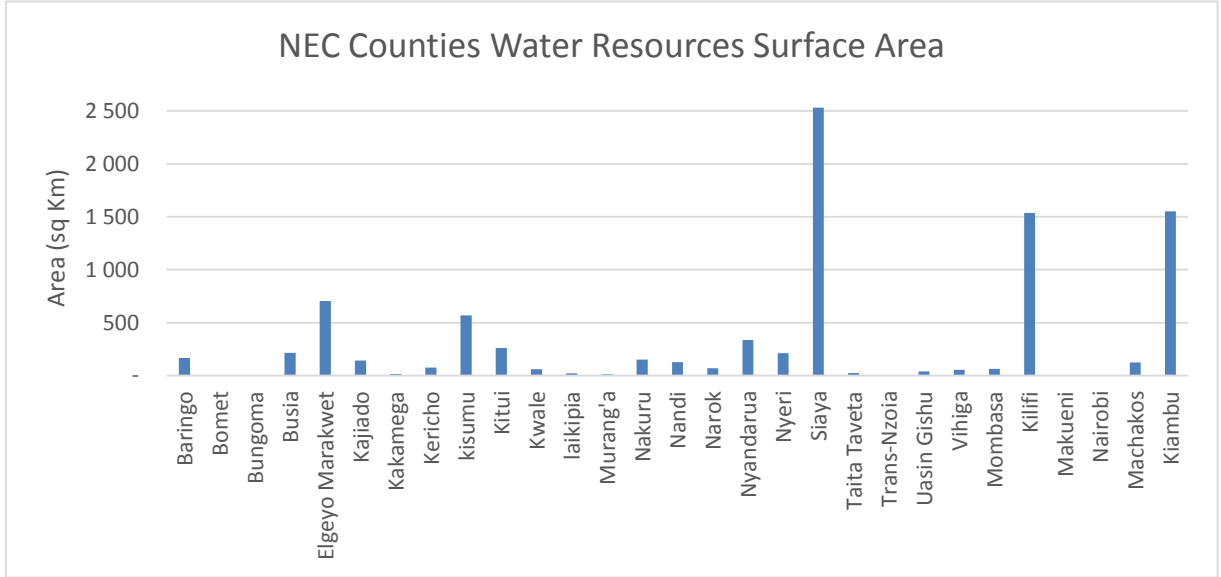
Basin/Sub-Basin	Major Wetlands	Land/Wetland Uses	Pressures	Impacts
			demand for resources • Reduced water levels • Land subdivision and fragmentation	
Athi	R Athi R Nairobi R Ramisi	• Wildlife conservation area (Nairobi National Park, Tsavo Conservation Area, Shimba Hills) • Industrial use • Farming (subsistence and commercial) • Pastoralism • Livestock ranching • Mining (sand, limestone) • Fishing • Forestry • Energy - wind and thermal water supply • Nature conservation and recreation • Irrigation • Salt harvesting • Dry season grazing • Cultural and spiritual use • Watering points for livestock	• Over-exploitation of surface and groundwater resources. • Wetlands resources degradation • Unregulated diversions of river channels • Catchment degradation due to overgrazing and sand harvesting. • Land use changes for settlement and	• Acute water scarcity due to high water demand • Limited ground water recharge • Changing river regime • Pollution of water resources from industrial effluents, and agricultural and domestic waste

Basin/Sub-Basin	Major Wetlands	Land/Wetland Uses	Pressures	Impacts
		• Wastewater treatment • Fishing	agriculture • Climate change and variability	

Figure 5.53 compares the areas occupied by water bodies in the NEC Counties. Siaya County has the largest area occupied by water bodies and Nairobi the least. However, given as a percentage of the total area of the county, Bungoma County has the lowest percentage whilst Siaya still has the highest.

In addition to being protected against degradation and pollution by national regulations, wetlands play important social, economic and environmental roles through the ecosystems services they provide. They are unique ecosystems which provide all four classes of ecosystems services namely, provisioning, regulating, supporting and cultural services. Despite this, wetlands face threats of degradation from anthropogenic factors including climate change. This study therefore considers wetlands to be constraint features in the NEC since additional pressure from infrastructure development can potentially lead to degradation.

Figure 5.53 Distribution of Water Surface Areas in the NEC Counties



Ramsar Sites

Kenya has six wetlands declared Ramsar Sites (wetlands of international importance) under the Ramsar Convention. Four of these sites namely Lakes Bogoria, Nakuru, Naivasha and Elementaita are intersected by the NEC. These lakes are part of the Great Rift Lakes in Kenya. The details behind their Ramsar designation are below (the year of designation is elucidated in parenthesis):

- **Lake Bogoria (2001):** The Lake provides critical refuge for the *Phoenicopterus minor* (Lesser Flamingo), with a population of 1 to 1.5 million. It supports over 300 waterbird species whilst the shoreline fringe of the lake and associated acacia woodland provide critical habitat for the endangered *Tragelaphus strepsciseros* (Greater Kudu) and other mammals[1]. Lake Bogoria is also a NR.

- **Lake Nakuru (1990):** The ecosystems within the site support globally endangered mammal species such as the black rhino and hippo in addition to regionally endangered bird species like the African darter, Great egret, the range-restricted Grey-crested Helmet-shrike, the Lesser kestrel and the Madagascar pond heron. L Nakuru supports over 450 avian species and about 70 waterbird species, including 1 million flamingos. Archaeological caves used by early man are also found in the area[2]. L Nakuru is also a NP.

- **Lake Naivasha (1995):** This site provides a habitat for globally threatened species including *Prionops poliolophus* (Grey-crested Helmet-shrike), *Acrocephalus griseldis* (Basra Reed Warbler). Regionally threatened species supported by L Naivasha include the Great Crested Grebe, Maccoa Duck, African Darter, Great Egret, Saddle-billed Stork, White-backed Duck, Baillon's Crake and African Skimmer. Populations of Hippopotamus are also found within the lake. The lake supports a diverse waterbird community, with more than 80 waterfowl species and over 400 total avian species[3]. L Naivasha is a county managed PA.

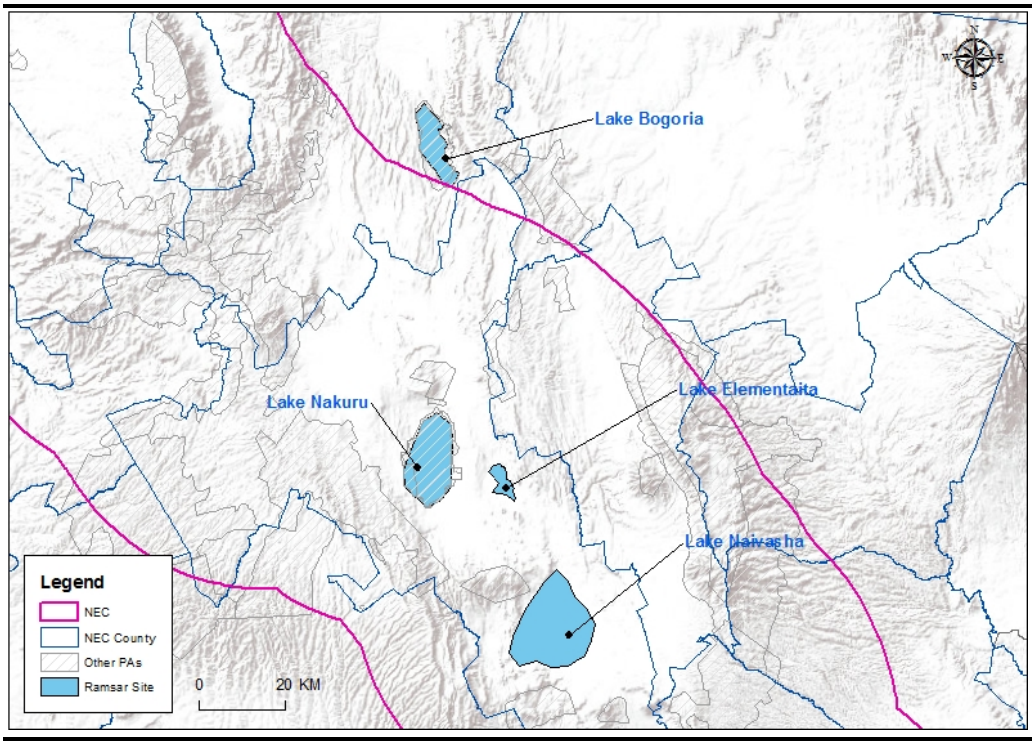
- **Lake Elementaita (2005):** This Lake supports several species falling into different conservation categories as threatened, vulnerable and

[1] Ramsar, (2001). Information Sheet on Ramsar Wetlands (RIS) - Lake Bogoria. Ramsar Site Information Service.
[2] Ramsar, (2005). Information Sheet on Ramsar Wetlands (RIS) - Lake Nakuru. Ramsar Site Information Service.
[3] Ramsar, (2005). Information Sheet on Ramsar Wetlands (RIS) – Lake Naivasha. Ramsar Site Information Service.

endangered at local, national, regional and international levels. These include the Lesser and Greater Flamingo. Other threatened species are Great Crested Grebe, Great White Pelican, Great Egret and Maccoa Duck. L Elementaita supports over 450 bird species that include approximately 80 waterfowl species. It is considered to support 1% of East Africa's flamingo population estimated at 1.5 million[1]. L Elementaita is a county management PA.

Figure 5.54 shows the location of these sites in relation to the NEC.

Figure 5.54 Ramsar Sites in the NEC



World Heritage Sites (WHSs)

Under the Convention concerning the Protection of the World Cultural and Natural Heritage (1972), several sites are designated to be World Heritage Sites (WHS). These sites are considered to be of outstanding value to humanity. Kenya has 6 WHS of which the 3 explained below with their inscription year in parenthesis are intersected by the NEC:

- **Fort Jesus (2011):** This site was designated due to its cultural and historical value. The Fort was built by the Portuguese in 1593-1596 to the designs of Giovanni Battista Cairati to protect the port of

[1] Ramsar, (2005). Information Sheet on Ramsar Wetlands (RIS) – Lake Elementaita. Ramsar Sites Information Service.

Mombasa. It is one of the well preserved examples of 16th Portuguese military fortification and a historical landmark in its type of construction. The property covers an area of 2.36 hectares and includes the fort's moat and immediate surroundings. It represents an exchange of cultural values amongst people of African, Arab, Turkish, Persian and European origin. In addition, The Fort exemplifies a new type of fortification that resulted from the innovations in military and weapons technology that occurred between the 15th and 16th centuries[1].

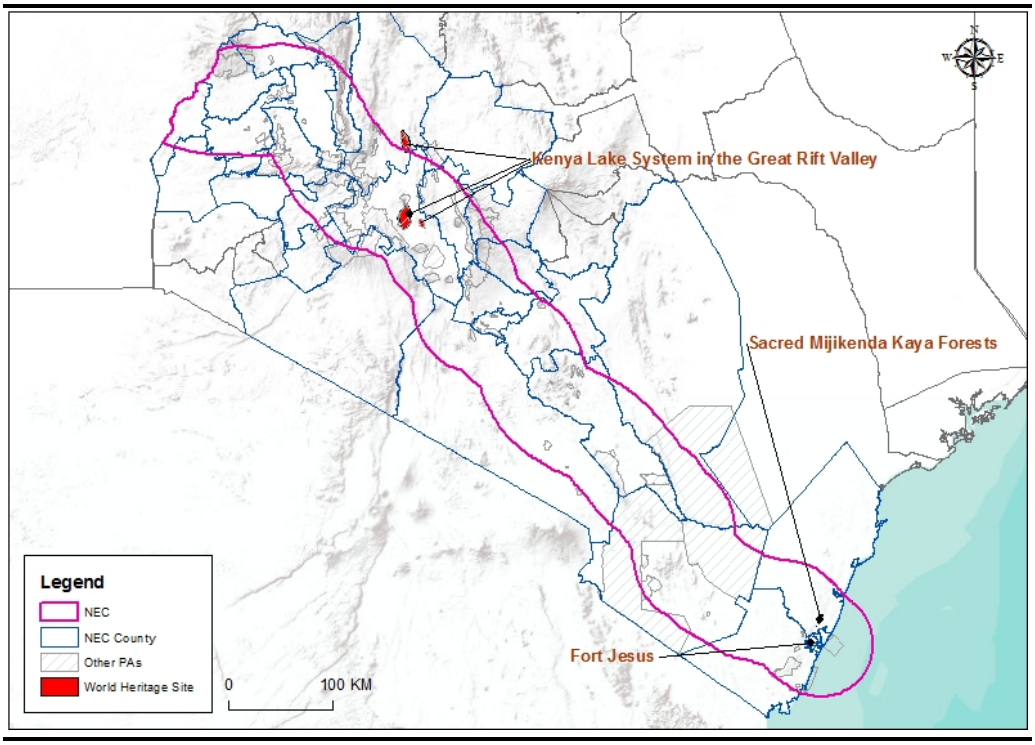
- **Kenya Lake System in the Great Rift Valley (2011):** Comprises of the three inter-linked relatively shallow lakes, L Nakuru, L Bogoria and L Elementaita. The lakes were added to the list because they present an appealing range of geological and biological processes in the landscape of the Great Rift Valley. The lakes create a habitat of up to 4 million Lesser Flamingos which migrate amongst them. They provide the main nesting and breeding grounds for Great White Pelicans whereas their terrestrial zones contain important populations of many mammal and bird species that are globally or regionally threatened. They are support to over 100 species of migratory birds and support globally important populations of Black-Necked Grebe, African Spoonbill, Pied Avocet, Little Grebe, Yellow Billed Stork, Black Winged Stilt, Grey-Headed Gull and Gull Billed Tern. The property makes a critical contribution to the conservation of the natural values within the Great Rift Valley, as an integral part of the most important route of the African-Eurasian Flyway System[2]

- **Sacred Mijikenda Kaya Forests (2008):** Consist of 11 separate forests spread over 200 km along the coast. 4 of these forests intersect the NEC, namely Kayas Chonyi, Ribe, Jibana and Kambe in Kwale. Kayas are remains of fortified villages of the Mijikenda people. They are revered as the repositories of spiritual beliefs of the Mijikenda people and are seen as the sacred abode of their ancestors. The kayas are designated as a WHS since they have metonymic significance to Mijikenda and are a fundamental source of Mijikenda's sense of being. Since they have been transferred from the domestic to spiritual sphere, the biodiversity in the Kayas has

[1] UNESCO, (2011). Cultural Properties - Fort Jesus, Mombasa (Kenya). UNESCO World Heritage Committee Decision: 35 COM 8B.19.
[2] UNESCO, (2011). Natural Properties - Kenya Lake System in the Great Rift Valley (Kenya). UNESCO World Heritage Committee Decision: 35 COM 8B.6.

been sustained due to restrictions on access and use of their natural forest resources. The Kayas are associated with beliefs of local and national significance, however they are under threat due to decline in traditional knowledge and practices[1].

Figure 5.55 WHSs in the NEC



UNESCO Man and the Biosphere Reserves

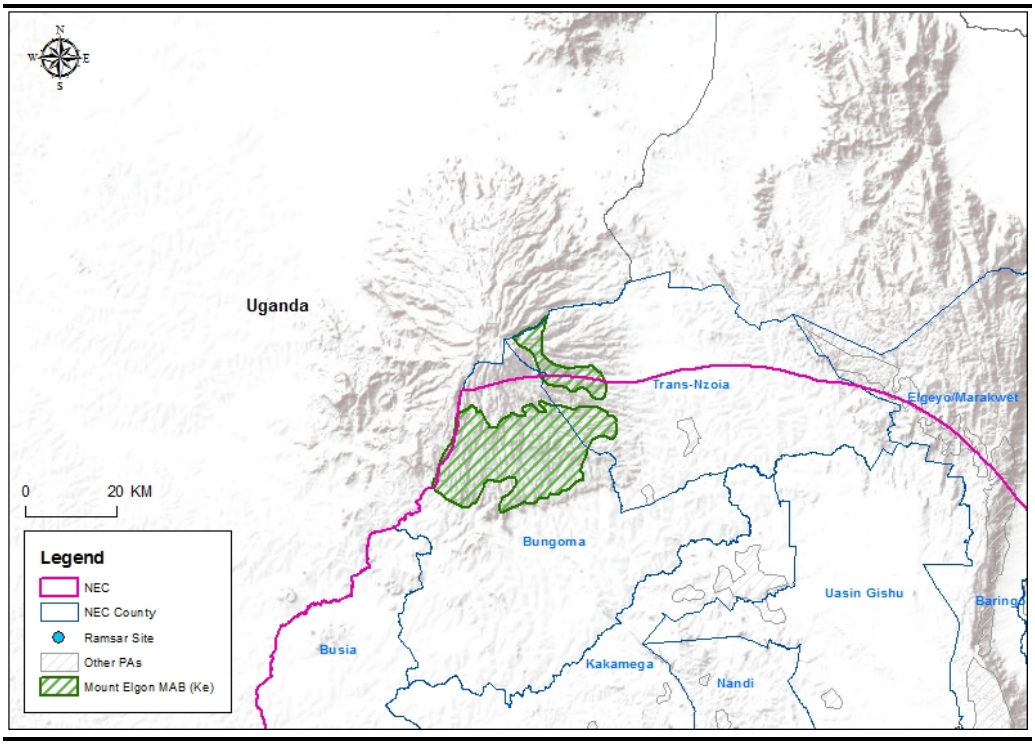
UNESCO Man and the Biosphere Reserves (MAB) are areas comprising either terrestrial, marine and coastal ecosystems designated to promote solutions reconciling the conservation of biodiversity with its sustainable use. They are special places for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity.

Mt Elgon, which was designated as a MAB in 2003 due to its importance as a water tower, is the only MAB in the NEC. It is a volcanic massif and water tower with high plant diversity. Mt Elgon has cultural significance to over 100,000 people, who live in its neighbourhood, depending on subsistence and commercial cropping,

[1] UNESCO, (2009). Examination of Nominations and Minor Modifications to The Boundaries of Naturel, Mixed and Cultural Properties to The World Heritage List - Sacred Mijikenda Kaya Forests (Kenya). UNESCO World Heritage Committee Decision: 32 COM 8B.50.

pastoralism, and ecotourism. The biosphere reverse covers about 208,821 Ha, comprising Mt Elgon National Park (16,916 ha) which forms the core area; the Mt Elgon Forest Reserve and Chepkitale NR, together forming a buffer zone of 90,905 Ha; and a 10 km strip of intensively used land in the foothills of the mountain range, covering approx. 101,00 Ha [1]. Mt Elgon's ecosystem intersects both Kenya and Uganda and it is thus a transboundary biosphere reserve. *Figure 5.56* displays the Kenyan section of the Mt Elgon MAB Reserve.

Figure 5.56 Kenyan Section of the Mt Elgon MAB Reserve



Important and Endemic Bird Areas

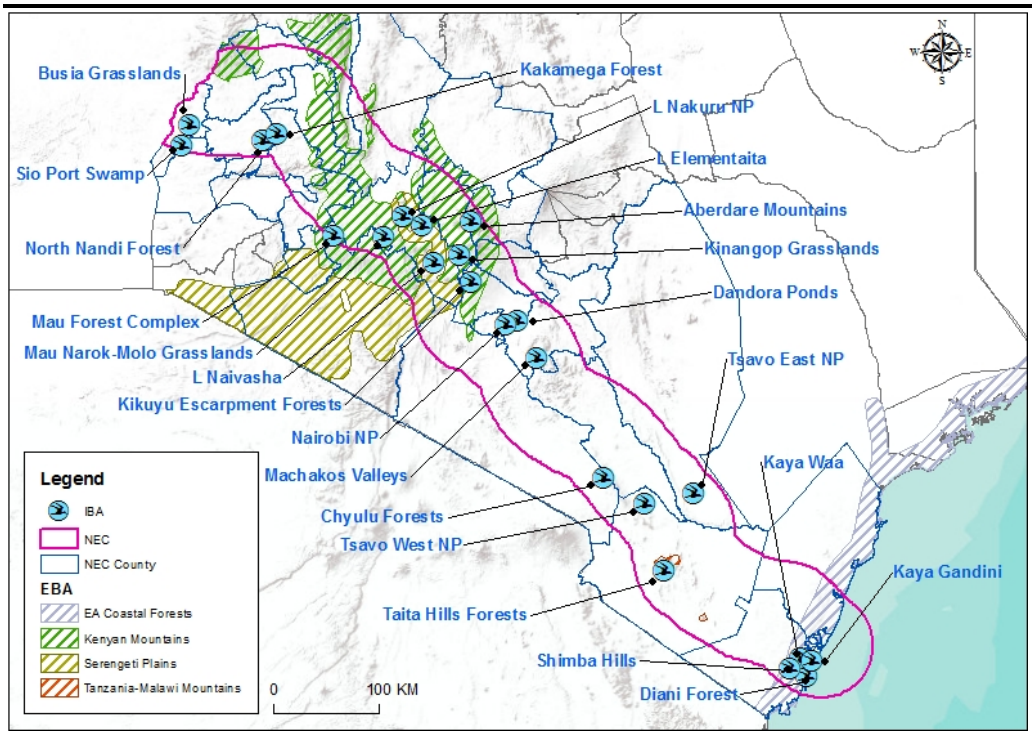
An Important Bird Area (IBA) is designated by BirdLife International as a site that is known or thought regularly to hold significant numbers of a globally threatened species, or other species of global conservation concern. The designation applies where the species are either CR, EN or VU according to IUCN Red List assessment method. VU species apply when threshold numbers are existent at the site. IBAs are usually small and often located in PAs or EBAs. LC, DD and NR species can also trigger an IBA classification if they are biome-restricted species (Criteria

[1] UNESCO, (2004). Biosphere Reserve Information. Kenya. Mt Elgon. UNESCO MAB Biosphere Reserves Directory. The MAB Programme.

A3) or if they form threshold congregations (Criteria A4) [1]. Kenya has 66 IBAs and 26 of them are located in the NEC.

An Endemic Bird Area (EBA) is a site where two or more species of restricted range (with world distributions of less than 50,000 km^2), occur together. This is because more than 70% of such species are globally threatened . Kenya has eight groups of EBAs from which five namely, Kenyan Mountains, Serengeti Plains, Kakamega and Nandi Forests, East Africa Coastal Forests and Tanzania-Malawi Mountains, intersect the NEC. These EBAs are distributed over 32 specific regions of which 15 intersect the NEC. *Figure 5.57* shows the spatial distribution of the IBAs and EBAs traversed by the corridor, while *Table 5.20* clarifies the number of trigger (threatened) species in each of the intersected IBAs and EBAs within the NEC Counties.

Figure 5.57 IBAs and EBAs in the NEC



[1] BirdLife International, (2016). Global IBA Criteria. Retrieved March 11, 2016 from www.birdlife.org

Table 5.20 Trigger Species in the Intersected IBAs and EBAs

Name	County	Trigger Species								
		CR	EN	VU	NT	LC	NR	DD	IBAs	A4[1]
IBAs										
Aberdare Mountains	Nyeri	0	2	1	1	39	10	0	N/A	0
Busia grasslands	Busia	0	0	1	1	5	0	0	N/A	0
Chyulu Hills forests	Kajiado	0	0	1	0	0	0	0	N/A	0
Dandora ponds	Nairobi	0	0	0	0	1	0	0	N/A	0
Diani forest	Kwale	0	1	0	3	0	0	0	N/A	0
Hell's Gate NP	Nakuru	0	1	0	1	0	0	0	N/A	0
Kakamega forest	Kakamega	0	1	1	0	35	4	0	N/A	0
Kaya Gandini	Kwale	0	2	0	2	0	0	0	N/A	0
Kaya Waa	Kwale	0	1	0	1	0	0	0	N/A	0
Kikuyu Escarpment forest	Kiambu	0	0	1	0	30	9	0	N/A	0
Kinangop grasslands	Nyandarua	0	2	0	2	1	0	0	N/A	0
Lake Ol' Bolossat	Nyandarua	0	1	0	1	0	0	0	N/A	0
Lake Elmenteita	Nakuru	0	0	0	3	6	0	0	N/A	1
Lake Naivasha	Nakuru	0	1	0	1	3	0	0	N/A	1
Lake Nakuru NP	Nakuru	0	1	0	2	8	2	0	N/A	1
Machakos valleys	Machakos	0	0	1	0	0	0	0	N/A	0
Mau forest complex	Bomet	0	0	0	1	39	10	0	N/A	0
Mau Narok - Molo grasslands	Narok	0	2	0	2	2	0	0	N/A	0
Mt Elgon	Bungoma	0	1	0	0	46	10	0	N/A	0
Nairobi National Park	Nairobi	0	1	0	1	2	0	0	N/A	0
North Nandi forest	Nandi	0	0	1	0	21	2	0	N/A	0

[1] These are congregations of birds under Global IBA Criteria A4.

Name	County	Trigger Species								
		CR	EN	VU	NT	LC	NR	DD	IBAs	A4[1]
Shimba Hills	Kwale	0	2	0	4	12	0	0	N/A	0
South Nandi Forest	Nandi	0	1	0	0	25	3	0	N/A	0
Taita Hills forests	Taita/Taveta	2	0	2	1	0	0	0	N/A	0
Tsavo East National Park	Kitui	0	1	0	0	60	1	1	N/A	0
Tsavo West National Park	Taita/Taveta	0	1	0	0	56	1	1	N/A	0
EBAs										
Kenyan Mountains	Kajiado, Nairobi, Nakuru	0	2	2	1	3	1	0	20	N/A
Serengeti Plains	Bomet, Narok, Nakuru, Kiambu, Kericho, Kajiado and Nyandarua	0	0	1	2	3	0	0	6	N/A
Kakamega and Nandi Forests	Kakamega and Nandi	0	0	1	0	0	0	0	2	N/A
East Africa Coastal Forests	Kwale, Kilifi and Mombasa	0	4	1	1	0	0	1	7	N/A
Tanzania-Malawi Mountains	Taita Taveta	4	7	7	4	10	5	0	1	N/A

Alliance for Zero Extinction Sites

The Alliance for Zero Extinction (AZE) is a joint initiative of conservation organizations around the world. It was formed with a purpose of preventing extinctions by identifying and safeguarding key sites, each one of which is the last remaining refuge of one or more Endangered or Critically Endangered species. An AZE site is designated if it meets the tri-fold criteria of: **Endangerment** (a CR or EN species exists), **Irreplaceability** (the site is the only area where the CR or EN species occurs), and **Discreteness** (the area has a definable boundary in the context of its neighbourhood)[1].

In the NEC, 3 out of Kenya's 5 AZE sites are located. These are identified in *Table 5.21* alongside the CR or EN species.

Table 5.21 AZEs in the NEC

AZE	County	Species
Mount Elgon	Bungoma	• *Petropedetes dutoiti* (Du Toit's Torrent Frog) (CR) • *Otomys barbouri* (Barbours Vlei Rat) (EN)
Taita Hills	Taita Taveta	• *Boulengerula niedeni* (Sagalla Caecilian) (CR) • *Apalis fuscigularis* (Taita Apalis) (CR) • *Suncus aequatorius* (Taita Shrew) (CR) • *Turdus helleri* (Taita Thrush) (CR)
Shimba Hills	Kwale	• *Hyperolius rubrovermiculatus* (EN)

Source: Alliance for Zero Extinction, (2013)[2].

Eastern Afromontane Biodiversity Hotspot

The Eastern Afromontane Biodiversity Hotspot (EAM) comprises several scattered and biogeographically similar mountain ranges in Eastern Africa, from Saudi Arabia and Yemen in the north to Zimbabwe in the south. Three ancient massifs make up more than 1,000,000 km^2 of the main part of the EAM. These massifs are the Eastern Arc Mountains and Southern Rift; Albertine Rift, and Ethiopian Highlands. A number of outlying mountains are also part of this hotspots, including the Neogene volcanic of the Kenyan and Tanzanian Highlands (e.g. Mt Kilimanjaro, Mt Meru, Mt Kenya, Mt Elgon, Aberdares Range, and

[1] Alliance for Zero Extinction, (2013). AZE Overview. Retrieved March 11, 2016 from www.zeroextinction.org.
[2] Alliance for Zero Extinction, (2013). Kenya AZE Sites.

other peaks), the Air Mountains (SW Saudi Arabia), the highlands of Yemen, and the Chimanimani Highlands (Zimbabwe)[1].

The hotspot supports close to 7,600 species of plants, of which 2,350 are endemic. The Eastern Arc Mountains support over 1,100 species of endemic plant and about 40 endemic plant genera. In addition, 1,300 bird species occur in the EAM, and about 110 of these are found nowhere else. The Eastern Arc and Southern Rift Mountains form a single EBA, as defined by BirdLife International.

The EAM is a habitat to nearly 500 mammal species, more than 100 of which are endemic to the region. Nearly 350 reptilians are found in the EAM, of which more than 90 are endemic. The Great Rift Lakes are located within this hotspot making it important for freshwater fish diversity and endemism, with more than 890 species of fish, of which nearly 620 are endemic.

Eco-regions which comprise of the EAM are defined as either Terrestrial Key Biodiversity Areas (KBA), Freshwater KBA (FWKBA) or EAM Corridors. KBAs are sites of global significance for the conservation of biodiversity (globally threatened species, restricted-range species, biome-restricted species assemblages or congregatory species). They are identified nationally using simple, globally standardised criteria and thresholds, based on the needs of biodiversity requiring safeguards at the site scale. They extend BirdLife's IBA concept to other taxonomic groups and it thus follows that all IBAs are KBAs. On the other hand, EAM Corridors are broad-scale landscape units that include clusters of KBAs [2]. The NEC intersects the KBAs and Corridors listed in *Table 5.22* and *Figure 5.58*.

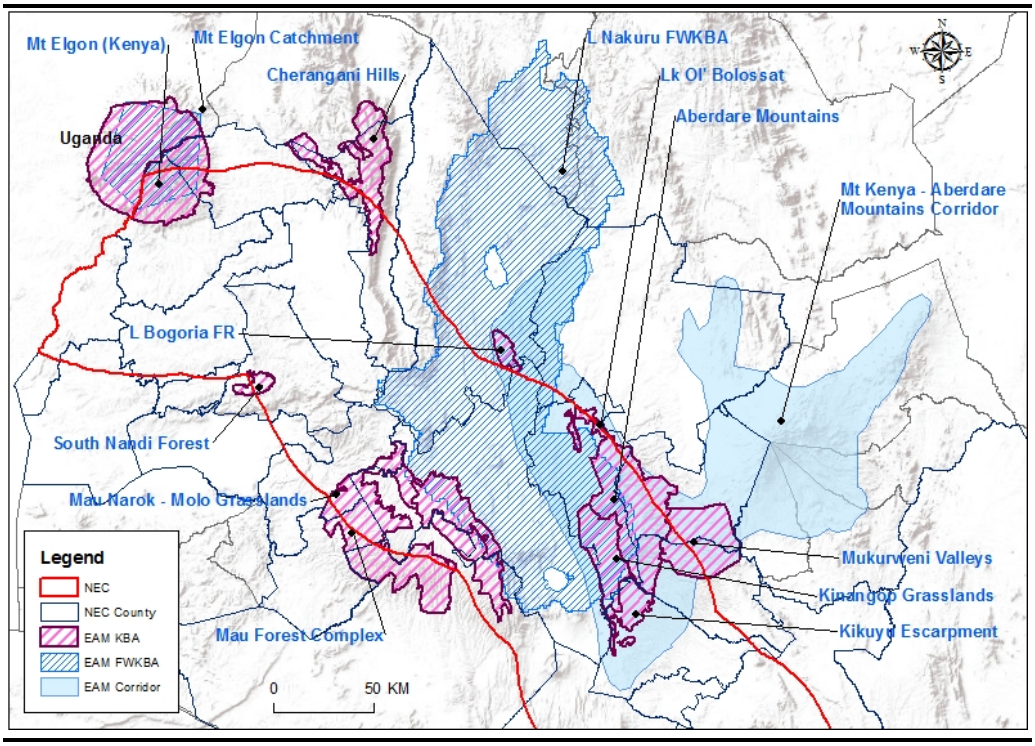
Table 5.22 EAM KBAs and Corridors in the NEC

Terrestrial KBAs	Freshwater KBA	EAM Corridors
• Lake Bogoria NR • Aberdare Mountains • Kikuyu Escarpment Forest • Mau Forest Complex • Mau Narok-Molo Grasslands • Taita Hills Forests	• Lake Nakuru • Mount Elgon Catchment	• Mt Kenya – Aberdare Mountains

[1] CEPF, (2011). Eastern Afromontane Ecosystem Profile Summary. Conservation International. Critical Ecosystem Partnership Fund.
[2] BirdLife International, (2008). What are Key Biodiversity Areas? Retrieved March 11, 2016 from http://www.birdlife.org/datazone/sowb/casestudy/88.

Terrestrial KBAs	Freshwater KBA	EAM Corridors
• Cherangani Hills • South Nandi Forest • Kinangop Grasslands • Lake Ol' Bolossat • Mukurweini Valleys • Chyulu Hills • Mount Elgon (Kenya)		

Figure 5.58 EAM KBAs and Corridors Intersected by the NEC



Source: CEPF, (2011).

Flyways

The East Asia/East Africa flyway, which is used by 331 known avifaunal species, intersects Kenya and the NEC. On this flyway typical journey follow a predominantly north-south axis, linking breeding grounds in the arctic and temperatre regions with non-breeding sites in in temperate and tropical areas. Numerous birds that breed in the mid-Palaearctic choose to embark on a much longer south-westerly migration to Africa rather than spending the northern winter directly to the south. Two main migration routes have been identified south through equatorial eastern Africa. Species such as the Barn Swallow, Willow Warbler and Red-backed Shrike (Lanius collurio) prefer a route through Uganda and the L Victoria basin, whilst others, such as the

Marsh warbler, Trush Nightingale (*Luscinia luscinia*) and Basra Reed-warbler (*Acrocephalus griseldis*) pass further to the east through the Kenyan highlands. The return migration in spring is relatively rapid with many birds completing the entire journey from the southern tropics to their northern breeding grounds in six weeks[1].

Coral Reefs

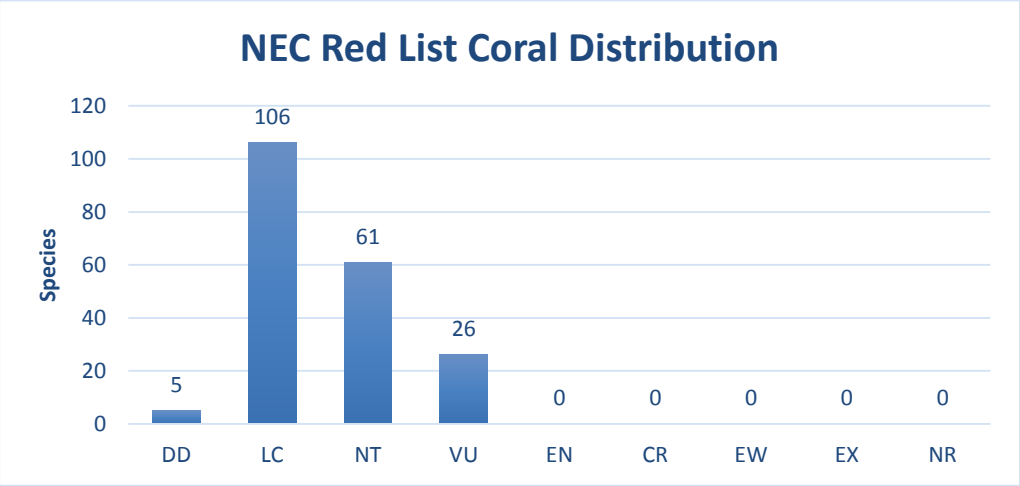
The total area of Kenya's coral reefs (warm water corals) is estimated at 50,000 Ha. These reefs are divided into two main areas – a fairly continuous 200 km long fringing reef along the south coast extending from Malindi to Shimoni and patch reefs (exposed and protected), and fore reef slopes in north coast from Lamu to the Somali border (See *Figure 5.59*). In both areas, hard substrate patches with coral growth are interspersed between extensive seagrass and algal beds. Coral cover is typically about 30% within these patches, and the reef's complexity and diversity is higher in the south decreasing northward past Lamu due to increasing influence of the cold-water Somali current system[2].

In the south, the narrow 200 km long fringing reef continues into the Tanzanian coast. It colonized the shallow part of the continental shelf along half of Kenya's coastline from about mean sea level to a depth of 20-25 m and at a distance of between 500 m and 2 km offshore. Exceptions exists where river systems create high turbidity and low salinity conditions, which limit coral growth. As a result of these conditions, estuaries and deltas along the coast are instead characterized by extensive mangrove forests.

This Study identifies 198 Red List species of corals belonging to 53 genera, within the NEC's marine region, distributed amongst the assessment categories as shown by *Figure 5.59*. These coral are stony corals whereas other important reef building organisms include soft coral and coralline red algae (or calcareous algae). In the general, the coral species are similar to other part of the Western Indian Ocean. They are dominated by *Porites sp.* assemblages in calm water and *Acropora sp.* assemblages in high energy environments. Stony coral cover averages between 30-40% of all corals in the Kenyan Coast

[1]Birdlife International (n.d). East Asia/East Africa Flyway.
[2] IUCN/UNEP, (1985).

Figure 5.59 Distribution of Red List Corals



Cold water reefs are found in dark, deep waters with temperatures between 4°-13°C. Cold-water corals are still being studied but are potentially located in all seas and at all latitudes. There are only six identified coral species that are able to build reefs (vs. approximately 800 warm-water species). Most cold water reefs are comprised of just 1-2 species. These reefs provide habitat and feeding grounds for a range of deep-water organisms. Their full ecological importance is still unknown. These reefs are at risk from bottom fisheries, oil and gas exploration activities, placement of pipelines and cables and pollution.

Cold-water reefs have been identified off the coast of East Africa, near Madagascar, and are potentially present off the coast of Kenya. They have however not been identified in the NEC's offshore area.

Sandy Beaches

Two types of sandy shores are present along the Kenyan coast:

- Gentle to steep sandy beaches without protection from reef barriers and often backed by one or more series of wind-blown sand dunes; and
- Gently sloping, usually sheltered behind a fringing reef, and common along the coast, south of Ungwana Bay (typical examples are Diani Beach and Tiwi Beach).

Species diversity on sandy beaches is usually low, with few burrowing crabs and amphipods. The density and diversity of crabs, bivalves, polychaetes and other marine invertebrates, increases in the inter-tidal zone, but remain low compared to most other habitats. Stranded debris in this zone may attract a variety of foraging waders and other birds.

Sandy beaches are considered sensitive because on top of being tourist attractions they serve as nesting sites for sea turtles. This is discussed in the next section under which *Figure 5.60* displays the sandy beaches intersected by the NEC.

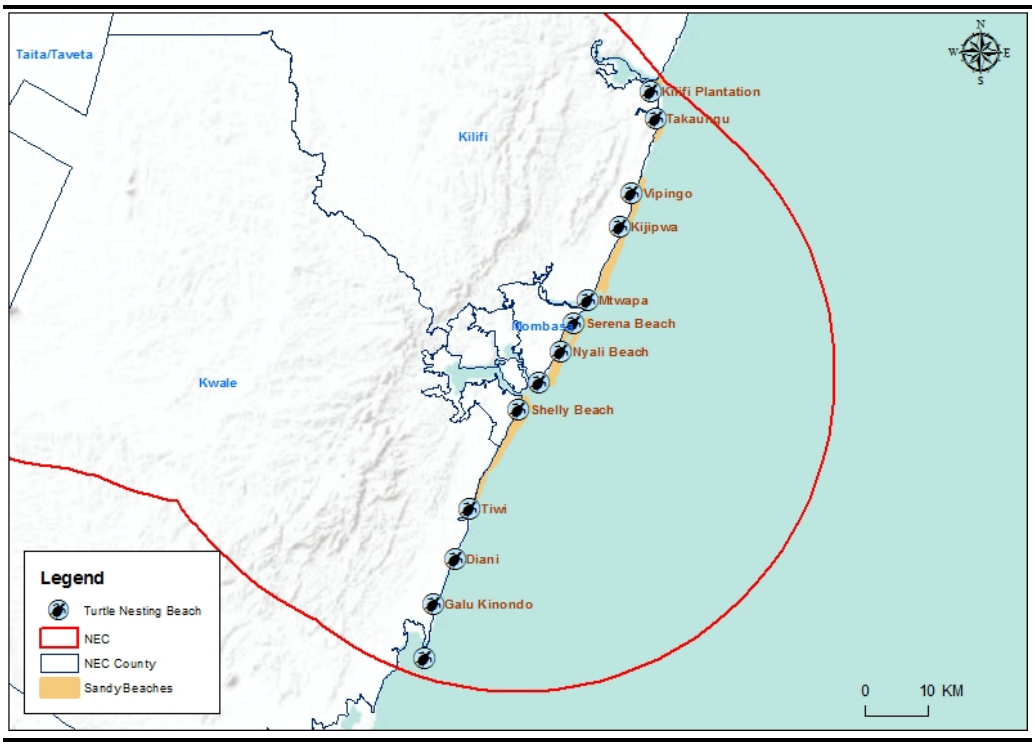
Sea Turtle Nesting Sites

Three of the five species of species of sea turtles in Kenya nest on Kenyan beaches. These are the green turtle, the hawksbill turtle and more rarely, the olive ridley. They nest on a variety of beach types with the basic requirements for a good nesting site are easy accessibility to/from the sea and beach sand text that is fine enough to prevent excessive slippage whilst the nest is being constructed. Other considerations are the nature of the offshore approach, the slope of the beach and the beach front vegetation. Although much progress has been made in identifying key nesting sites, there has been inadequate information on the status and extent of sea nesting beaches along the Kenyan coast. This information is important in conservation decision making.

Large numbers of migratory sea turtles - the loggerhead (*Caretta caretta*) and leatherback (*Demochelys coriacea*) which can reach two meters in length and weigh 500 kg - also forage in Kenyan waters, especially around Wasini island at the south coast of Kenya. Other nesting areas on the Kenyan Coast include Mpunguti ya chini, Funzi island, Msambweni, Chale, Diani, English Point and Serena beach.

The predominant threats on sea turtle nesting beaches are shoreline developments such as sea walls, soil erosion, predation (by humans, crabs and birds), and human activity (such as fishing, tourism and recreation). *Figure 5.60* shows key sea turtle nesting sites in the NEC although it is important to note that all sandy beaches can be considered to be potential turtle nesting sites.

Figure 5.60 Sandy Beaches and Turtle Nesting Sites



Transboundary Resources

Transboundary natural resources are identified and explained in the *Sections* below.

Lake Victoria Catchment

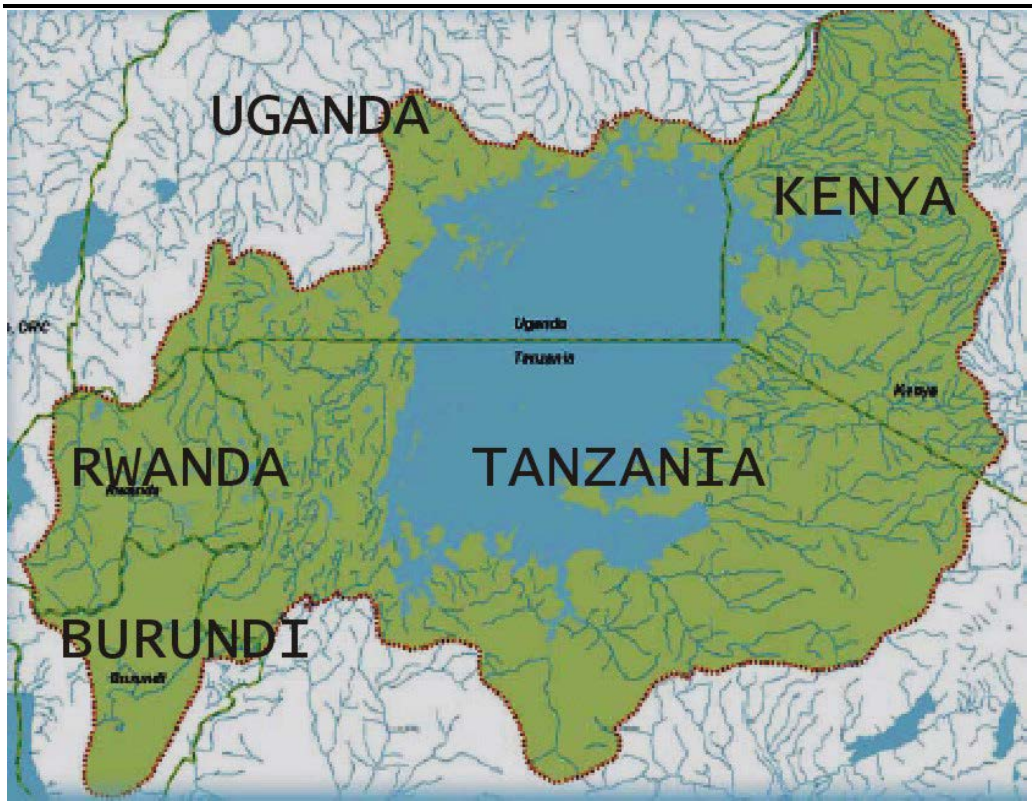
Lake Victoria is a transboundary catchment shared amongst Uganda (16%), Kenya (22%), Tanzania (44%), Rwanda (11%) and Burundi (7%) (see *Figure 5.61*). The lake itself occupies an area of 178,710 km^2 within its catchment area of 499,870 km^2. As a result of this size, L Victoria plays a vital role in the ecology of the entire East African region. It supports numerous fish and bird species, including the crested crane and the Sitatunga, a globally threatened species of water antelope.

L Victoria shapes regional weather patterns thus playing an important ecological role. Its surface temperature is significantly correlated to the basin-wide spatial distribution of rainfall through frictional and thermal contrasts between lake surfaces and the adjoining land areas, (Mukabana and Pielke 1996 as cited in Kelly L. (2009)[1]. Moreover, it is a source of moisture and latent heat, both of which drive the tropical

[1] Kelly L. (2009). Cooperation and Competition: Managing Transboundary Water Resources in the Lake Victoria Region

climate in its surrounding area. As compared to other large inland lakes, L Victoria effect on temperature and climate is more significant due to its high altitude. This contributes to the strong wind circulations in the region. Changes to this system and correlation can have a major impact on the agricultural productivity of the region, (Anyah and Semazzi (2004) as cited in Kelly L. (2009). The main rivers of L Victoria's catchment include Rivers Yala, Nzoia, Nyando and Sio, and which are intersected by the NEC.

Figure 5.61 Lake Victoria Catchment



Source: Kelly L. (2009).

Mt Elgon Ecosystem

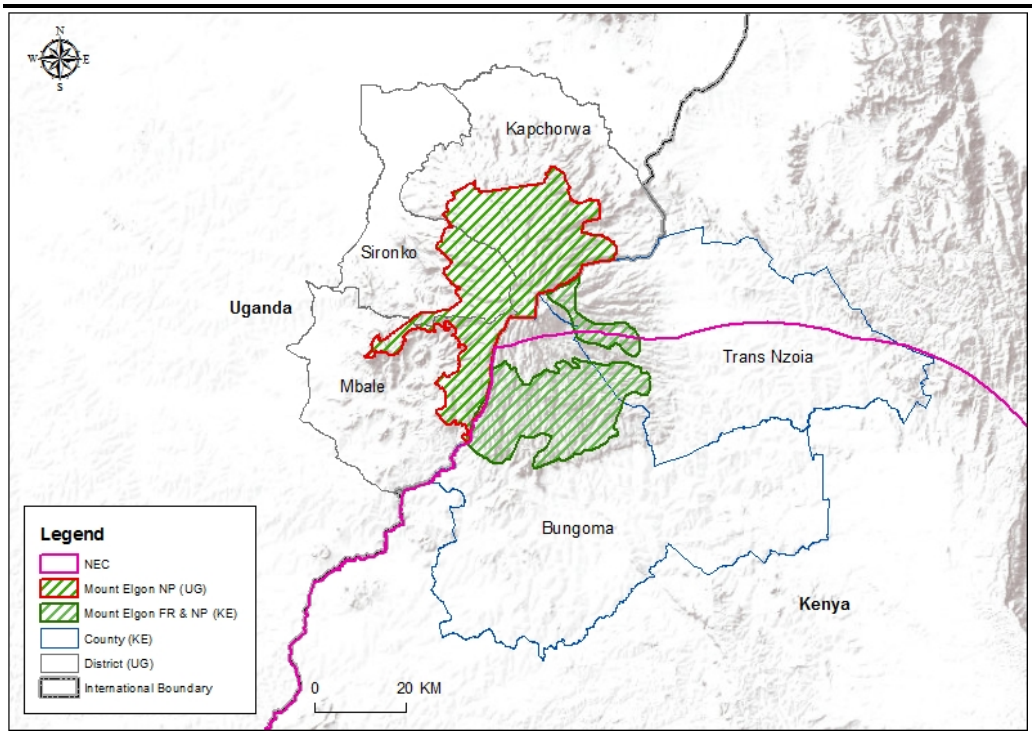
Mt Elgon is an extinct volcano that rises to 4,321 m asl covering an approx. area of 4,000 km^2 between Kenya (Bungoma and Trans Nzoia Counties) and Uganda (Kapchorwa, Sironko and Mbale Districts). A larger portion of the ecosystem is located in Uganda (314,394 Ha) as compared to Kenya (236,505 Ha), and about 2 million people are estimated to live around the ecosystem's neighbourhood[1].

[1] KWS, (2011). Mt Elgon Transboundary Ecosystem. Western Conservation Area, Kenya. Presentation by Anastasia Mwaura. Biodiversity Department, KWS.

Mt Elgon is the source of Rivers Nzoia and Turkwell, this importance as a water tower is the reason why it was designated as a MAB in 2003. The entire ecosystem supports 37 globally threatened species (22 mammals, 2 insects and 13 birds) and it is also a designated AZE site. In addition, there are several PAs gazetted in the ecosystem on both sides of the border. These PAs include: Mt Elgon NP and Namatale Central Forest Reserve (CFR) in Uganda; and Mt Elgon NP, Mt Elgon FR and Chepkitale NR in Kenya . *Figure 5.62* shows the PAs within Mt Elgon's ecosystem.

Mt Elgon also features a trans-boundary volcanic aquifer shared between Uganda and Kenya. It occupies and area of 5,400 km^2 which had 806,500 inhabitants by 2013[1,1].

Figure 5.62 Mt Elgon Protected Areas



Sio-Siteko Wetland

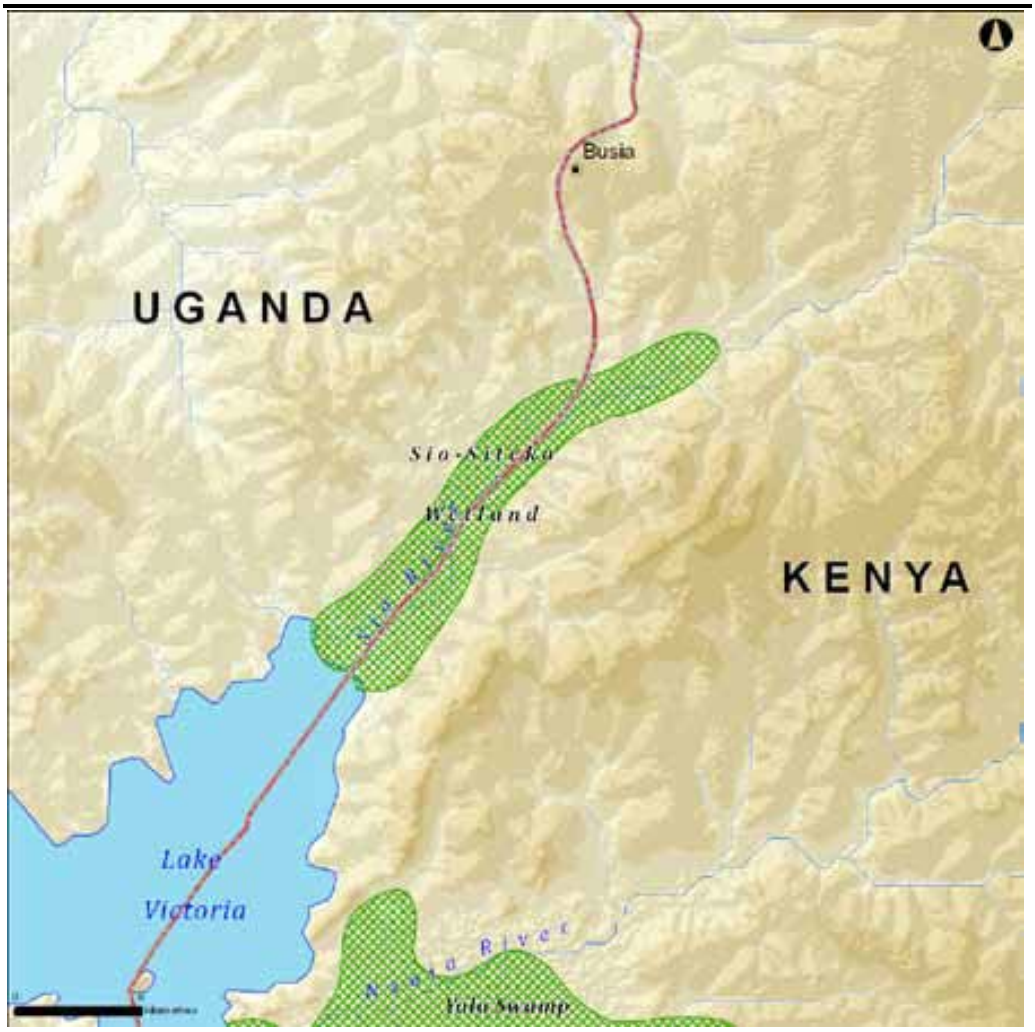
The Sio-Siteko Wetland is located on the Kenya-Uganda border, intersecting Busia County and District in Kenya and Uganda (*Figure 5.63*). It is part of the wider Sio-Malaba-Malakisi catchment and it consists of a number of interconnected secondary and tertiary wetland subsystems which drain into L Victoria. R Sio's source is Mt Elgon and

[1] IWMI, (2013). Transboundary Aquifer Mapping and Management in Africa. CGIAR. Research Program on Water, Land and Ecosystems.

its length and catchment area are 85 km and 1,338 km^2 respectively. The wetland provides important ecosystems goods and services including storage and purification of water, food (fish), construction materials and supports agricultural activities[1, 1, 1].

The catchment and linked wetlands provide a habitat for several species including 206 plants, 29 fish, 25 mammals, 8 reptiles and several invertebrates. It is an IBA in which over 300 bird species have been documented. These birds have included the globally threatened *Laniarius mufumbiri* (Papyrus Gonolek) and *Circus macrourus* (Pallid Harrier). Notable mammals found in the area include Vervet Monkey, Otter, Sitatunga, Hippopotamus and Water Mongoose[1, 1, 1].

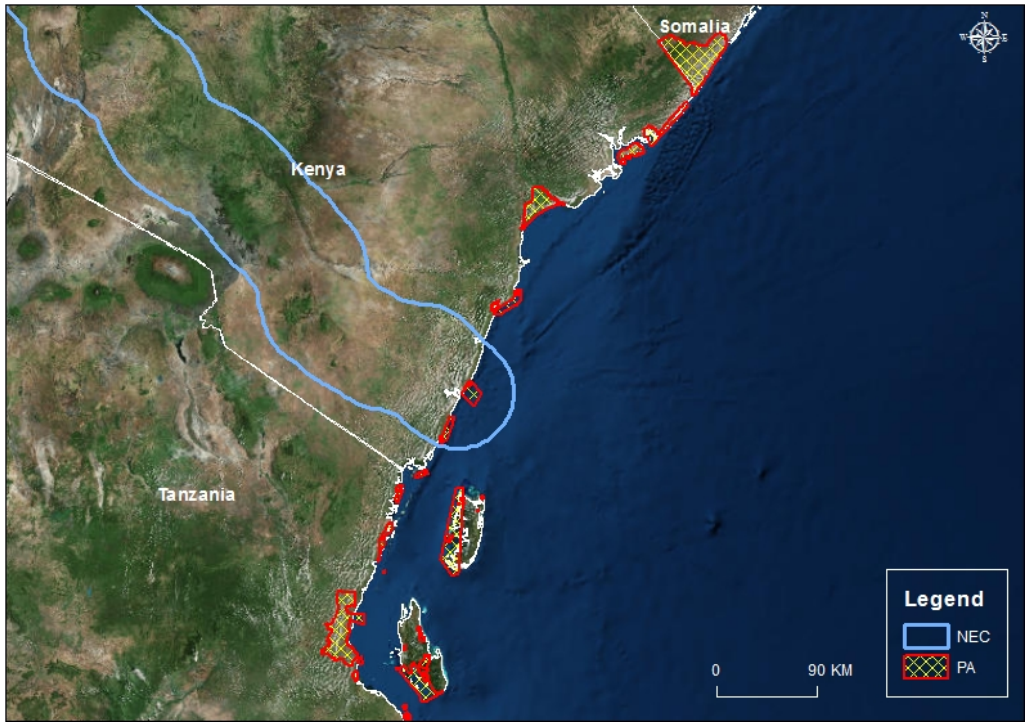
Figure 5.63 Sio-Siteko Wetland



Western Indian Ocean

The Western Indian Ocean is shared amongst the East African states of Kenya, Somalia and Tanzania. Its pelagic and benthic habitats support numerous species some of which are globally threatened. Moreover, it features numerous coastal and marine PAs in these three countries, which are considered to be sensitivities by this study. Those PAs along the coasts of Somalia, Kenya and Tanzania are shown in *Figure 5.64*.

Figure 5.64 Indian Ocean PAs

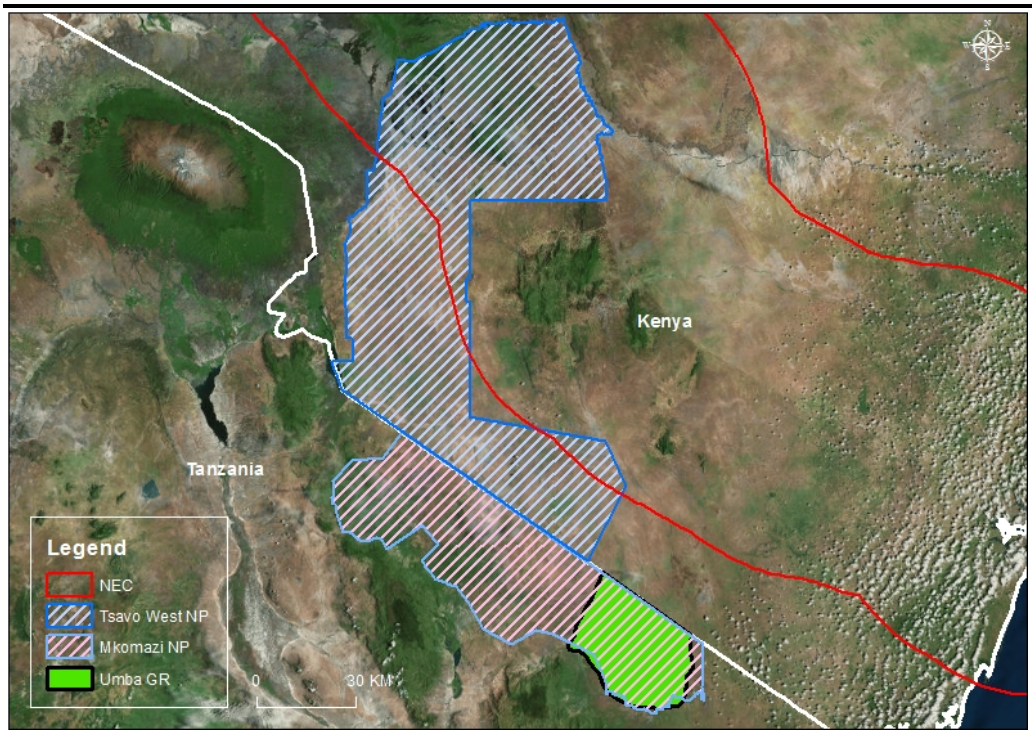


Tsavo West National Park (NP)/Mkomazi NP

Tsavo West, located in southeast of Kenya and traversed by the NEC, is adjoined to Mkomazi NP at the Kenya-Tanzania border. Although the region of adjoinment between these two NPs is not intersected by the NEC, this study considers the entire transboundary ecosystem to of interest to the NEC. Tsavo West NP is discussed in *Section 5.4.4* as a NP and as an IBA. Mkomazi NP is located north-eastern Tanzania, stretching over an area of 3,500 km^2. Mkomazi NP intersects Umba Game Reserve (GR), over a region that has a designated IBA. Thus these two PAs support at least 405 bird species and other endangered species of fauna such as *Loxodonta africana* (EN) (which are migratory between Mkomazi NP and Tsavo West (TCA)), *Panthera leo* (VU), *Acinonyx jubatus* (VU) and *Diceros bicornis* (CR) (introduced through a special

programme[1]. *Figure 5.65* displays the location of this transboundary PAs in context of the NEC.

Figure 5.65 Tsavo West and Mkomazi National Parks



Box 5.8 Constraints - Sensitive and Designated Areas or Ecosystems

The sensitive and designated areas or ecosystems, located within the NEC are classed to be constraints because:

- Despite their ecological and economic significance most of them are at risk of degradation;
- They are protected by national regulations in that some are designated as PAs nationally whilst others are also designated internationally under different classification systems;
- The potential and consequences of degradation can be exacerbated by the implementation of the NEC MP, and
- Location and or development of infrastructure against the provisions of their management plans can result in opposition from local communities and conservation groups and subsequently reputation losses for the NEC MP implementers.

[1] BirdLife International, (2016). Important Bird and Biodiversity Area factsheet: Mkomazi Game Reserve. Retrieved March 17, 2016 from www.birdlife.org

5.4.5 Anthropogenic Hazards

Kenya's natural and social resources are placed at risk by a number of anthropogenic hazards which frequently or continually occur driven by economic and social factors. Four key hazards are discussed in this section namely *pollution*, *climate change*, *groundwater over-abstraction* and *unsustainable land use changes*.

Pollution

In Kenya, air, water and soil pollution are mainly driven by a growth in population that is not met with adequate services. This results in pollution from the: by-products from the manufacture of the goods demanded by this population, service industry used by this population and the goods consumed by the same population. Other factors contribute to the pollution such as the level of technological advancement of the country, level of awareness, and enforcement of and compliance with regulations. These drivers are not universal and they would apply in any combination and interlinked manner for a particular case of pollution.

Air pollution is primarily caused by emissions from motor vehicles, emissions from dumpsites, industrial activities, land use changes, civil and construction activities, combustion of fossil fuels and combustion of green fuels (firewood, charcoal amongst others). Air pollution affects both natural resources and humans reducing the quality of life. This study notes that there has been an increase in cardio-respiratory diseases in the country, that has been partly attributed to both indoor and outdoor air pollution[1]. Lower outdoor air quality has been documented in the urban and more populated regions in the NEC as compared to rural and less populated areas. This is attributed to the high density of people, vehicles and industries. On the contrary, rural areas have higher preference to firewood as a fuel source and often have lower indoor air quality. Amongst the NEC Counties firewood is the main source of cooking fuel whilst tin lamps and lanterns (which use paraffin) are also the most preferred mode of lighting in these counties.

Water and soil pollution are caused by improper disposal of solid wastes; industrial, domestic and agricultural effluents, and accidental

[1] KNBS, (2014). Kenya Demographic and Health Survey 2014.

spills from industries and transportation of hazardous or toxic wastes. This study notes that Kenya does not have a single sanitary landfill, therefore solid wastes are by and large not managed sustainably. This has resulted in growing dumpsites in all major towns and cities such as Dandora (Nairobi), Mwakirunge and Kibarani (Mombasa), Gioto (Nakuru) and Mwenderi (Eldoret).

Water and soil pollution have a variety of impacts on human health and natural resources, depending of the characteristics of specific pollutants. Low access to sanitation in the country is a precursor to these forms of pollution and contributes to a high prevalence of water-borne diseases. Water pollution is in addition identified as one of the threats in all the wetlands and water resources in the NEC that places them at risk of degradation and reducing their ecological integrity. On the other hand, soil pollution or land contamination is a co-factor in land degradation which lowers land productivity in the country.

Climate Change

Climate change is considered to be amongst the most significant threats facing Kenya. This is even though the country is amongst the low emitters of Greenhouse Gases (GHGs) globally. The country was estimated to emit 0.33 MTC in 2011[1], meaning that whilst the country plays a small role toward the emission of GHGs, it is mostly vulnerable to the associated effects of climate change. Kenya was ranked 154 out of 180 countries in the ND-GAIN[2] index in 2014[3]. This is attributed to prevailing poverty levels which manifests in low coping, resilience and adaptive capacity in majority of the population which leaves them predisposed to hazards. The ASAL regions of the country are particularly most vulnerable since they have the highest poverty levels across the country. On the broad scale, lack of a comprehensive legal and policy framework on land management also contributes to Kenya's climate change vulnerability. This is because the situation results in land fragmentation and disparities in ownership which cause conflict and disincentivize sustainable investments on the lands or conservation practices.

[1] World Bank, (2016). CO2 emissions (metric tons per capita). Data on Kenya.
[2] The ND-GAIN Country Index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. It measures the overall vulnerability by considering vulnerability in six life-supporting sectors – food, water, health, ecosystem service, human habitat and infrastructure.
[3] ND-GAIN, (2014). Country Rankings. Retrieved March 23, 2016 from http://index.gain.org/ranking

Studies have elucidated that the effects of climate change are already being experienced in Kenya. The country warmed by 1 °C from 1960 to 2010, with projections suggesting that it will rise to 2.5 °C by 2050. General trends of increases in temperature and reduced rainfall over long-term means have been observed in the country. These changes place the country's economic goals at risk since they have been associated with short and long-term negative effects on agriculture, health and tourism. Adding on to this, it is postulated that climate change would increase the frequency of natural hazards such as floods, El Nino and drought. Climate change is in addition amongst the co-factors of land degradation and desertification, especially since 80% of the country comprises ASALs[1].

Another potential effect of climate change is reduction in water availability due to negative variance in the hydrometeorological regimes brought about by rising temperatures. Models applied at the national level predict decreases of 50-150 mm between 2000 and 2025 for most of the country with higher decreses in the ASALs. This would increase competition for water resources since the country is already water scarce and has a growing population. About 98% of Kenya's crop production is rain-fed and this reliance predisposes the sector and majority of farmers to the risk of climate change- or climate variability-induced crop failure. Moreover, women are most vulnerable since they manage 40% of smallholder farms whilst providing 80% of the labour for crop production.

Lastly, sea-level rise along the coast has already been documented whereas it increases the risks of coastal erosion, loss of coastal wetlands, loss of agricultural land, infrastructure damages from storm surges and salt intrusion. It is estimated that sea-level rise in Kenya can result in losses of 7-58 million USD per year by 2030 and 31-313 USD million per year by 2050[1].
In summary, the risks and impacts of climate change in Kenya have been postulated by NEMA (2015) to be those given in the table below.

[1] Netherland Commission for Environmental Assessment, (2015). Climate Change Profile Kenya. Dutch Sustainability Unit.

Table 5.23 Summary of Climate Change Risks and Impacts in Kenya

Sector	Impacts and Risks
Water Resources	This is already affected by inter- and intra-annual rainfall variability, including the extremes of flooding and drought. Climate change may further reduce the availability of water resources through altered rainfall patterns, higher evaporation, lower lake levels, accelerated loss of glaciers and rising sea level.
Food Security	The agriculture, livestock and fisheries sector is key for Kenya in terms of employment, food security, livelihoods and economic development. Climate change has the potential to significantly affect agriculture-based livelihoods by challenging the sustainability of current arable, pastoral and fishing practices.
Coastal Zones	Increases in sea surface temperature, sea level rise and coastal erosion are likely to put additional pressure on coastal ecosystems, including islands, estuaries, beaches, coral reefs and marine biodiversity. Coral reef ecosystems are particularly vulnerable to climate change impacts, with associated consequences for the livelihoods of millions of people depending on those ecosystems for food, income and shoreline protection. In coastal locations, ports and transport infrastructure is particularly exposed due to flooding, together with tourism assets and settlements situated close to the coast.
Human Health	Climate change is expected to put human health at risk by exacerbating the magnitude and occurrence of existing impacts, such as heat stress, air pollution, asthma, vector-borne diseases (such as malaria, dengue, schistosomiasis – also referred to as swimmer's itch or snail fever – and tick-borne diseases), water-borne and food-borne diseases (such as diarrhoeal diseases).
Forestry and Wildlife	Anticipated impacts of climate change on biodiversity include shifting of ecosystem boundaries, change in natural habitats and sharp increases in extinction rates for some species.
Urban and Housing	Climate change is likely to make rural livelihood strategies and living conditions increasingly challenging and as a result is likely to exaggerate the current rural-to-urban migration trend. Specific risks and challenges for communities, especially those living in urban environments and particularly the most vulnerable, include river and flash flooding, with flood-related fatalities constituting 60 per cent of disaster victims in Kenya. Extreme events also have indirect impacts through water scarcity and quality issues and food insecurity.
ASALs	Over the past few decades, transformations in the ASALs have impacted the livelihoods of the pastoralists. The migration of rural communities from the congested high-potential areas and the dry

Sector	Impacts and Risks
	arid areas to cities has contributed to overpopulated slums and settlements that lack basic services. Implications for women included the additional burden of sustaining household food, water and human security. School attendance rates for children has decreased, child labour increased land conflicts over resources have intensified in such situations.
Tourism	Climate variability and climate change, partnered with broader environmental degradation has the potential to significantly affect the tourism sector, including wildlife tourism. With its close connections to the environment and climate itself, tourism is considered to be a highly climate-sensitive industry.
Manufacturing, Transport and trade	Impacts to critical supporting infrastructure, such as energy, water, communications and transport, have the potential to reverberate into the private sector, with consequences for business continuity, revenue, workforce and associated supply chains. Climate induced changes affecting productivity and crop diversity, in the tea, coffee and horticulture sectors, have implications for exports and imports
Infrastructure (for energy and transport)	Climate change has the potential to compromise infrastructure design, function and performance across a range of settings. In coastal locations, ports and transport infrastructure is particularly exposed. Riverine flooding and landslides have the potential to cause significant damage to physical infrastructure such as roads, bridges, water pipelines and power lines.

Source: NEMA, (2015)[1].

[1] NEMA, (2015). Kenya Second National Communication to the United Nations Framework Convention on Climate Change.

Groundwater Over-Abstraction

Groundwater plays a vital role in water supply in Kenya, a water scarce country. It either supplements surface supplies or in other cases is the main mode water access. It is observed that amongst the NEC Counties an average of 27% households per county depend on it as the main mode of supply. In spite of its importance it has been observed that only about 17.3% of the annual available renewable groundwater is utilized in the country. However, due to growing demand groundwater is often abstracted unsustainably particularly in densely populated areas such as urban areas. It is observed that of the 44,754 boreholes that were existent in Kenya by 2012, 49.2% and 34.6% were located in the Athi and Rift Valley catchment areas or basins[1].

Amongst the dominant drivers of over-abstraction is the country's weak legal framework of groundwater management. Kenya does not have explicit limitations on spacing of boreholes but regulations rather recommend authorities to establish these limits through evaluations on groundwater availability. Such evaluations have not been done in the case of most aquifers and thus abstraction permits are issued on a case by case basis. Moreover, only one Groundwater Conservation Area (GCA) has been established in the country and it is not enforced. This GCA is in Nairobi.

Potential impacts of over-abstraction include land subsidence, falling water table, pollution and increased competition for reducing resources. Increased competition and pollution promote malpractices such as abstracting groundwater against the conditions of abstraction permits. In areas such as Nairobi, competition, pollution and availability of groundwater has led to increases in the depth of boreholes and establishment of illegal boreholes.

Unsustainable Land Use Change

The growth of the population in Kenya post-independence has led to increases in demand for goods and services provided through land based resources. This has led to conversion of more land for commercial and residential purposes in addition to increased consumption of natural resources. These changes in land use have not been sustainable on several occasions whilst population growth reduced the amount of land available per capita reduced from 9.6 Ha in 1950 to 1.7 Ha in

[1] Ochillo D., (2012). Groundwater Governance and Policies in Kenya: Institutional Structure and Legal Settings. WRMA Presentation.

2005[1]. Poor enforcement of regulations and a weak governance framework on land further challenge sustainable utilization of land. Incompatible land uses thus occur against existing regulations and policies.

Unsustainable land use changes place the country's natural resource at risk of degradation in addition to leading to precarious and illegal settlements. Documented impacts of unstainable land use changes include amongst others:

- Loss of biodiversity including in sensitive areas such as forests, wetlands and PAs
- Habitat degradation
- Increased emissions of GHGs
- Increased run-off
- Reduction in water quality and availability

Hotspots in which land use changes are deemed to be significant in the NEC include:

- Nairobi NP
- Mlolongo Township
- L Nakuru Ecosystem
- L Naivasha Ecosystem
- The Mau Forest Complex

Source: UNEP, (2009).

6 SOCIO-ECONOMIC BASELINE

6.1 INTRODUCTION

The purpose of this *Chapter* is to describe the socio-economic receiving environment within which the NEC is located. The baseline provides a critical contextual component for identifying and assessing any potential socio-economic impacts of the Master Plan.

The NEC traverses 29 Counties in the main route (as indicated in *Box 6.1* and *Figure 6.1* below) and 4 Counties in the sub-route (as shown in *Box 6.2*) As the coverage area of the NEC Master Plan is so extensive, the level of baseline information collected is at national and county levels.

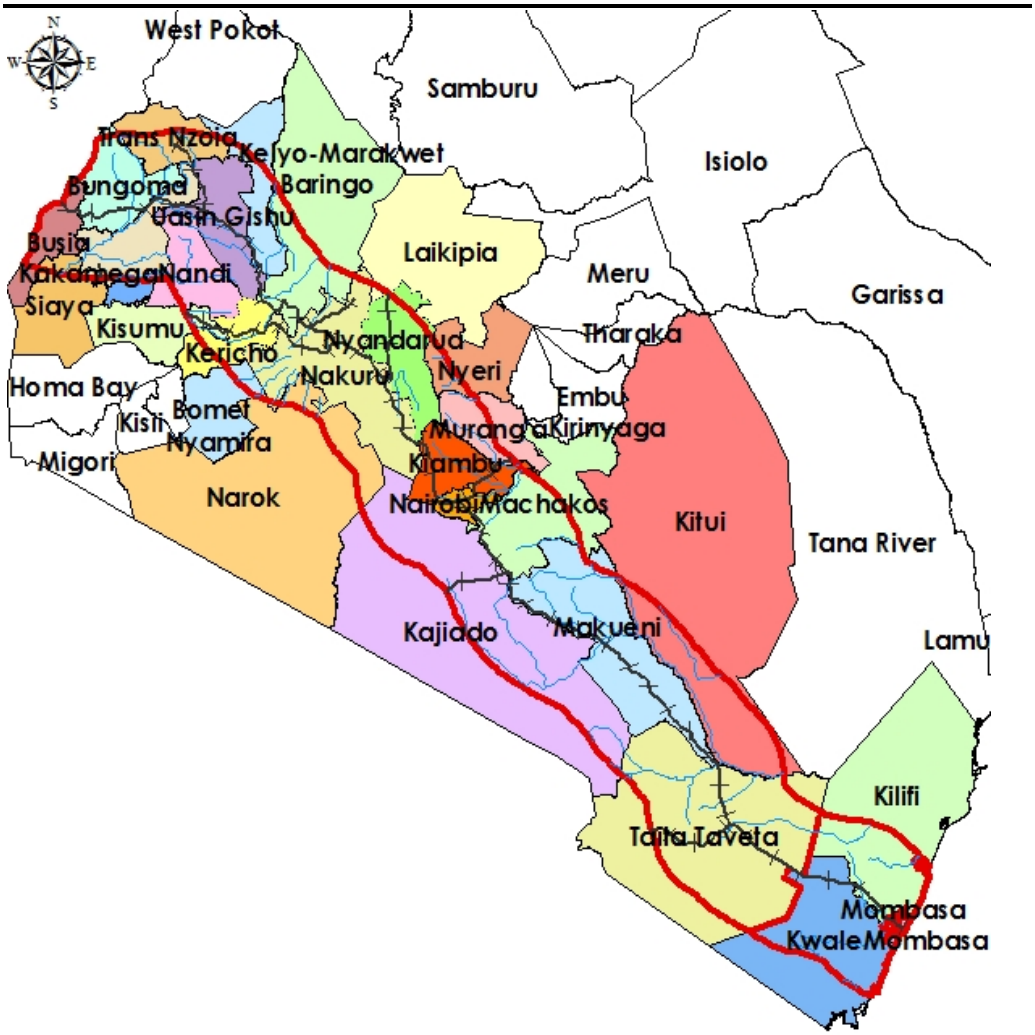
Box 6.1 NEC Counties along the Main Route of the NEC

- Counties that are fully transversed by the NEC main route include Mombasa, Makueni, Nairobi, Kiambu, Muranga, Nyandarua, Nakuru, Uasin Gishu, Kericho, Nandi, Kisumu, Vihiga, Kakamega Siaya and Busia.
- Counties that are partially transversed by the NEC main route are Kwale, Kilifi, Kitui, Kajiado, Narok, Nyeri, Laikipia, Baringo, Elgeyo Marakwet and Trans Nzioa.

Box 6.2 NEC Counties along the Sub-Route of the NEC

- Counties that are traversed by the NEC sub-route are Trans Nzoia, West Pokot, Elgeyo Marakwet and Turkana

Figure 6.1 NEC Counties within the Main Route



Information provided in the following *Sections* is collected from:

- Consultative discussions, specifically stakeholder meetings and Key Informant Interviews (KII) with high level Stakeholders, and
- Secondary data sources such as County Integrated Development Plans (CIDP), World Bank Reports, the Kenya National Bureau of Statistics (KNBS) Reports, Ministry of Health Reports, JST Progress and Interim Reports, etc.

6.2 PEOPLE AND CULTURE

The Bantu are the largest single group of people found within the NEC and they are also the single largest population division in Kenya. The Bantu are mainly farmers. There are three main clusters of Bantu in Kenya:

- Those near the Coast and in the plains a short distance inland. These are mainly the Pokomo, Taita, Makonde, Taveta tribes as well as the 'nine tribes' of the Mijikenda;
- The Central Highlands Bantu, mainly found around Mount Kenya and the Nyandarua (Aberdare) Range. These are comprised of the Chuka, Embu and Mbeere, Kamba, Kikuyu, Meru and various related tribes; and
- Those in and to the north of the Lake Victoria Basin in the far west of the country, specifically the Gusii (Kisii), Kuria, and the various Luhya sections (1) .

Although each of these tribes shares Bantu as a root language, their own languages (of which there are usually many dialects and variations) are not necessarily mutually understandable.

The second largest group of people within the NEC are the Nilotes. The Nilotic-speaking tribes comprise the Luo, Maasai, Pokot, Samburu, Turkana, and many of the subgroups which constitute the Kalenjin. They mainly occupy the western Kenya's Rift Valley. The Nilotes are traditionally cattle-herders, although some groups, notably the Luo and Kalenjin, have converted to agricultural ways of life.

While this classification of people is true for most rural areas and some smaller towns, the same cannot be said of big towns such as Nairobi, Nakuru and Mombasa. In these areas, there are diverse people including other Africans, Arabs, Indians and Europeans who come from different cultural backgrounds (2).

The two main groups of people in the NEC are Bantus and Nilotes and, culturally are farmers. Therefore most of the goods expected to originate from the areas these people occupy will be mostly agricultural goods; food and cash crops and, live animals and animal products. Conversely, these groups of people constitute the market for agricultural inputs as well as a market for industrial consumer goods.

6.3 DEMOGRAPHIC PROFILE

6.3.1 Population

According to the Kenya National Bureau of Statistics (KBNS) (3), Kenya's population is projected to be 47.47 million by 2017, an increase

(1) http://www.bluegecko.org/kenya/contexts/bantu.htm
(2) http://www.bluegecko.org/kenya/contexts/nilotes.htm
(3) KNBS, Population and Housing Census 2009

of over 1.2 million since 2016. The natural increase is expected to be positive, as the number of births will exceed the number of deaths by 1, 247,263. *Table 6.1* below shows the population between 1951 and 2010, while *Table 6.2* shows the Country's projected population from 2020-2050.

Table 6.1 Kenya's Population 1951-2010

Year	1951	1960	1970	1980	1990	2000	2010
Pop.	6,158,567	7,982,960	11,060,092	15,964,660	23,057,234	30,683,530	39,799,151

Source: KNBS, 2009

Table 6.2 Kenya's Projected Population 2020-2050

Year	2020	2025	2030	2035	2040	2045	2050
Pop.	52,186,722	58,610,170	65,411,901	72,599,575	80,090,725	87,770,496	95,504,636

Source: KNBS, 2009

Box 6.3 Opportunities - Increasing Population

- A growing population can generate economic growth
- The labour force increases if the rise in population has resulted from an increase in the birth rate or immigration. The expanding economy industries can recruit new workers to the labour from this labour force
- If the population is above the optimum size, the country will be able to make better use of its resources
- A large population translates into a greater domestic market, a stimulating investment in knowledge and attracting investors and multinational companies in areas that previously lacked them

Box 6.4 Constraints - Increasing Population

- If a country is currently overpopulated and agricultural productivity is low, there is a risk that the country may not be able to feed more dependants
- Resources which could have been used to improve living standards may have to be devoted to the provision of goods and services for the extra number of dependants in the population
- Increases in population may put pressure on the government to divert resources from productive sectors to provision of social services
- More people in a country will exert pressure on natural resources
- An increase in the number of people of working-age without a corresponding increase in appropriate skills and jobs will result in unemployment
- More dependants in the population may result into an increased burden on the working population and the economy.

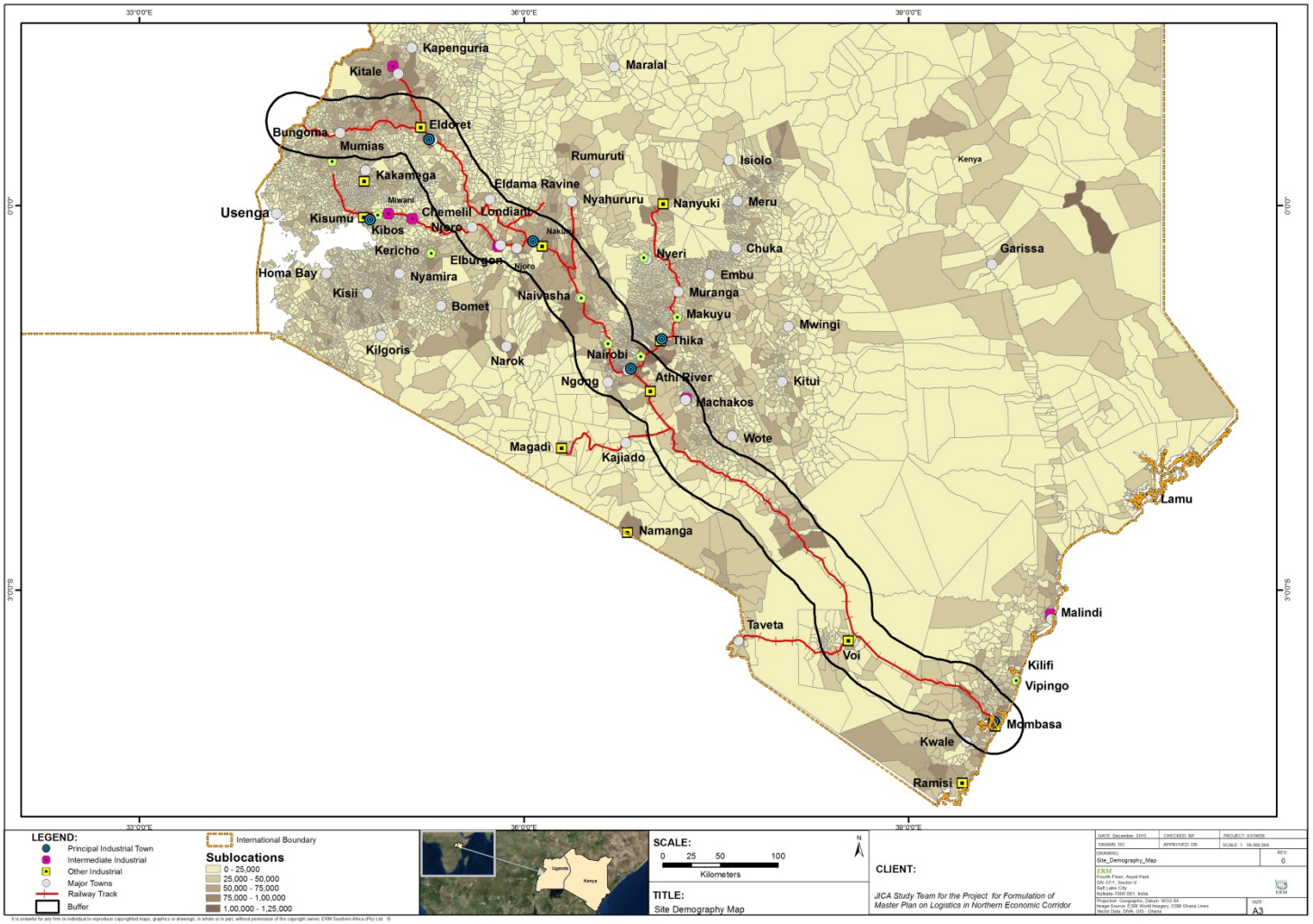
6.3.2 Population Density

Within the NEC, high population densities occur in the following Counties: Mombasa, Nairobi, Machakos, Kiambu, Muranga, Nyeri, Nyandarua, Trans Nzoia, Bungoma, Kericho, Kakamega, Vihiga, Siaya, Kisumu, and Bomet. Moderate population densities are found in Makueni, Uasin Gishu, Nakuru, Tran Nzioa and Nandi Counties. Low population densities are in Taita Taveta, Kajiado, Narok and Elgeyo Marakwet Counties (see *Figure 6.2*).

Box 6.5 Constraint - High Population Density

Densely populated areas within the NEC means that implementation of some the Development Strategies would require that many people are displaced and resettled elsewhere and their properties compensated appropriately. High resettlement and compensation costs can in turn make the infrastructure projects costly.

Figure 6.2 Population Density in the NEC Main Route



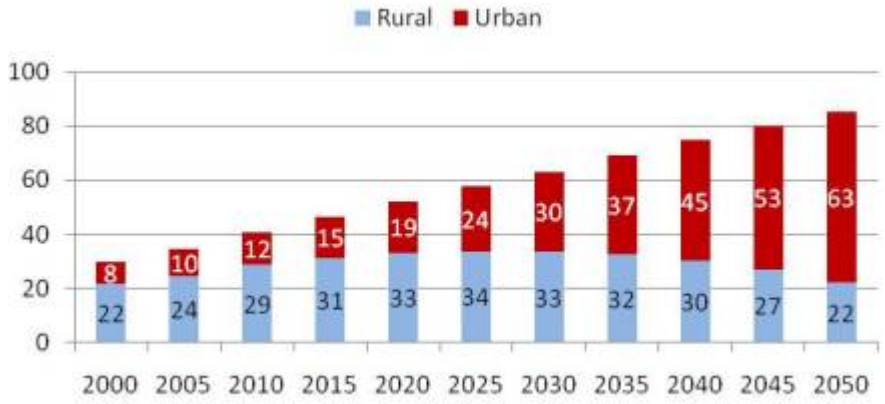
6.3.3 *Rural to Urban Migration*

Approximately 30% of the Kenyan population currently reside in urban areas. However, the number of people migrating from rural to urban areas is increasing, for the following reasons:

- It is believed that good jobs are found in the urban areas and industries in the major towns,
- Better living standards and services in the urban areas, and
- Insecurity, famine and natural disasters in the rural areas.

While the total national population will double by the year 2045, the urban population will more than quadruple. According to the World Bank (2010), by the year 2033 the Country will reach a "spatial tipping point", when half of the Kenyan population will reside in the urban areas.

Figure 6.3 ***Rural and Urban Population in Kenya***



Source: World Bank, 2010

Box 6.6 ***Opportunities - Rural and Urban Migration***

- The industrial centres and logistics hubs will have ready semi-skilled and unskilled labour.
- Agricultural, industrial and mining and oil development projects will be developed and logistics hubs to reduce the rural-urban migration trend will be established

Box 6.7 Constraint - Rural and Urban Migration

- **Rural areas** are deprived of labour in agricultural sector leading to decline or slow growth of agricultural output; and families and cultural bonds break or weaken as the population moves to the urban areas.
- As the population moves to the **urban areas**, unemployment increases, crime rates rise, slums or shanties develop and social services become inadequate.

6.4 EDUCATION PROFILE

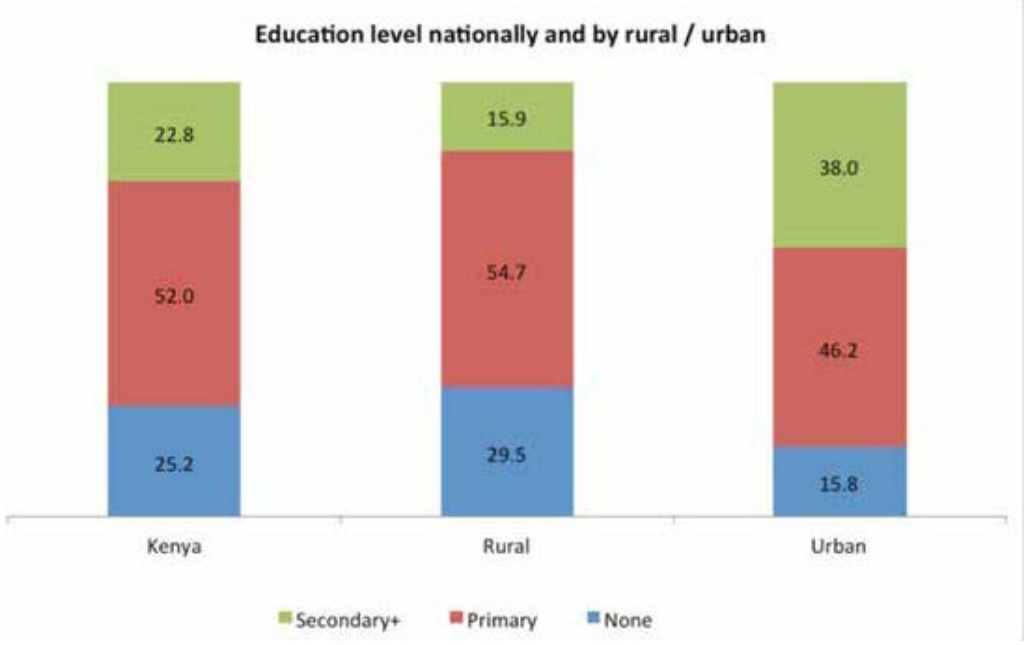
Major urban areas in Kenya have high education levels but there are very large disparities with regards to levels of education within these populations. Mombasa, Nairobi, Nakuru, Eldoret and Kisumu all have gaps between highest and lowest wards in share of residents with secondary school education or higher levels. In most rural counties, education levels are lower but the gap, while still large, is somewhat lower than that experienced in urban areas (1) .

The share of residents with secondary education or higher in Nairobi (50.8%) is more than that of an average Kenyan County. Conversely, those living in rural counties are less likely to have any secondary education compared to an average Kenyan. The proportion of individuals with secondary education in male headed households is higher than that for female headed households across all Counties.

The Counties with the highest share of primary education are concentrated in the Western part of the Country, specifically Siaya, Vihiga and Busia. Elgeyo Marakwet. *Figure 6.4* below shows the education levels in the Country.

(1) KNBS & SIDS, 2013. Exploring Kenya's Inequality. Pulling Apart or Pooling Together?

Figure 6.4 Education Levels in Kenya



Source: KNBS and SID, 2013

The percentage of residents by level of education varies from County to County. The Counties with the highest residents without formal education are Kwale and Kilifi, while Counties with the lowest residents without formal education are Nairobi and Kiambu. The Counties with residents with the lowest level of primary education are Kajiado and Mombasa and the Counties with residents with the highest level of primary education are Kitui, Nyandarua, Elgeyo Marakwet, Nandi, Busia and Kericho. The Counties with residents with the lowest level of secondary education are Kwale and Mombasa and Counties with residents with the highest level of secondary education are Nairobi, Kiambu and Mombasa.

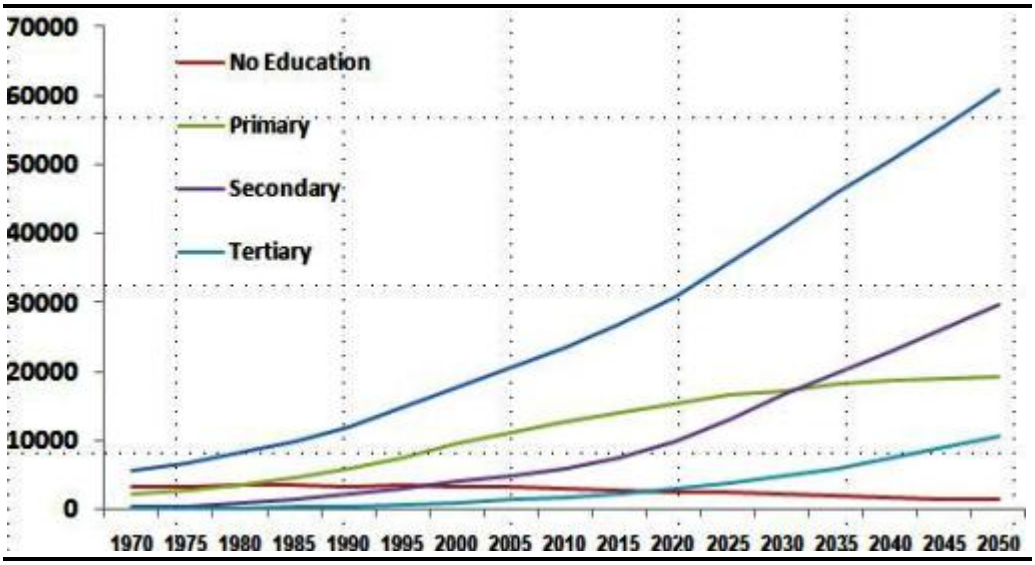
Table 6.3 below shows the percentage of residents within the NEC and their levels of education, while *Figure 6.5* presents the national levels of education between 1970 and 2050.

Table 6.3 Percentage of Residents by Level of Education (in %)

County	No education	Primary education	Secondary education	*County*	No education	Primary education	Secondary education
Mombasa	17	46	37	Narok	38	51	11
Kwale	39	51	10	Nakuru	17	55	28
Kilifi	36	52	13	Baringo	36	48	16
T.Taveta	18	60	21	U.Gishu	17	54	29
Kitui	25	62	14	Nandi	19	63	19
Makueni	17	62	21	E.Marakwet	20	62	18
Kajiado	31	42	28	T. Nzoia	20	59	21
Machakos	15	58	27	Kakamega	21	61	19
Nairobi	11	39	51	Vihiga	18	63	20
Kiambu	12	48	40	Bungoma	18	61	21
Muranga	14	62	25	Busia	23	62	16
Nyandarua	16	62	22	Kericho	16	62	22
Nyeri	12	54	34	Kisumu	18	57	25
Laikipia	24	53	23	Siaya	16	64	20
Bomet	17	64	19	West Pokot	55	38	06
Turkana	82	15	03				

Source: KNBS & SID Report, 2013

Figure 6.5 Education Levels in Kenya, 1970-2050



Source: World Bank, 2010

Box 6.8 Opportunities - High Education Levels

- High education levels will provide a steady workforce for the NEC Development Strategy Projects
- High education levels will also result in workers with higher incomes that ultimately contribute more through taxes over the course of their lifetimes.

Box 6.9 Constraints - High Education Levels

- High education levels without relevant and sufficient skills for agricultural, industrial mining and oil development and transport infrastructure projects would result in structural and frictional unemployment and a waste of manpower.
- Lack of relevant and sufficient skilled manpower locally would mean the County would have to depend on foreign manpower to develop the agriculture, industrial, mining and oil and transport infrastructure projects proposed in the NEC Master Plan. As foreign manpower would be paid in foreign currencies, this would result into loss of scarce foreign exchange for the country

6.5 HEALTH PROFILE

According to the Ministry of Health (2013), Kenya currently has a total of 9,694 health facilities that are government, private, NGO and religious owned. The majority of Kenya's population within the NEC receives healthcare services from the public sector. The range of services includes:

- **preventive services**, which includes routine childhood immunizations and environmental activities to control mosquito breeding,
- **promotive services** that are mostly educational services provided to the general population on healthy lifestyles and available interventions, and
- **curative and rehabilitative services**, which include all treatment activities available at hospitals and other healthcare facilities.

Under the devolved government system, healthcare facilities are organised into 6 levels as follows:

- **Level 1: Community Health Services**, which are community-based demand services,
- **Level 2: Dispensaries** for both public and private health services providers,
- **Level 3: Health Centres,** provided by county governments
- **Level 4: Sub County Referral Hospitals**, which are managed by the respective County Governments,
- **Level 5: County Referral Hospital**, which are managed by the National Government, and
- **Level 6: National Referral Hospitals**, which comprise of facilities that provide highly specialized services and include all tertiary referral facilities.

In the NEC, all 29 counties have Level 1-4 healthcare facilities. Only 6 Counties have Level 5 health care facilities, namely:

- Nairobi County (Kenyatta National Hospital),
- Mombasa County (Coast General Hospital),
- Nakuru County (Nakuru Hospital),
- Kisumu County (Kisumu Hospital), and
- Kakamega County (Kakamega Hospital).

Within the NEC, there are a total of 4 Level 6 healthcare facilities as follows:

- Kenyatta National Hospital, Spinal Injury Hospital and Mathere Mental Hospital in Nairobi County, and
- Moi National and Teaching Hospital in Uasin Gishu County.

In 2012, the Country had an average of 19 doctors and 173 nurses per 100,000 population, compared to WHO recommended minimum staffing levels of 36 and 356 doctors and nurses per 100,000 people (1) .

About 52% of Kenya's population have access to basic health services within 5 km. Access to basic primary health care and referral services, however, still remains a significant challenge. Significant disparities in service availability exist between rural and urban areas and in hard to reach areas. Mortality rates remain high and the causes of death in both the Country and NEC Counties include:

(1) Health Sector Working Group Report, 2012

- HIV/AIDS (29.3%),
- perinatal conditions (9.0%),
- lower respiratory infections (8.1%),
- tuberculosis (6.3%),
- diarrhoea (6.0%), and
- malaria (5.8%).

Other causes of death include cerebrovascular diseases, ischaemic heart disease, road traffic accidents and violence.

Box 6.10 Opportunities - Health

- Availability of adequate health facilities and health workers in the NEC will control common diseases such as Malaria and HIV/AIDS. This will increase the quality of labour force in the NEC and consequently increase overall productivity in agricultural, industrial and transport sectors.
- The strategy to move cargo from the trucks to the railway and pipeline will decrease the spread of HIV/Aids along the major trucking routes.

Box 6.11 Constraints - Health

- Poor access to basic primary health care
- High mortality rates
- Low staffing levels of doctors and nurses
- Prevalence of communicable disease in the country
- Poor health affects the quality of labour

6.6 SOCIAL INFRASTRUCTURE

6.6.1 Water and Sanitation

Most of the residents in the NEC use improved sources of water. An improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside

contamination, in particular from contamination with faecal matter (1). However, less than half of the residents in Kwale, Makueni, Kitui, Machakos, Muranga, Baringo, Nandi, Bomet and Siaya Counties use unimproved sources of water, as presented in *Table 6.3* below.

(1) http://www.wssinfo.org/definitions-methods/watsan-categories/

Table 6.4 Percentage of Residents Using Improved and Unimproved Water Sources by NEC County

County	Improved water source (percentage)	Unimproved water sources (percentage)	County	Improved water source (percentage)	Unimproved water sources (percentage)
Mombasa	76	24	Nakuru	60	40
Kwale	47	53	Baringo	24	76
Kilifi	64	36	U.Gishu	74	26
Taita Taveta	68	32	Nandi	37	63
Kitui	26	74	E.Marawet	51	49
Makueni	36	64	Trans Nzoia	65	35
Kajiado	66	34	Kakamega	61	39
Machakos	37	63	Vihiga	63	37
Nairobi	84	16	Bungoma	73	27
Kiambu	75	25	Busia	61	29
Muranga	41	59	Kericho	40	60
Nyandarua	59	41	Bomet	24	76
Nyeri	64	36	Kisumu	54	56
Laikipia	50	50	Siaya	36	64
Narok	21	79	West Pokot	25	75
Turkana	39	61	-	-	-

Source: Compiled from KNBS & SID Reports, 2013

Box 6.12 Opportunities - Water

- Inadequate water supplies in the NEC will make it possible for relevant authorities to plan for better water use, conservation and management of water resources.
- It is essential to ensure that the NEC is planned to protect water resources and water harvesting areas to protect water quality

Box 6.13 Constraint – Water

- Lack of access to improved water services is a cause of water borne diseases
- Women and children labour is spent more on looking for water rather than for productive purposes
- Lack of water frustrates the demand of the commodity for domestic use, food production and industrial development
- Water shortages due to drought limit the amount of hydro-electric power produced in the country. This adversely affects industries and businesses

6.6.2 *Energy*

Majority of the residents in the NEC use firewood for cooking followed by charcoal (see *Table 6.5*). LPG is the least used energy source for cooking. Paraffin is mostly used in Mombasa, Nairobi and Kiambu Counties. This means that if the present rate of using firewood and charcoal is not well managed, more trees in the NEC will be harvested in future. Loss of trees would result in deforestation, especially if the rate of tree planting is less than the rate at which trees are harvested (as is the case presently).

Table 6.5 Percentage Energy Use for Cooking by NEC County

County	LPG	Paraffin	Firewood	Charcoal	County	LPG	Paraffin	Firewood	Charcoal
Mombasa	9	39	6	41	Nakuru	5	8	46	40
Kwale	1	6	80	11	Baringo	1	1	87	11
Kilifi	2	8	67	21	U.Gishu	5	7	55	32
Taita Taveta	2	5	69	24	Nandi	1	1	89	8
Kitui	1	2	89	8	E.Marakwet	1	1	90	8
Makueni	1	3	85	11	T.Nzoia	1	3	77	18
Kajiado	13	19	41	25	Kakamega	1	2	87	9
Machakos	3	11	69	16	Vihiga	1	2	91	6
Nairobi	23	54	1	17	Bungoma	1	2	85	11
Kiambu	13	23	35	26	Busia	1	2	84	13
Muranga	2	6	85	7	Kericho	1	2	84	12
Nyandarua	1	1	78	19	Bomet	1	2	92	5
Nyeri	5	5	73	16	Kisumu	3	7	58	29
Laikipia	3	3	65	29	Siaya	1	2	82	15
Narok	1	2	80	17	West Pokot	1	1	91	7
Turkana	1	1	87	11	-	-	-	-	-

Source: Compiled from KNBS & SID Reports, 2013

6.6.3 *Housing*

Majority of residents in the 29 Counties of the NEC have houses with corrugated iron sheet roofs (see *Table 6.6)*. Muranga and Nairobi Counties have substantial percentages of residents that have houses with concrete roofs.

In the event that residents along the Corridor are required to give-way to development of some of the proposed NEC projects, they would have to be relocated and resettled elsewhere. Compensation for loss of housing would take into account the costs of materials used to build the houses.

Table 6.6 Percentage of Residents in the NEC Counties by Roofing Materials

County	Concrete roof	Corrugated iron sheet	Grass and makuti roof	Mud/dug roofs	Others
Mombasa	9	75	4	1	11
Kwale	1	37	60	None	2
Kilifi	2	42	52	None	4
Taita Taveta	1	85	8	1	0
Kitui	1	76	21	1	0
Makueni	1	87	11	None	1
Kajiado	3	67	11	10	8
Machakos	3	89	5	None	3
Nairobi	21	65	1	None	13
Kiambu	7	88	3	1	1
Muranga	2	94	1	1	2
Nyandarua	1	95	1	None	3
Nyeri	2	94	None	None	4
Laikipia	2	80	10	3	5
Narok	1	49	35	11	4
Nakuru	1	87	6	1	5
Baringo	1	58	39	1	1
U.Gishu	1	84	8	1	0
Nandi	1	82	15	None	2
E. Marakwet	1	58	39	1	2
T. Nzoia	1	83	14	None	2
Kakamega	1	77	20	None	2
Vihiga	1	92	4	None	3
Bungoma	1	78	19	None	2
Busia	1	50	49	None	1
Kericho	1	83	14	1	1
Bomet	1	68	27	1	3
Kisumu	1	85	9	None	5
Siaya	1	66	32	None	1
West Pokot	None	27	68	4	0
Turkana	None	12	72	1	0

Source: Compiled from KNBS & SID Reports, 2013

6.7 TRANSPORTATION INFRASTRUCTURE

6.7.1 Roads

As discussed in *Chapter 5,* the primary infrastructure component of the NEC is the Main Arterial Road (MR) (A109 and A104 highway) which links Mombasa and Malaba.

Roads are the most fundamental infrastructure for logistics in Kenya. In fact, cargo from Mombasa Port to seven countries namely Kenya, Uganda, Rwanda, Burundi, D.R.Congo, South Sudan and Tanzania,

relies significantly on road transport by heavy trucks and trailers. The dominant share of road transport is said to be more than 95%.

Along the NEC, there are increasing traffic demands and bottlenecks of road traffic in the urban areas of Mombasa, Nairobi, Nakuru, Eldoret, Kisumu and their surrounding areas, as well as around the borders, Mombasa Port and railway stations. Road sections with four lanes are limited to Mombasa, Nairobi and Nakuru and trunk roads with high capacity are limited. The road's surface on the main route is generally good although there are many potholes in Mombasa County. The section between Nairobi and Eldoret has good surface and well balanced capacity.

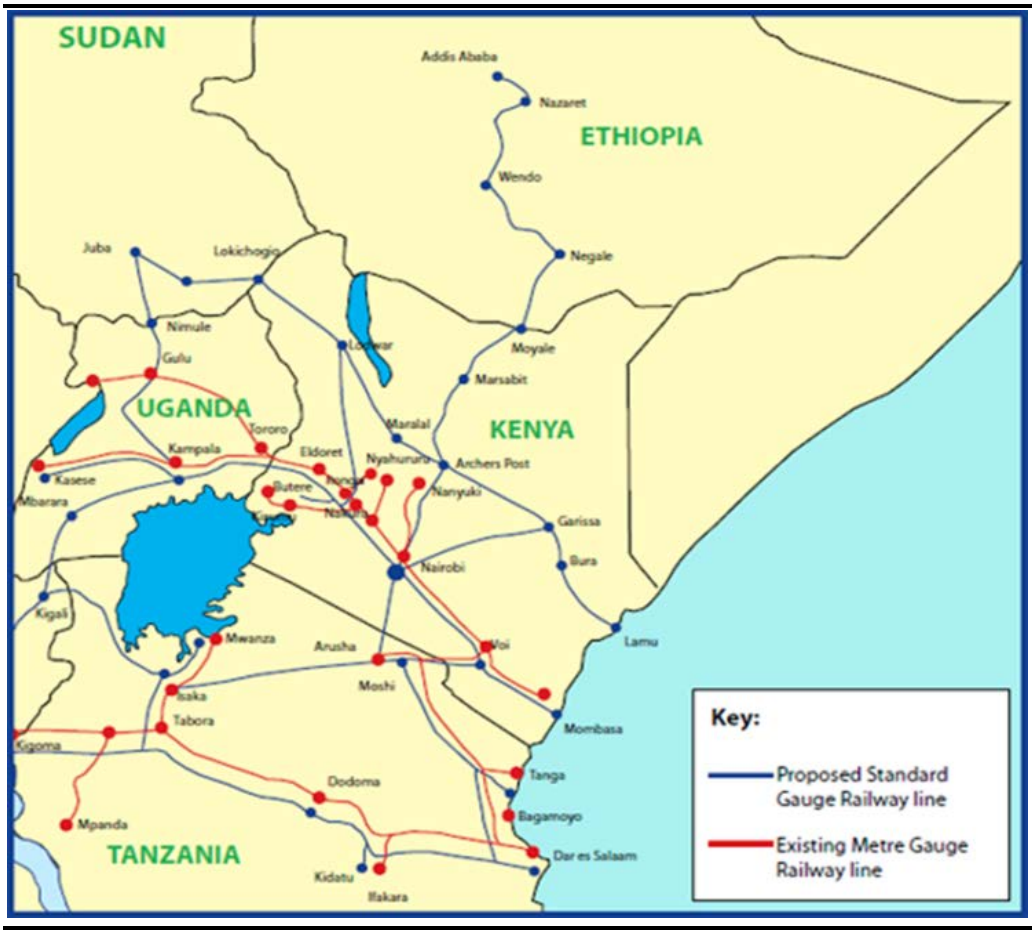
Box 6.14 Constraints - Current State of the Roads along the NEC

- Congestion in city centres of Mombasa, Nairobi, Nakuru, Eldoret, Kisumu, as well as around the borders of Malaba and Busia, and Mombasa Port
- Long queues on Mombasa weigh bridge.
- Quick deterioration of road surfaces due to overloading by trucks
- Accident black spots along Nairobi – Mombasa road
- Lack of exclusive lanes for trucks along Nairobi – Mombasa road causing traffic jams
- Lack of alternative exit roads from Mombasa Island
- Lack of timely road repair on degraded sections

6.7.2 Railway

The Kenyan Meter Gauge Railway (MGR) system operated by Rift Valley Railways (RVR) comprises approximately 1,320 km of track. This includes the mainline of about 1,185 km from Mombasa to Malaba passing through Nairobi. Branch lines to Thika and Nanyuki complete the system. *Figure 6.6* below shows the proposed Standard Gauge Railway (SGR) Line and existing MGR Line, while *Figure 6.7* shows an inventory of current railway line operating facilities.

Figure 6.6 The SGR and MGR Lines



Source: Kenya Railways Corporation, 2016

Nairobi County has experienced serious traffic congestion that has necessitated the opening of the following three railway stations that commute to the Nairobi Railway Station:

- Syokimau railway station,
- Makadara railway station ,and
- Imara Daima railway station.

Figure 6.7 Inventory of Railway Line Operating Facilities

Marshalling yards	ICDs	Locomotive Depot	Wagon Depot	Locomotive Fuelling	SGR Location
Mombasa	Mombasa (Port Container Train Yard)				New container terminal; + possibly general cargo area
Kipevu					No
Changamwe		Changamwe	Changamwe	Changamwe	Possibly Fueling
Voi (Not Operating)		Voi (Not Operating)	Voi (Not Operating)		No
Nairobi	Nairobi	Nairobi		Nairobi	Yes; Possible addition of wagon depot
Nakuru		Nakuru (Not Operating)	Nakuru (Not Operating)	Nakuru (Not Operating)	No
Eldoret	Eldoret	Eldoret	Eldoret	Eldoret	Yard, if Kisumu branch is built
Kisumu (Not Operating)	Kisumu (Not Operating)	Kisumu (Not Operating)	Kisumu (Not Operating)	Kisumu (Not Operating)	Yard, if Kisumu branch is built

Source: JST, 2016

Box 6.15 Opportunity - the Standard Gauge Railway (SGR)

- The completion of the SGR will be in line with the NEC Master Plan and its development objectives

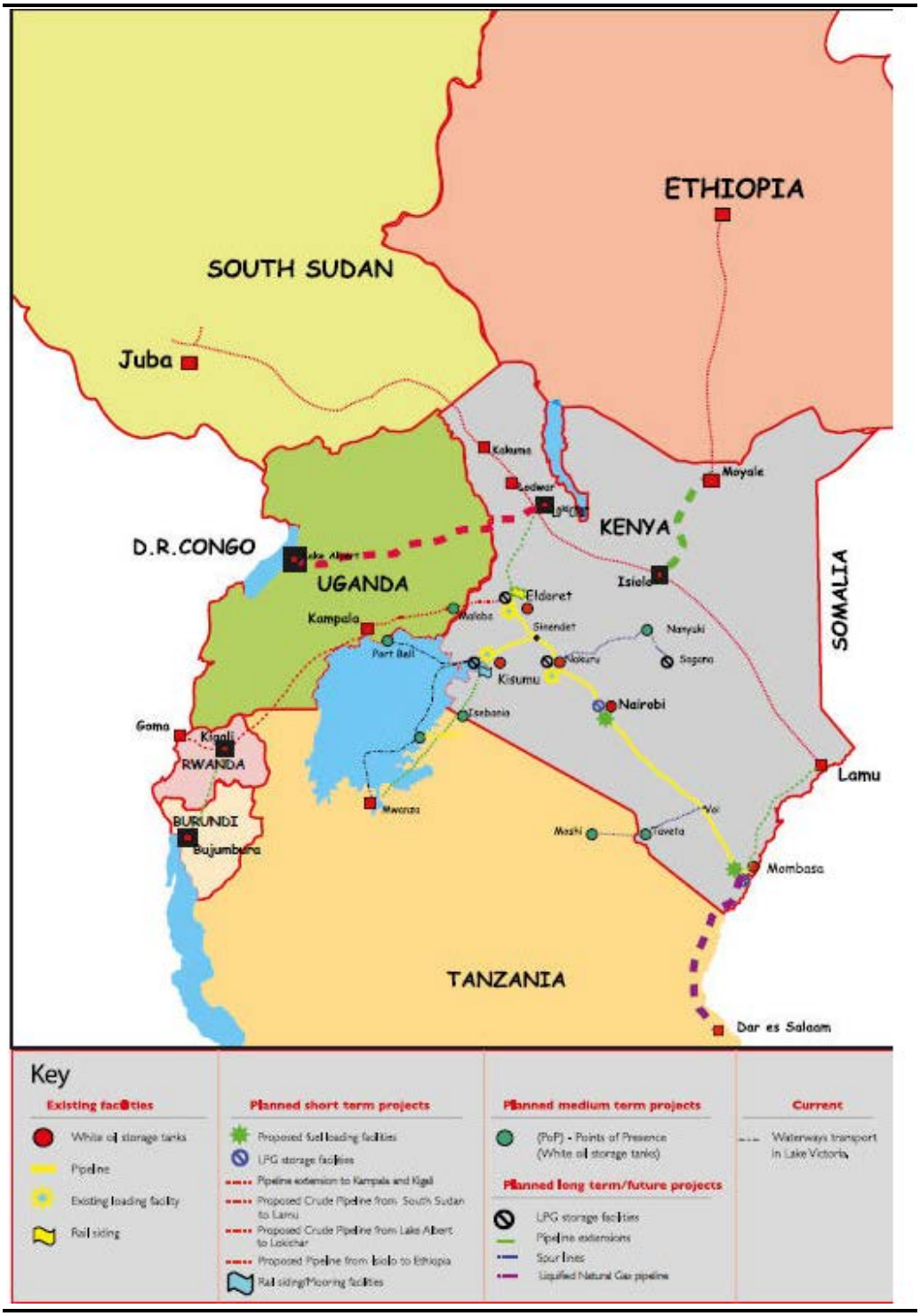
Box 6.16 Constraints on the Railway Line along the NEC

- **Financial capability of the railway operating agency – RVR.** Though RVR increased volume (net tonne kilometres) and revenue in 2014 it recorded an operating loss and negative cash flow (earnings before interest, taxes, depreciation and amortization).
- **Poor wagon and locomotive conditions and shortages.** Prior to RVR taking over the operation of the railway in 2006 and under RVR's operation through 2009, the railway suffered from lack of investment in infrastructure, rolling stock and equipment. This led to a decline in service levels and over time to a drop in volume. At the same time Kenya's economy has been growing significantly and cargo throughput at Mombasa Port has grown significantly.

6.7.3 *Pipeline*

Figure 6.8 and *Table 6.7* both show the existing pipeline network in Kenya.

Figure 6.8 Pipeline Network



Source: http://www.kpc.co.ke/operations/pipeline-network

Table 6.7 Summary of Existing Pipeline Infrastructure

Line Section	Length (KM)	Diameter (inches)	Installed Flow Rate (Litres/Hr)	Number of Pumping Stations with Dual mainline Pumps
Mombasa – Nairobi (Line I)	450	14″	830,000	8
Spur line from KOSF to SOT	2.8	12″	450,000	1
Changamwe – Moi International Airport	3.8	6″	120,000	1
Nairobi – Nakuru – Eldoret (Line II)	325	8″/6″	220,000	4
Nairobi – Eldoret (Line IV)	325	14″	378,000	2
Sinendet – Kisumu (line III)	121	6″	100,000	-

Source: JST, 2016

Box 6.17 Opportunity on the Pipeline along the NEC

- In line with the NEC strategy, the pipeline will allow for bulk transport and trucks off the roads/highways

Box 6.18 Constraints on the Pipeline along the NEC

- **Risk of spillage due to broken pipelines causing losses.** Large amounts of oil are lost through spillage, such as the one experienced at Kibwezi in May 2015
- **Danger of fires due to illegal settlement along the pipeline.** On September 12th 2011, an oil spillage in Lunga Lunga at the Industrial area of Nairobi caused a fire that caused death of around 100 people at an illegal settlement

6.7.4 Airports

The Kenyan International Airports on the NEC are:

- Jomo Kenyatta International Airport (JIKA) in Nairobi,

- Moi International Airport in Mombasa,
- Eldoret International Airport, and
- Kisumu Internitonal Airport.

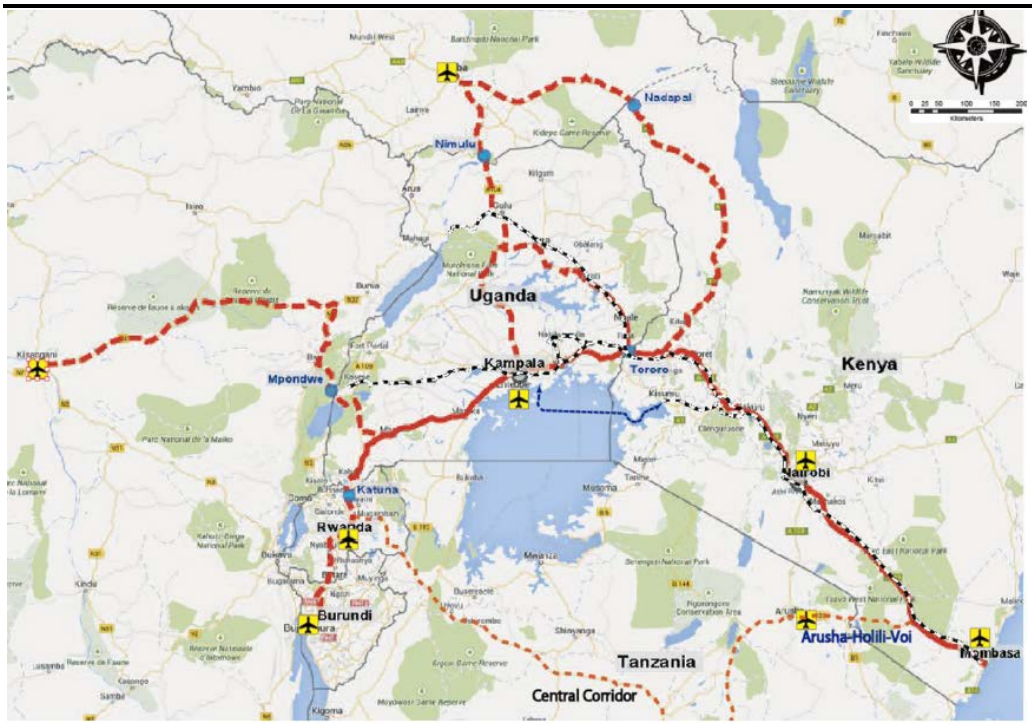
The Kenyan Domestic Airports on the NEC are:

- Wilson Airport
- Malindi Airport

JKIA is expected to be the hub of Africa for both passengers and cargo and it handled the largest cargo volume of 279 thousand tons per year in the East African Community (EAC) in 2012 (JST, 2015),

There are seven major airports around the NEC as shown in *Figure 6.9*

Figure 6.9 Location of Major Airports



Source: JST, 2015

Figure 6.10 Constraints - Airports

- Lack of efficient last mile transport from the airport to the consumer.
- Insufficient warehouses for goods at the port.

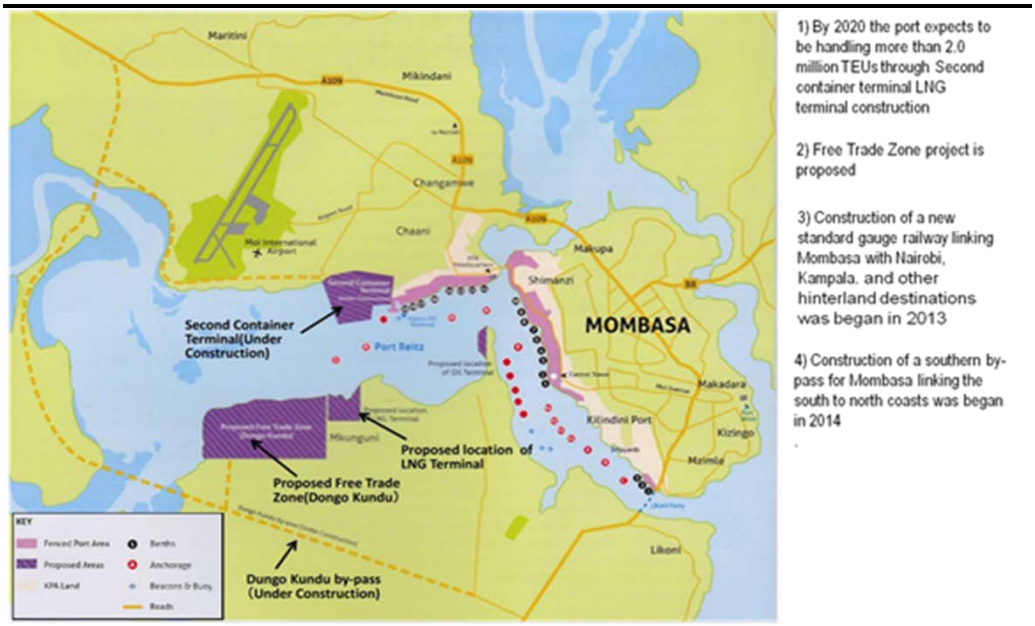
6.7.5 Port Facilities

The maritime transport system in Kenya consists of one major seaport in Mombasa and several smaller ones at the Coast. The Ports are managed by Kenya Ports Authority (KPA). The other port along the NEC is the port of Kisumu.

Figure 6.11 (see below) shows the existing and proposed facilities in Mombasa Port as follows:

1. Mombasa Port Development Project/ JICA, project schedule: November 2007 - November 2015
    a. Construction of the Second Container Terminal(depth: 15m and 11m; berth ×2)
    b. Procurement of cargo handling equipment (SSG cranes and RTG cranes)
    c. Construction of an access road (approx. 1.6km)
    d. Dredging works (dredging volume: approx. 3 million cubic meters)
    e. Consulting services (detailed design, bidding assistance, construction supervision and assistance for selection of terminal operators, etc.)
    f. Master Plan on Logistics in Northern Economic Corridor
2. Project on Master Plan for Development of Dongo Kundu, Mombasa Special Economic Zone/ JICA, project schedule: January 2014-March 2015
3. The Project for Technical Assistance to Kenya Ports Authority on Dongo Kundu Port, Mombasa Master Plan/ JICA, project schedule: August 2014 - October 2015
4. Study on the Project for Construction of Mombasa Gate Bridge/ JICA
5. Construction of a new SGR linking Mombasa with Nairobi, Kampala and other hinterland destinations, which began in 2013
6. Construction of a Southern By-Pass for Mombasa linking the South to North Coast (began in 2014).

Figure 6.11 Proposed and Existing Facilities at the Port of Mombasa



Source: JST, 2016

Box 6.19 Constraints - Ports

- Congestion of urban roads within Mombasa town.
- Long cargo clearance time.
- Lack of sufficient funding to develop infrastructure.
- Multi – agency clearance at the port contributing to the high cost of doing business.
- Lack of synergy among the key stakeholders involved in clearing cargo.
- Lack of strict regulations to distribute cargo fairly among the different modes of transport from the port leading to over dependence on trucks.

6.7.6 Inland Waterways

There are six ports around Lake Victoria, namely:

- Kisumu in Kenya,
- Jinja and Port Bell in Uganda,
- Mwanza, Musoma and Kemondo Bay in Tanzania.

Along the NEC, Kisumu, Jinja and Port Bell have been used for railway cargo transit in the past. Currently, Port Bell is operation with cargo coming in once a week or several times a month.

In the recent years, cargo transport has shifted from lake transport to road transport with the decline of railway logistics. It is possible to revive the Lake Transport after the SGR project is completed and railway is operating and covering the region.

Box 6.20 Opportunities - Inland Waterways

- **Increased linkages among the ports on Lake Victoria.** Kisumu and Port Bell will be well linked with Mwanza port through the improvement of infrastructure of wagon/car ferry port and provision of new vessels including car ferry and passenger vessels.

6.8 URBANISATION

Urbanization refers to a process in which increasing proportion of an entire population lives in cities and the suburbs of cities. As stated in *Section 6.3.3* over the years, urban centres in the NEC have been experiencing population increase due to rural-urban migration. The urban population is growing very fast, while the economic growth and development transformations necessary to support it and enhance quality of life are not occurring at the same rate.

The populations of major urban centres by 2012 are as indicated in *Table 6.8* below, while *Figure 6.12* shows the Cities, Municipalities and Towns within the NEC. Figure 6.13 shows urban growth trends in Kenya from 1948-2009.

Table 6.8 Population within Urban Centres in the NEC

Urban Centre	Population	Urban Centre	Population	Urban Centre	Population
Mombasa	1.2 million	Matuu	53,144	Nairobi	3.5 million
Mariakani	89,321	Kangundo-Tala	218,557	Ongota Rongai	40,178
Mtwapa	48,625	Machakos	150,041	Ruiru	238,858
Ukunda	62,529	Athi River	139,380	Kikuyu	233,231
Voi	45,483	Ngong	107,188	Kiambu	88,869
Wundanyi	62,404	Kitengela	58,167	Juja	40,446
Naivasha	181,966	Gilgil	35,293	Maragua	32,315
Thika	139,853	Karuri	129,934	Makuyu	71,913
Molo	107,806	Limuru	104,282	Ol Kalou	66,015
Rumuruti	66,015	Nyahururu	51,434	Nandi Hills	73,626
Eldoret	289,380	Burnt Forest	32,993	Malava	60,831
Luanda	49,346	Malakisi	41,784	Vihiga	118,696
Mumias	116,358	Webuye	65,280	Kimilili	94,927
Kapsabet	91,030	Kakamega	91,768	Nambale	34,735

Urban Centre	Population	Urban Centre	Population	Urban Centre	Population
Busia	61,715	Malaba	63,324	Kisumu	409,928
Londiani	44,953	Kipkeleon	49,939	Kericho	104,282
Ukwala	57,081	Awasi	93,369	Ahero	76,828
Siaya	45,353	Muhoroni	34,457	Ugunja	33,878
Yala	33,646	Kapengria	71,477	Kakuma	65,814
Lodwar	58,218	-	-	-	-

Source: Compiled from KNBS & SID Reports, 2013

Figure 6.12 Cities, Municipalities and Towns found along the NEC Main Route

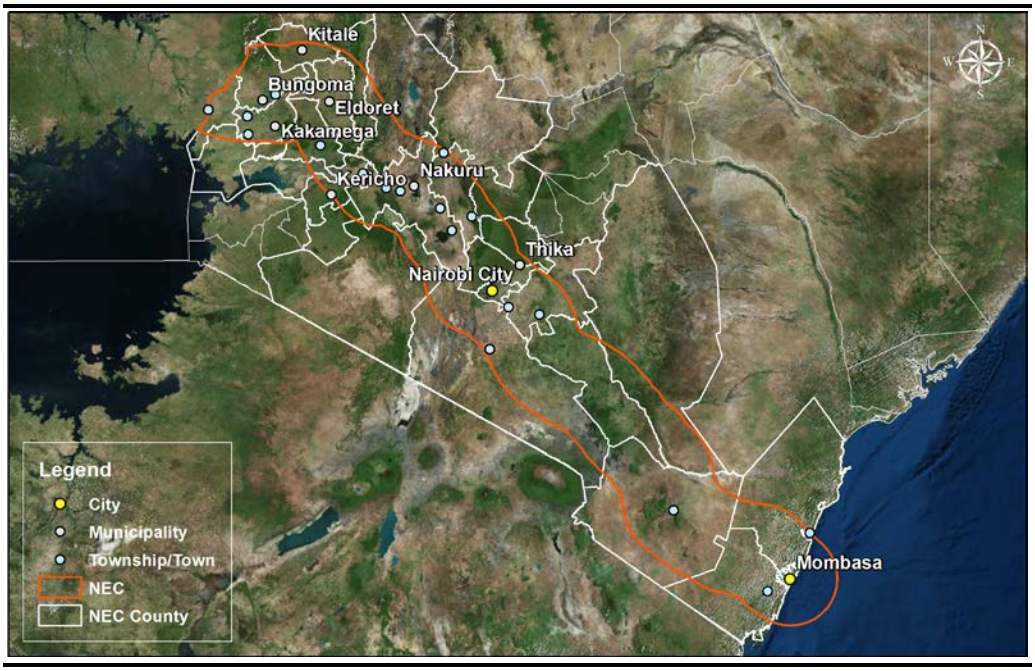
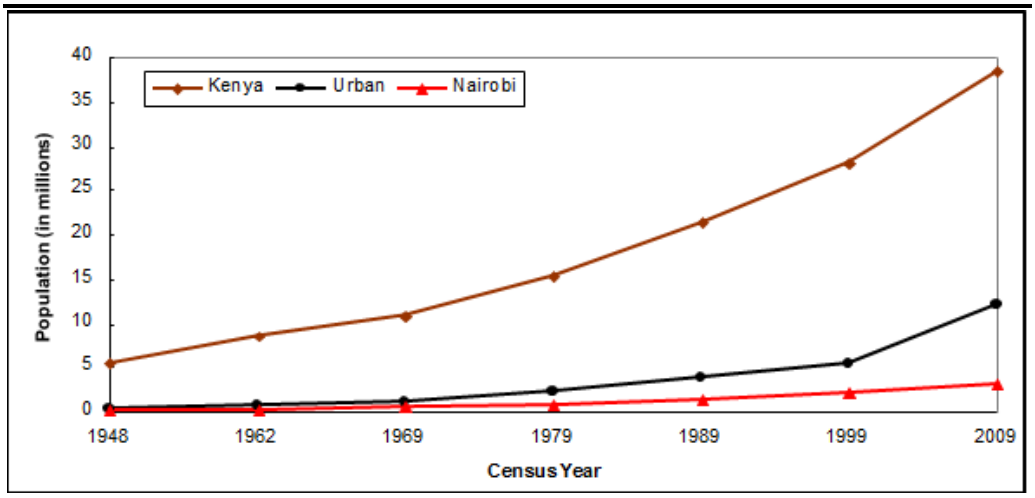


Figure 6.13 Trends of urban growth in Kenya (1948-2009)



Source: Ministry of Planning and National Development and Vision 2030

Box 6.21 ***Opportunity - Urbanisation***

- Urbanization will result in social, economic, environmental and spatial development challenges that will be addressed by the Master Plan. Implementation of regional, industrial and transport strategies of the Master Plan are meant bring about that desired development,

Box 6.22 ***Constraints - Urbanisation***

- Urbanization will encourage rapid inflows of rural populations to urban areas that give rise to housing problems and the development of slums
- An increase in urban areas will pressurise water and sanitation facilities and potentially result in environmental pollution, as well as increased unemployment in urban areas

6.9 LAND ISSUES

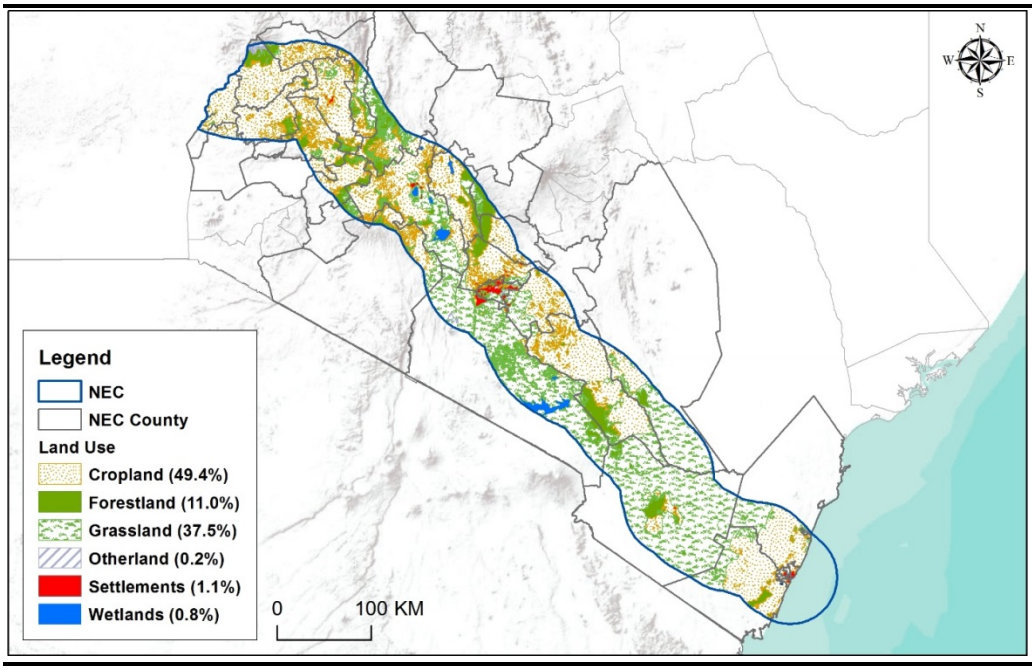
6.9.1 Land Use

Land use types along the NEC vary significantly as it traverses northwards through the landscape. Factors such as land value, zoning rules that control development, technology, climate and proximity to network infrastructure (e.g. availability of water, electricity and telecommunication) influence the land use along the Corridor.

Residential, commercial, educational, public purpose, public utilities, transportation and industrialization are the land uses found along the NEC. Changes in land use are very popular along the NEC as land that was previously meant for agricultural purposes is being changed to residential, commercial and industrial land uses. *Figure 6.14* shows the land use classification according to the Kenya Forest Service (KFS) (1) .

(1) Data for the sub-route was not available

Figure 6.14 Land Use along the NEC Main Route



Source: Kenya Wildlife Services, 2015

Box 6.23 Constraint - Land Use Conflicts and Conversions

Implementing the Master Plan Development Strategies could result in land use conflicts. Use of certain areas/parcels of land to implement the Development Strategies will need trade-off with other existing and potential uses e.g. developing transport infrastructure in certain sections of the NEC would require converting agricultural and conservation land for such a purpose. In sections where conversions are resisted, land use conflicts and litigations may occur which can delay and increase the cost of the project.

6.9.2 Land Tenure

Land tenure is the relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land. In this case "land" is used to include other natural resources such as water and trees.

Rules of tenure define how property rights to land are to be allocated within societies. They define how access is granted to rights to use, control, and transfer land, as well as associated responsibilities and restraints. In simple terms, land tenure systems determine who can use what resources for how long, and under what conditions, it is an

important part of social, political and economic structures and it is therefore very important to put it into consideration (FAO, 2009).

The land tenure system along the NEC falls into the following broad categories:

- **Private/ individual**, where land rights are assigned to a private party who may be an individual, a married couple, a group of people, or a corporate body such as a commercial entity or non-profit organization,
- **Community/ Customary**, where land rights exist within a community and each member has a right to independently use the holdings of the community. For example, members of a community may have the right to cultivate on a common piece of land, and
- **Public/ State**, where property rights are assigned to some authority in the public sector. For example, open spaces fall under the mandate of the state and all members of the state can use them freely.

Along the NEC land is either owned on lease or freehold. In many rural areas land is owned on freehold, this gives the holder absolute ownership of the land for life. This means that descendants can remain as the owner for as long as the family lineage exists. A freehold title deed has no restrictions as to the use or occupation.

In urban areas land is mostly owned on leasehold where the interest in land is for a specific period, subject to payment of a fee or rent to the grantor. Payment of rates is made to the respective local authority for services rendered. Leases are granted by:

- Government for public land,
- local authority for trust land, and
- individuals with freeholds.

The maximum term of government leases is 999 years for agricultural land and 99 years for urban plots. It is also common to find 33 year leases in respect to urban trust land.

6.9.3 Land Values along the NEC

Land value in Kenya is determined by the economic principle of highest and best use of land which produces the highest net return in any term, over a period of time. As mentioned previously, the NEC traverses 29

Counties and the land values for the various counties are different as they are influenced by:

- physical attributes,
- accessibility to economic activities,
- present and future land use,
- location and transport linkages, and
- demand and supply for the land.

Figure 6.15 shows the land values in the counties along the NEC

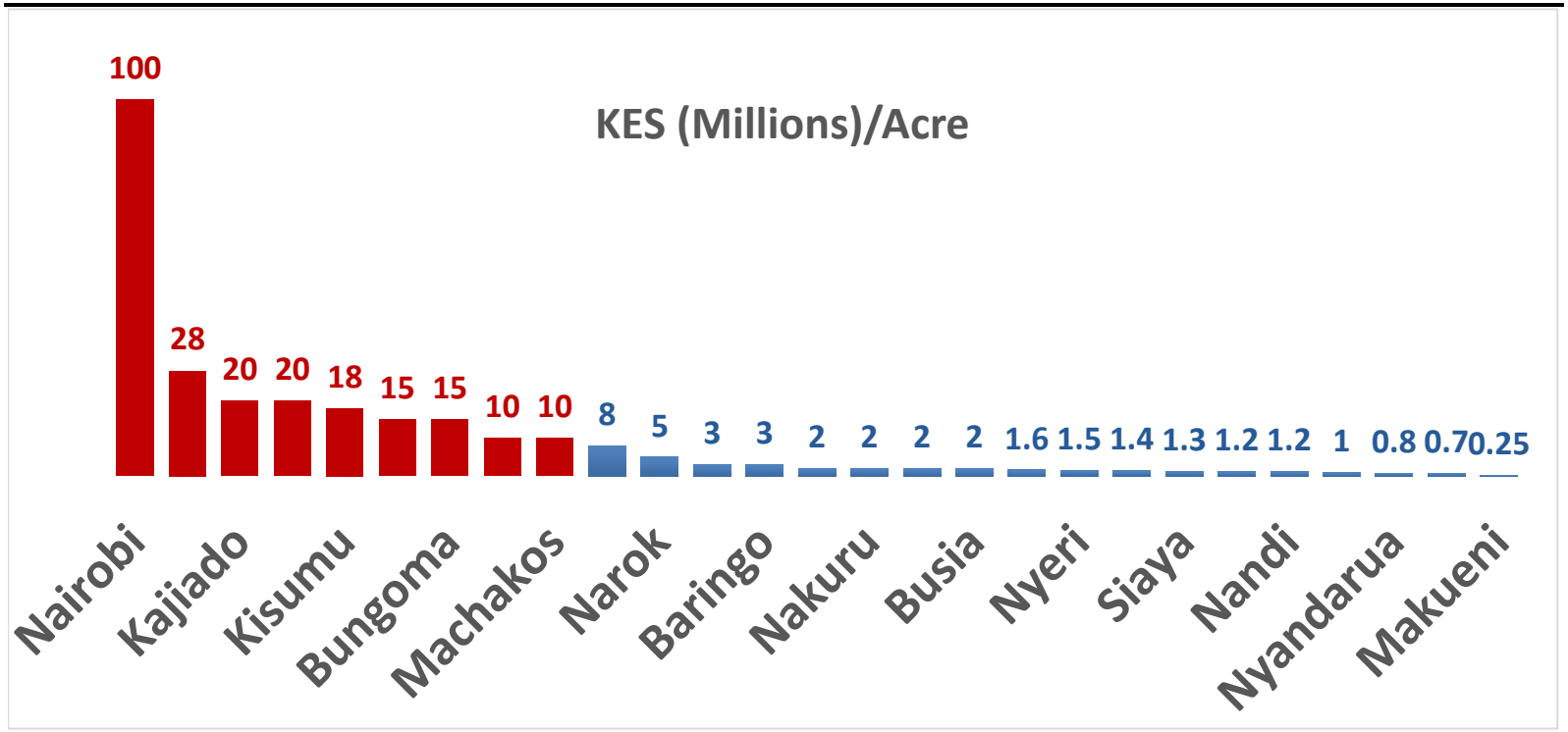
Box 6.24 Opportunity – Understanding Land Values

- Factors affecting land value are of importance in calculating or estimating land prices, understanding of these factors will provide more accurate and realistic price of land when it comes to land acquisition and negotiation of wayleave during implementation of the Master Plan

Box 6.25 Constraint - High Land Values

- Resettlement and compensation will be highest in Nairobi and Mombasa Counties
- Land speculation may drive the land prices even higher

Figure 6.15 Land Values along the NEC



6.9.4 *Settlement Patterns along the NEC*

Human settlements are defined as communities or groups of people living together in a particular place to realize certain objectives. Human settlements therefore have 3 major roles:

- **Residential functions,** particularly for those people who derive their livelihood from non-farming activities. It is usually assumed that those in agricultural areas have their own accommodation,
- **Service functions**, the settlements have to offer some facilities such as educational, health, administrative, social-cultural etc.
- **Economic functions** usually offered by the settlements including markets, goods and services, employment and income generating opportunities and also enable people to access manufactured goods.

As settlements grow, they form identifiable patterns depending on the various factors which limit their growth in different areas. There is therefore a range of settlement patterns exhibited along the NEC, as discussed in the *Sections* below:

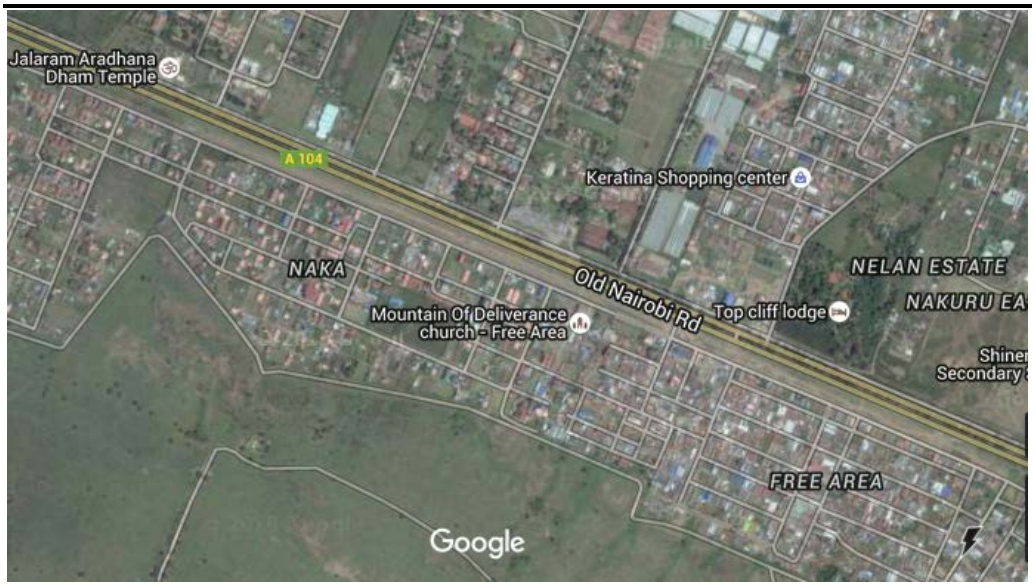
Linear Pattern

This type of settlement pattern develops when structures are built along linear features such as roads, rail, a coastline and rivers. Many Kenyan urban centres attribute their growth and development as a result of infrastructure development, for example, Nairobi City grew due to the construction of the Kenya-Uganda railway, being strategically placed between Mombasa and Kampala. The ease of movement when located along a transport network greatly contributes to increased settlement growth along a corridor.

Table 6.9 Advantages and Disadvantages of Linear Settlement Patterns along the NEC

Advantages	Disadvantages
Easy access to the NEC	No open spaces, which may limit development
-	This type of settlement can lead to traffic congestion in many areas along the NEC
-	Prone to accident

Figure 6.16 Linear settlement along the corridor in Nakuru



Source: Google Earth Pro, 2016

Clustered Pattern

Clustered settlement is observed in urban areas such as Mombasa, Nairobi, and Kisumu. Nairobi City is an ideal example of a cluster of human settlements within the Central Business District (CBD).

Table 6.10 Advantages and Disadvantages of Clustered Settlement Patters along the NEC

Advantages	Disadvantages
Good transport network	High population density, which can lead to diseases spreading quickly
It is easy to provide services to this type of settlement	Urban areas with this type of settlement pattern suffer from shortage of housing, transport, health and civic amenities.
There in convenience , in that access to facilities and services is easy	This settlement pattern attracts inadequate social infrastructure and basic facilities due to over-population and lack of financial resources in the cities.

Dispersed Pattern

Dispersed settlement is evident along the NEC, especially in rural areas, whereby homesteads or development are separated and scattered throughout the landscape. This usually occurs in the low population density areas and this is as a result of limiting factors such as unfavourable climatic and geographic conditions.

Table 6.11 Advantages and Disadvantages of Dispersed Settlement Patterns along the NEC

Advantages	Disadvantages
Clustered settlement pattern provides open spaces which provides community members with larger recreation areas and create a sense of openness that people along the corridor desire	It is expensive to provide services to this type of settlement
Open spaces also benefit the environment by providing habitat for wildlife, naturally filtering storm water, reducing storm water runoff from impervious surfaces, and protecting the natural features of an area	Methods to protect and maintain the open space must be carefully developed, implemented and monitored
Linking the open space of several conservation design subdivisions will help to develop larger and more effective "environmental corridor" within and between communities	Although not necessarily a restricting disadvantage, the management of waste water must be carefully designed for smaller lots. While these disadvantages should be acknowledged and addressed, none should preclude the use of cluster development
Clustered settlement pattern will benefit the implementers of the NEC corridor because in areas where there is this kind of settlement the costs of development is reduced	-
Clustered settlement pattern helps to reinforce the policy of maintaining the local rural character which is included in many comprehensive land use plans	-

Figure 6.17 Dispersed settlements in Makueni County

Source: Google Earth Pro, 2016

Summary

The most visible settlement forms within the NEC are clustered and linear patterns whereby people and activities are located in large groups and along linear features, in this case being the road and railway (see *Figure 6.2*).

6.10 ECONOMIC ACTIVITIES

6.10.1 Agriculture

The main crops are grown in the NEC shown in *Table 6.12.*

Table 6.12 Crops Grown in the NEC Counties

County	Crops Grown
All Counties within the main route	Maize, beans
Kiambu	Coffee, Tea, Irish potatoes, bananas, commercial horticulture
Muranga	Coffee, Irish potatoes, bananas, commercial horticulture
Nyeri	Coffee, tea
Bungoma	Coffee, bananas
Kericho	Tea
Bomet	Tea
Nandi	Tea
Vihiga	Tea
Nakuru	Wheat, Irish potatoes, cut flowers, commercial horticulture
Busia	Tobacco
Kilifi	Coconuts, mangoes
Mombasa	Coconuts
Kwale	Coconuts, mangoes
Siaya	Cotton, rice
Kisumu	Rice
Nyandarua	Irish potatoes, commercial horticulture
Makueni	Pigeon peas, sorghum, mangoes,
Machakos	Pigeon peas, mangoes
West Pokot	Maize, potatoes, beans, onions and millet
Turkana	Maize, sorghum, millet and cow peas

Source: various CIDP

Box 6.26 Opportunities - Falling Prices of Exports

Falling exports prices will present opportunities for market forces to reallocate resources to production of goods and services with high demand and high prices. The invisible hand of free market forces will determine the type of exportable goods and quantities that will be produced in the NEC

Box 6.27 Constraint - Falling Prices of Exports

Kenya's export prices for agricultural products like tea and coffee are volatile because the demand for them is elastic. The prices have been rising and falling in the international market for quite some time. Moreover, the more export prices fall, the less the country earns foreign exchange. As a result, farmers cut down on production of exportable crops, or resort to using the land for other enterprises. This adversely affects the volume of export cargo to be handled by the transport infrastructure.

6.10.2 Livestock Production

The main livestock produced in the NEC is shown in *Table 6.13.*

Table 6.13 Livestock Production within the NEC

Livestock Production	NEC Counties
Subsistence cattle, goats and sheep	Pastoral counties of Kajiado, Narok, Baringo, Laikipia and Elgeyo Marakwet Counties. The rest of the counties also keep these animals though on a smaller scale.
Dairy cattle	Uasin Gishu, Kiambu, Nandi, Nyandarua, Nakuru and Muranga Counties
Commercial beef cattle	Nakuru and Laikipia Counties. Large scale dairy farming is practiced on livestock ranches found between Naivasha and Nakuru ie, Soysambu, Marura Ranches, Major Boinet, Kedong, Sanctuary Farm, Morendat, Marula, Malewa Bay Loldia, Olsuswa, Korongo, Wileli (Kipkulei), Lapieve Ltd (Kongoni), Soyisambu, Mboi-Kamiti, Malewa & Munyaka Farm. Small scale dairy farming is practiced widely within the sector. Pastoralism is practiced on the western side of Narok County
Subsistence poultry	All Counties
Commercial poultry	Kiambu, Nakuru and Nairobi Counties
Piggery	Kiambu, Muranga and Nyeri Counties

6.10.3 Mining and Quarrying

As illustrated in *Table 6.14* mining and quarrying activities take place in various parts of the NEC. The presence of minerals resources will enable the regional strategy of the NEC Master Plan to be realised.

Mineral resource productive areas will be linked to the NEC and the LAPSSET Corridor.

Table 6.14 Mining and Quarrying Activities in the NEC

Mineral/Quarrying Activity	Area
Limestone	Athi River, Bamburi and Waa
Artisanal mining of Tsavorite, red garnets, green garnets, yellow garnets, ruby, green tourmalines, yellow tourmalines, change colour, blue sapphire, pink sapphire, amethyst, peridot, iolite, spinel, rhodolites and kyanites	Kasigau, Kuranze. Taita Hills and Mwatate areas
Coal	Mui Basin (Kutui County) and West Pokot
Sand, limestone and granite	Machakos
Quarrying activities are centered in 15 quarries located mainly in Njiru and Embakasi areas that produce natural building stones, ballast, etc	Nairobi County
Sand harvesting, limestone, granite, gypsum, and quartz	Makueni
Quarrying for construction stones, ballast and hardcore	Isinya and Kitengela
Fluorspar	Kerio Valley
Diatomite	Kariandusi
Geothermal power generation	Olkaria , Menengai and Ol Doinyo Emburu
Sand harvesting	Along river banks such as Nyano and Awach, Lake Victoria beaches and River Nzoia in Siaya County.
Gold	Bondo, Siaya, Rarieda, Ugunja, Gem (Siaya County) and West Pokot
Mining potentials for limestone	Sigor (Bomet), Koru (Kisumu) and West Pokot
Oil	Nyando and Nyakach Sub-counties, Elgeyo Marakwet and Turkana
Granite and black sand	Yala Valley and Kogello, West Pokot and Taita Taveta

Source: various CIDP

6.10.4 Fishing

Most fishing activities take place along the Indian Ocean and along Lakes Naivasha and Victoria. The marine capture fishery is composed

of coastal and near shore artisanal, semi industrial and offshore industrial fisheries. Artisanal and semi-industrial fisheries are exploited by the coastal local communities while the industrial fisheries are exploited by foreign fishing companies. There are 51 fish landing sites in Mombasa County alone and several sites in Kilifi and Kwale counties that are within the NEC. The main types of fish caught are Rabbit Fish, scavengers, Jack Fish and King Fish.

The main fish landing beaches on Lake Naivasha are Karagita, Kamere, Kihoto, Tarembete,and central. The main fish caught include common carp, minor carp, tilapia, black bass and catfish.

On Lake Victoria, there are several landing beaches. They include Kaloka, Ndere Island, Kisumu Port, Dunga Beach, Sango Beach and Kusa Beach in Kisumu County; Luanda Kotieno, Wichlum Uhanya, Usenge, Nango Kamariga, Mahanga Mageta, Sirongo, Ndeda Island, Misori B, Luando Kotieno, and Kopiata in Siaya District; and Osindo in Siaya County; and Rudacho, Marenga, Nalera Beach, Bukoma, Namabusi, Rukala, and Wayasi Island in Busia County. Additional fishing activities take place on Lake Kanyaboli in Siaya County and, in dams and ponds that are widespread in the four counties ie Kericho, Bomet, Kisumu and Siaya, though on small scale. The fish caught include; Rastrineobola argentea (Omena), Tilapia, Nile perch, among others.

Minor fisheries exist in a variety of other inland waters, as follows: a) L. Victoria Basin: rivers Nzoia, Sondu, and Yala; b) Rift Valley Basin: rivers Suam-Turkwel Kerio, Lessos and Turkwell Gorge reservoirs; c) Athi River Basin: rivers Athi-Galana-Sabaki, and Voi, lakes Chala and Jipe; d) Tana River Basin: upper Tana River and impoundments including Masinga, Kamburu, Gitaru, and Kindaruma reservoirs.

Fishing also takes place on both private and community owned dams. In addition, fish farming is being encouraged by the government and a number of fish ponds are producing fish especially in Kiambu, Nyahururu and Muranga counties. The main fish farmed are Tilapia and catfish. Although fish farming is being encouraged by the government, it has not picked up in most parts of the NEC due to shortage of water.

Box 6.28 Opportunities - Fish and Farming

Declining fish stocks and fishing may result in a call for more prudent management of fresh water fisheries resources in the country, including supporting marine fishermen with better fishing gear and encouraging people in the NEC to start fish farming.

Box 6.29 Constraints - Fish and Farming

Declining fish stocks and fishing activities in lakes means that there will not be enough fish to be transported from these water bodies to the markets. It also means that the fishermen may lose their livelihoods.

6.10.5 Industries/Manufacturing

Most of the manufacturing enterprises are found in the urban centres as shown below in *Table 6.15.*

Table 6.15 Industries and Manufacturing Enterprises in Urban Centres in the NEC

Urban Centre	Manufacturing Enterprises
Mombasa	Export processing zone
Nairobi	80% of the total industries in the County. There are 2,061 industries and out of this number 422 of them are in manufacturing. Most of these industries are located in industrial area, Kariobangi and Baba Ndogo.
Athi River	114 manufacturing enterprises including Mabati Rolling Mills, Kenya Meat Commission, Agrichem & Tools Ltd, Athi River Steel plant, EAPCC, Bamburi Cement, Mombasa Cement, Savannah Cement, Simba Cement, Primarosa , Kenya Meat Commission (K.M.C), etc
Nakuru	Textile industries, animal feeds, agricultural implements, printing, dairy products, engineering works and body builders, saw mills, contractors, bitumen products and quarrying, posho mills, canners, edible oils and soap manufacturers and pyrethrum processing plants.
Eldoret	Wood processing, grain milling, milk processing and oil storage

Urban Centre	Manufacturing Enterprises
Limuru	Bata Shoe Factory, Farmers´ Choice Ltd, Kenchic Co. Ltd, Brookside Dairies, Githunguri Dairies, Ndumberi Dairies, Limuru Milk and Palmside Dairies
Thika	Bidco Oil Industries, Thika Motor Vehicle dealers, Thika Pharmaceutical Manufacturers Limited, Devki Steel Mills, Broadway Bakeries, Kenblest Industry, Kel Chemicals, Thika Rubber Industries Limited, Macadamia Nuts, Campwell Industry and Kenya Tanning Extracts Limited.
Naivasha	Breweries and milk processing
Ruiru	Clay Works and Spinners and Spinners
Sotik	Milk Processing
Kericho	Nandi Hills, and Vihiga have tea processing factories
Nzoia, Mumias, Chemill, Muhoroni, Nambale and Kibos	Sugar refining factories
Ahero	Mattresses manufacturing and rice processing
Kisumu	27 manufacturing industries and 16 bakeries
Voi and Mtito Andei	Sisal fibre production
Makindu	Bakery
Mariakani	Iron sheet manufacturing
Malakisi	Cotton ginning and tobacco curing
Kitale	Flour milling
Kapenguria	Flour milling
Kalakol	Fish processing

Source: various VIDP

Box 6.30 Opportunities - Domestic Challenges in the Manufacturing Sector

- Domestic challenges in the manufacturing sector can present opportunities for the industrial sector to plan and address them, specifically through the improvement of the investment environment, increasing the market size, increasing employment and incomes and providing raw materials from the agricultural and mineral and oil sectors.

Box 6.31 Constraint - Domestic Challenges in the Manufacturing Sector

- Domestic challenges in the manufacturing sector include unconducive business environments especially: the high cost of doing business; low domestic savings and investments; high cost of finance; high cost and unavailable industrial land; limited market access; as well as counterfeit dumping and substandard goods.

Box 6.32 Constraint – Limitation to Growth in the Manufacturing Sector

- Inability of small scale firms enjoying economies of scale
- Lack of comprehensive policy;
- Regulatory and incentive framework to attract investors
- Small talent pool
- Lack of marketing
- Rigid labour laws for export services;
- Lack of a formalized one stop shop to facilitate the ease of doing business
- Competition from other countries offering competitive prices due to their comparative advantage.

6.10.6 Tourism

Most of tourist attractions are found in and around Mombasa and Nairobi Counties as well as within the protected areas discussed in *Chapter 5*.

Mombasa has several tourist attractions including Fort Jesus Museum, the gigantic elephant tusks mould, Likoni ferry, old town, the old port, Mombasa Marine Park, Haller Park and Butterfly Pavilion. Mombases has over 430 beach and tour operator firms that provide various tourist related services. The county has 201 registered hotels and lodges with a total bed capacity of 8,000 beds. Several tourist facilities and tour operator firms also exist along the Kwale and Kilifi parts of the beach front and along the Mombasa-Diani and Mombasa-Malindi highways.

Nairobi County is a major centre of tourism in the Country. Its proximity to many tourist attractions both in Kenya and East Africa and the good communication network makes it a focal point of great

importance to the tourism sector. As the capital city and commercial centre, it attracts many businessmen and leisure tourists. Tourist attractions include the Nairobi National Park, Nairobi National Museum, Karen Blixen Museums and several historical sites and monuments.

Other tourist attractions in the NEC include:

- Iveti hills scenery, Kyamwilu gravitational defying area and the wood carving in Wamunyu (Machakos),
- Paradise Lost and Mugumo Gardens in Kiambaa (Kiambu),
- Mau Mau Caves (Nyeri),
- Gatamaiyu Fish Camp, historical sites in Gatundu and Githunguri,
- Hell's Gate, Mt Longonot and Lake Nakuru national parks,
- Kakamega National Forest Reserve and Park,
- Mt Elgon National Reserve,
- Kitale Museums (Trans Nzoia),
- National Museums in Kisumu and Ndere Island,
- Nasalot Game Reserve , Saiwa National Park , Turkwell Dam and the Prison Meseum at Kapenguria in West Pokot
- Lake Turkana National Park, Eliye Springs and the Desert Meseum in Turkana

Uasin Gishu is well known worldwide as the "city of champions" because majority of international athletes come from the region. There is however need to leverage on this for the purpose of tourism.

Potential tourist areas include:

- Chepkiit Water Falls on the Kipkaren River,
- Tindinyo falls along River Yala,
- the famous Koitalel Samoei Museum in Nandi Hills Town and
- the Keben caves in Mogobich, Lessos Division.

Historic sites such as Songhor Paleontological Site situated in Muhoroni, the viewpoints in Nyabondo, the legendary Luanda Magere site in Miwani, Kit Mikayi in Kisumu West, recreational sailing and sport fishing on Lake Victoria can be developed to provide attractive sites for tourists. A variety of tourist attractions including diversity of landscapes, wildlife, culture and the many historical sites are available in Kericho and Bomet counties.

Box 6.33 Opportunity - Tourism

- Infrastructure needs for the tourism industry range from physical infrastructure such as ports of entry to modes of transport to urban infrastructure such as access roads. The NEC Master Plan Development Strategies include the improvement of these infrastructures.

Box 6.34 Constraints - Tourism

- Projects developed within the NEC need to avoid areas of high tourism potential such as protected areas.

6.10.7 Employment

Counties with the lowest percentage of residents with no formal education and are working for pay include Narok and Baringo and Counties with the highest percentage of residents with no formal education and are working for pay are Nairobi, Uasin Gishu and Mombasa.

Counties with the lowest percentage of residents with primary level education and are working for pay for pay are Narok, Busia and Bungoma while the counties with highest percentage of residents with primary level education and working for pay are Nairobi and Mombasa.

Counties with the lowest percentage of residents with secondary level education and are working for pay are Mombasa and Nairobi while the Counties with the highest percentage of residents with secondary level education and are working for pay are Mombasa Kiambu and Nairobi

Table 6.16 Percentage of Residents Working for Pay by NEC County

County	No formal education	Primary level of education	Secondary level of education and above	County	No formal education	Primary level of education	Secondary level of education and above
Mombasa	28	37	46	Baringo	5	14	26
Kwale	10	16	34	U. Gishu	28	23	32
Kilifi	16	23	39	Nandi	24	22	27
T.Taveta	21	22	32	E. Marakwet	13	11	21
Kitui	18	20	27	T.Nzoia	25	20	26
Makueni	19	23	25	Kakamega	17	15	22
Kajiado	12	32	44	Vihiga	18	16	22
Machakos	23	27	33	Bungoma	14	10	19
Nairobi	34	45	49	Busia	10	10	21
Kiambu	34	38	39	Kericho	20	21	30
Muranga	17	22	24	Bomet	13	15	24
Nyandarua	17	16	21	Kisumu	19	20	32
Nyeri	21	25	28	Siaya	11	13	22
Laikipia	16	22	32	Nakuru	24	26	36
Narok	8	10	26	West Pokot	55	38	06
Turkana	82	15	03	Turkana	82	15	03
West Pokot	55	38	06	-	-	-	-

Source: Compiled from KNBS & SID Reports, 2013

6.10.8 Unemployment

Unemployment and underemployment have both been identified as Kenya's difficult and persistent problems. Over 13% of the working age population is unemployed. About 67% of Kenya's unemployed are youths between 15 and 34 years of age. The highest unemployment rates are for people around 20 years old at 35%. This makes unemployment in Kenya a youth problem. It should be noted that the Kenyan labour market, just like other countries, is always in a state of flux with people leaving and changing jobs while others are joining.

6.10.9 Gini Coefficient

The *Gini index* measures the extent to which the distribution of consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of

'0' represents perfect equality, while an index of '1' implies perfect inequality. See *Table 6.17* for the Gini Index by NEC County.

Counties with Gini coefficient closer to zero have more even income distribution than those with Gini coefficient closer to one. Income distribution reveals possible markets sizes in the NEC that will support manufactured goods resulting from proposed industrial projects.

Table 6.17 Gini Coefficient by County

County	Gini Coefficient	County	Gini Coefficient
Mombasa	0.356	Baringo	0.356
Kwale	0.597	U. Gishu	0.370
Kilifi	0.565	Nandi	0.343
T.Taveta	0.437	E. Marakwet	0.358
Kitui	0.388	T.Nzoia	0.360
Makueni	0.376	Kakamega	0.394
Kajiado	0.403	Vihiga	0.399
Machakos	0.403	Bungoma	0.430
Nairobi	0.341	Busia	0.459
Kiambu	0.335	Kericho	0.378
Muranga	0.361	Bomet	0.340
Nyandarua	0.394	Kisumu	0.430
Nyeri	0.365	Siaya	0.405
Laikipia	0.369	Nakuru	0.376
Narok	0.376	West Pokot	0.318
Turkana	0.283	-	-

Source: Compiled from KNBS & SID Reports, 2013

6.10.10 Regional Integration and Preferential Trade Arrangements

Kenya's total exports to East African Community (EAC) increased by 60% between 2008 and 2012 (KNBS, 2013). Uganda was Kenya's leading export destination (absorbing 13% of the country's total exports) while Tanzania was second at 9%. Exports to the EAC are diversified and include chemicals, fuels and lubricants, machinery and transport services.

In 2012, Kenya's exports the EAC accounted for 54% of the total exports to Africa and 26.1% of its exports. The exports to the Common Market for Eastern and Southern Africa (COMESA) increased by 58% and accounted for 34& of the total exports in 2012. On the other hand, the total exports imports from COMESA increased by 117%. (KNBS, 2013)

Box 6.35 Opportunities- Regional integration and preferential trade agreements

- Admission of Rwanda, Burundi and South Sudan in the EAC has expanded the market for products and services produced in this region. As a result, Kenya's industries are bound to produce and sell more in the region.

Box 6.36 Opportunities-Competition from Neighbouring Countries in Attracting Regional Infrastructure

- Competition from neighbouring countries will enable the proposed projects in the NEC to be undertaken in earnest and to operate efficiently. That way, the NEC will not only be a head of its competitors but will keep Uganda, Rwanda, South Sudan and DRC using it as their transit route to and from the sea port of Mombasa

Box 6.37 Constraint - Competition from neighbouring Countries in Attracting Regional Infrastructure Projects

- Tanzania, Ethiopia, Sudan, Eritrea and Kenya appear to be competing to attract the landlocked countries of Uganda, Rwanda, Burundi and South Sudan to use the transport corridors through their countries. For example, Tanzania managed to attract the Uganda oil export pipeline away from the Kenyan route. This has deprived Kenya of the oil cargo that would support meeting the cost of its LAPSSET project.

6.10.11 Challenges to Kenya's Economy

As a nation, Kenya's economy faces a number of challenges. The heavy dependence on rain-fed agriculture and the tourism sector leaves it vulnerable to cycles of boom and bust. The agricultural sector employs nearly 75 per cent of the country's 42 million people and half of the sector's output still remains subsistence production.

The economy has been hampered by numerous factors:

- population growth that is almost outstripping economic growth,

- heavy dependency on a few agricultural exports that are vulnerable to world price fluctuations,
- prolonged drought that has necessitated power rationing,
- deteriorating infrastructure, and
- extreme disparities of wealth that have limited opportunities of most to develop their skills and knowledge.

Poor governance and corruption also have had a negative impact on growth, making it expensive to do business in Country. According to Transparency International (2012), Kenya ranks among the world's half-dozen most corrupt countries. Bribery and fraud cost the country as much as US$ 1 billion a year.

Other areas that have an impact on the Country's economy are youth unemployment, HIV/Aids burden, increasing debt and terrorism threats.

Box 6.38 Constraints – Challenges to Kenya's Economy

Inequality between Regions
Not all regions within the NEC produce adequate cargo necessary to sustain the transport infrastructure. The undeveloped areas need to be developed before they can produce goods for handling by the transport modes. Developing underdeveloped regions requires a lot of resources to be dedicated to these regions before they may be able to produce more goods

Fluctuating Growth Rates of the Economy
Recent experiences show that Kenya's economic growth rate has been fluctuating, giving the impression that economic growth is not steadily occurring. In situations where the actual economic growth rates fall below the planned rates (at an average annual growth rate of 6.6%) as envisaged by the Master Plan, implementation of the development strategies would be slowed down, delayed, or even frustrated.

Increasing Prices for Imports
Due to inflationary situations in developed countries, the general trend has been that prices of Kenya's imports have been increasing in the past and, will continue to increase in the future. This adversely affects the volume of cargo to be handled by the transport infrastructure. More goods would be imported if import prices were to increase much more slowly than they currently do.

Limited Funds for Development Projects
Implementation of the Development Strategies requires a lot of funds which Kenya may not have or have in limited amounts. The Government needs to reform the tax system so as to maximize revenues. Even when funds are available, the Government would have to prioritize its expenditure among competing interests. Funding can limit the Government to spend money on big infrastructure projects.

Corruption
Corruption leads to the depletion of national wealth. Large scale corruption hurts the economy and impoverishes entire population. In the social sphere, corruption discourages people to work together for the common good. Frustration and general apathy within the public results in a weak civil society. Demanding and paying bribes becomes the tradition. It also results in social inequality and widened gap between the rich and poor, civil strife, increased poverty and lack of basic needs like food, water and drugs, jealousy and hatred and insecurity. Corruption will thus adversely affect implementation of the strategies by making infrastructure project expensive, delay or, even fail. A country suffering from corruption cannot implement sound plans and thus is not expected to benefit from sustainable development despite embarking upon economic growth from time to time for some reason or the other.

6.11 POLITICAL ENVIRONMENT

Kenya has made considerable progress in recent years towards a politically stable, democratic Country with the enactment of a new Constitution in August 2010, the conclusion of a peaceful political transition following the March 2013 elections, and the launch of a devolved system of Governance in the same month.

However, Kenya exhibits some fragile characteristics, most importantly the high level of poverty and regional disparities as well as high youth unemployment, which, if not effectively addressed, might pose threats to the country's overall stability. There is, therefore, a strong need to create economic opportunities for the disadvantaged groups of society, in particular the youth, to avoid conflict and violence in the future.

Other factors of fragility include terrorist activities and ethnic tensions compounded with a post-colonial land allocation that left certain communities feeling dispossessed and created long-standing sources of unrest.

Box 6.39 Constraints - Security Concerns

Security Concerns
The economic growth and development anticipated in Vision 2030 can only be achieved and sustained in a peaceful, stable and secure environment. In the recent years, there has been a surge of terrorist attacks in Eastern Africa and Kenya has had a share of these attacks. Terrorists are motivated to disrupt the economy, to cause personal injury to concentrations of people, to strike at symbolic targets, and transport tools of terror using transport infrastructure. A secure transportation system is critical to overall national security from terrorism. There are also instances where intermittent insecurity, conflicts and tensions occur thereby threatening movement of cargo.

Lack of Will
The implementation of government major projects and programs largely depends on the political willingness of the government of the day. There are many experiences in Kenya where good plans have been shelved or postponed or overtaken by time for lack of political will. This is because prioritizing of national projects is not only economic but also a political decision

Absence of an Interagency Coordination Mechanism
The successful implementation of the NEC Master Plan Strategies will require the active participation of other government agencies such as the Ministries of Agriculture, Mining, Industrialization, and Internal Security that have different mandates, policies, programs and plans to be effectively coordinated. Failure or absence of such mechanism would result into inter agency conflicts, competition, and duplication of efforts and a waste of resources.

6.12 HERITAGE SITES AND MONUMENTS

6.12.1 *Archaeological Sites*

Archaeological heritage encompasses places that bear evidence of human activity, all vestiges of human existence, abandoned structures, and all kinds of remains, including under water and subterranean sites, as well as, all the portable cultural material that may be associated with them (1) . These places are preserved, conserved and protected by

(1) Panosa, M. I (2012) Historical and Archaeological Heritage: Contributions and challenges. International Journal of Humanities and Social Science, Vol.2 No, 22, 2012

countries not only because they reveal the heritage of people, but are also tourist attractions. *Table 6.18* below lists the important archaeological sites within the NEC.

Table 6.18 Important Archaeological Sites within the NEC

Archaeological Sites	Brief Description	Location
Jumba la Mtwana	Fifteenth century site and slave trade port	Mtwapa, Kilifi County
Olorgesailie	Lower Paleolithic archaeological site	64 km southwest of Nairobi along the road to Lake Magadi, Kajiado County
Kiandurusi	Pre-historic site	Kariandusi, Nakuru County
Enkapune Ya Muto, also known as Twilight Cave	Late Stone age site	Mau Escarpment
Enkorika	Iron Age smelting site	Narok
Njoro River Cave	Dated to roughly 1000 BC	Njoro, Nakuru County
Sirikwa holes	Sirikwa people settlement site	Kerio Valley and Uasin Gishu
Ngenyn	Late Stone Age and/or a Savanna Pastoral Neolithic	Kapthurin River Basin, Baringo
Kaputhurin	Acheulean stone tools and animal bones left behind here	Near Lake Bogoria and Lake Baringo
Gogo Falls	Earliest appearances of artifacts and domestic animals are in the area	Kanyamkago Hillside near the modern dam on the West bank of Kuja River, L.Victoria Basin
Hyrax Hill	Prehistoric site	Near Narok
Koobi For	Palaeontological locality	Eastern shores of Lake Turkana
Lomekwi	Kenyanthropus site	North western shores of Lake Turkana
Namaratunga	Archaeostronomical site	West of Lake Turkana
Naturuk	Pre-historic site	South-West of Lake Turkana
Lake Turkana Basin	Australopicthecus fossils	Lake Turkana Basin

Source: National Museums of Kenya, 2016

Box 6.40 Constraint – Presence of Archaeological Sites

Along the NEC there are a number of archaeological sites that have to be preserved. . Development of the NEC transport infrastructure is likely to disturb or disrupt these sites.

6.12.2 Historical Sites and Monuments

Historical sites and monuments represent great achievements in art and architecture of a country. It is therefore important they are preserved so that present and future generations can continue to enjoy and learn from them as well. Important historical sites and monuments found within the NEC are presented in *Table 6.19* as well as *Annex F.*

Table 6.19 Historical Sites and Monuments in the NEC

County	Historical Site/Monument
Mombasa	Fort Jesus, Kisauni Bell Tower, Mbaraki Pillar, Old Law Courts, Mnarani Ruins, Mombasa Old Town, Portuguese Ship Wreck, Redoubt, Mama Ngina Drive, Mombasa Old Club, Babu Motors, Kilindini House, Ivory House, Issa Thawar House, Mombasa Hospital Dispensary, Central Police Station, District Officer's Office, Anglican Cathedral, Macknon Market, Alidina Visram School, Grindlays Bank, National Bank of Kenya, Valentine High School, Kaya Kiteje, Kaya Pungu, Similani Cave, Uhuru Gardens, Jomo Kenyatta Public Beach, KPA Maritine Museum Building, KPA, St Emmanuel Church, Frere Town, Leven house, Sheikh Mwinyime Shrine, Holy Ghost Cathederal, and Castle Hotel.
Kilifi	Mtwapa Ruins, Takaungu North and Tangaungu South, Kaya Mudzimiru, Mnarani, Old Ronald Ngala Tombstone, Bedida Sacred Grove, Kaya Mzizima, Kaya Bomu/Fimboni, Kaya Lunguma, Kaya Mudzi Muvya, Kaya Kavuma, and Kaya Kauma
Kwale	Kaya Bombo, Kaya Waa, Kaya Sega, Kaya Gonja, Kaya Jego, Kaya Tiwi, Kaya Chitsanze, Kaya Chonyi, Kaya Mstwakara, Tiwi, and Diani Ruins
Taita Taveta	Old St. Marks ACK Church, Sagala
Machakos	Paul Ngei Mausoleum, Ol Donyo Sabuk House, the first District Commissioner's (DC's) Office
Nairobi	Old Provincial Commissioner's (PC's) Office, Nairobi, Uhuru Park National Monument, Uhuru Gardens national Monument, Kenya National Archives, Mc Millian Library, High Court Building, Kipande House, City Park, Former Parkland Railway Staff Quarters, Jeevanje Gardens, the Calton Fenzi Memorial Stone, the War Memorial Statute, Institute of African Studies-Chiromo, Nairobi School, Khoja Mosque, Pensions Building, Old Mutual Building, Standard Chartered Building, Pan Africa House, Royality House, Imperial Chambers, Imperial British East Africa, Bull Gate, Prembro House, Surat District Association House, Rahimutulla Trust Library, Bohra Mosque, Makhan Sigh House, Dedan Kimani Statue, War Memorial Pillar, Nairobi Club, City Park, Railway House, Lower Hill Road, Land's Offices, Moi Avenue, Siri Gurdwara Ramgharia, Peponi Road House No 21, Westmister House, Shaffi Mosque, City Market, Nairobi South Cementry, Desai House, 2nd Parklands Avenue, Pumwani Community Memorial Hall, Tom Mboya Statue, YWCA International House and Cameo Cinema Building.

County	Historical Site/Monument
Kiambu	Kijabe Church , AIC Church Ruins , Fort Smith near Muguga , Manse Kikuyu, St Paul Church ACK , Watson Scot Memorial, PCEA Church at Thogoto, Githunguri Gallows, Jomo Kenyatta College's Residence, Mbiyu Koinanges' College Residence, Githunguri Girls Dormitory (Kiriri), Italian Prisoners of War Pillar, Italian Prisoners of War Brick Manufacturing
Muranga	Fort Hall, Mukurwe wa Nyagathanga, Bildad Kaggia Moseleum and Ichagaki Prison Church
Nyeri	Mau Mau Caves, Burgret Mau Mau Shelter and Mau Mau Trench;
Nakuru	Lanet Prehistoric site, Fort Terman Paleo Site, Blixen House (Naivasha) and Lord Egerton Castle
Nakuru	Mt. Suswa Caves
Uasin Gishu	Former Italian Barracks, Old Asian School, St. Peters' Catholic Church at Tuluap-Sigis
Bungoma	Muhanda and Chetambes Forts
Kakamega	Muliro Gardens and *Ikhonga Murwi* (weeping stone)
Vihiga	Abatondo Sacred Forest, King George's Tower and Asubwe Sacred Groove
Busia	Kakapeli Rock Shelter and Oluchiri Sacred Grove
Siaya	Jaromogi Oginga Odinga Mausoleum, Got Ramogi Hill, Kit Mikayi Shrine and East Alego Nyangoma Kogelo, Kanam-Kanjera
Kisumu	Old PC's Office, DC's Office, Police Headquarters
West Pokot	Kapenguria Prison Meseum
Turkana	Kenyatta House

Source: National Museums of Kenya, 2016

Box 6.41 Opportunity - Presence of Historical Site and Monuments

Along the NEC there are a number of historical sites and monuments that have to be avoided. The NEC Master Plan could plan for these sites and boost tourism by making these sites more accessible.

Three alternative spatial structures for the NEC were examined, taking into account the following factors:

i) *regional industrial development*: promoting regional industrial development;
ii) *urban centers of the region*: centralizing urban functions or decentralizing; and
iii) *Transport network*: promoting regional linkage.

The three alternative spatial structures for the NEC are described in this *Chapter*, and include:

- ***Alternative A***: Includes a "Super Double-Core Type" for concentrating investments in capitals, which reflects the current situation.

- ***Alternative-B***: Includes a "Double-core with Regional Industrial Promotion Type" for expanding export with industrial promotion; and

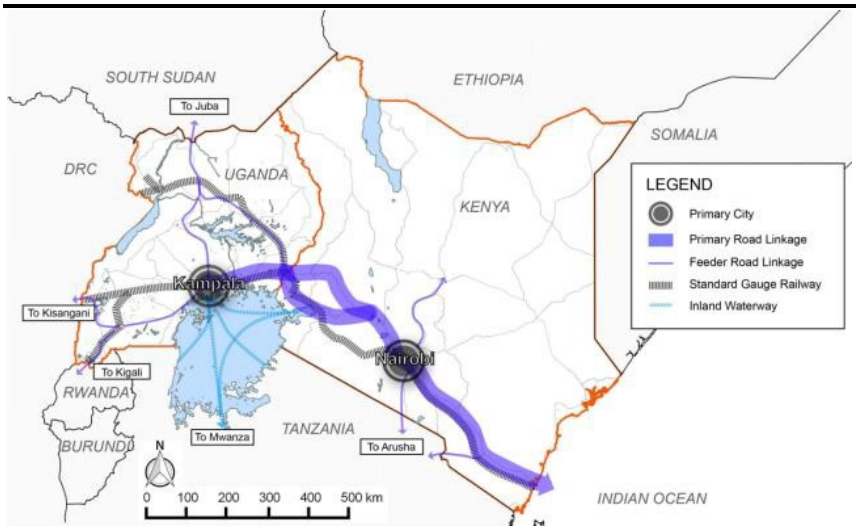
- ***Alternative-C:*** Includes a "Multi-core with Regional Industrial Development Type" for expanding export with industrial promotion and balanced development.

7.1 ALTERNATIVES

7.1.1 Alternative A: Super Double Core Type

The *Super Double Core Type* alternative relates to concentrating investment in capitals, which reflects the current situation. This spatial structure follows current market demands and concentrates investment especially in Nairobi and Kampala, which are referred to as "Primary Cities". Existing urban functions including businesses, commerce and services would be centralised in 'Primary Cities' and these will grow into much larger consumption areas. The supply of goods will rely heavily on imports and the Primary Cities will become logistic hubs for their surrounding areas and beyond (see *Figure 7.1*).

Figure 7.1 Alternative A: Super Double Core Type



Source, JST 2016

Table 7.1 below discusses the advantages and disadvantages of Alternative A.

Table 7.1 Advantages and Disadvantages of the Super Double Core Type

Advantage	Disadvantage
Lower development cost as it follows current market demands and concentrates investment especially in Primary Cities (such as Nairobi)	Excessive imports and imbalanced freight volumes
Relatively short development period	Imbalanced development
Low cost to realize this structure plan as the area to be newly developed is smaller than the other alternatives	-

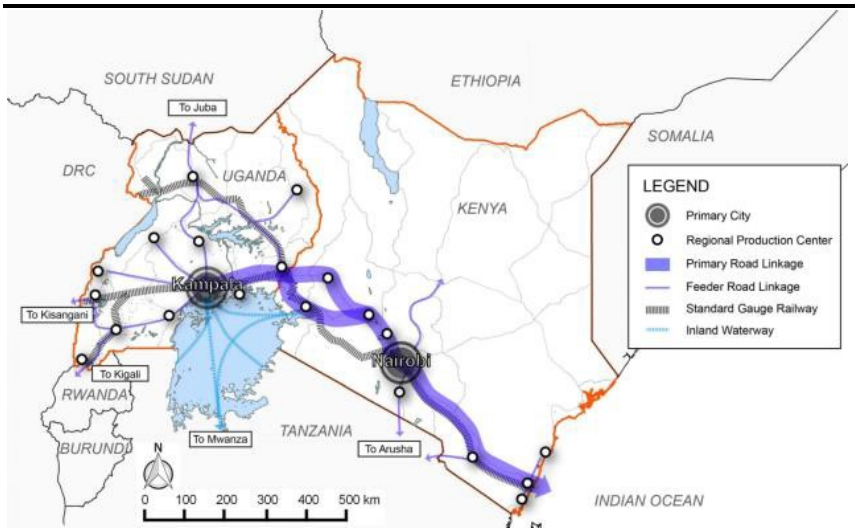
Source, JST 2016

7.1.2 Alternative B: Double Core with Regional Industrial Promotion Type

Alternative B (*Double Core with Regional Industrial Promotion Type*) relates to the expansion of export services along with industrial promotion. It is similar to *Alternative A* in that urban functions would also be centralised in the two Primary Cities of Nairobi and Kampala. This spatial structure plan aims for developing "Regional Production Centres" which aims to promote their potential regional products including industry, agriculture, mining resources and tourism resources.

Key industries in "Regional Production Centres" will be promoted to produce goods for export through utilising resources as the regional advantage. These products will be transported to Primary Cities and out of the NEC region (see *Figure 7.2*). In this alternative, the involvement of local Government will be required so as to improve the production of products and goods from the regional production centres. Export of the regional products will be expected to make transportation cost to Mombasa port decrease with improving the problem of empty return cargo.

Figure 7.2 Alternative B: Double Core with Regional Industrial Promotion Type



Source, JST 2016

Table 7.2 below discusses the advantages and disadvantages of Alternative B.

Table 7.2 Advantages and Disadvantages of Alternative B

Advantages	Disadvantages
Expansion of exports	Imbalanced development
Replacement of imports by domestic products	High development cost
-	Longer development period

Source, JST 2016

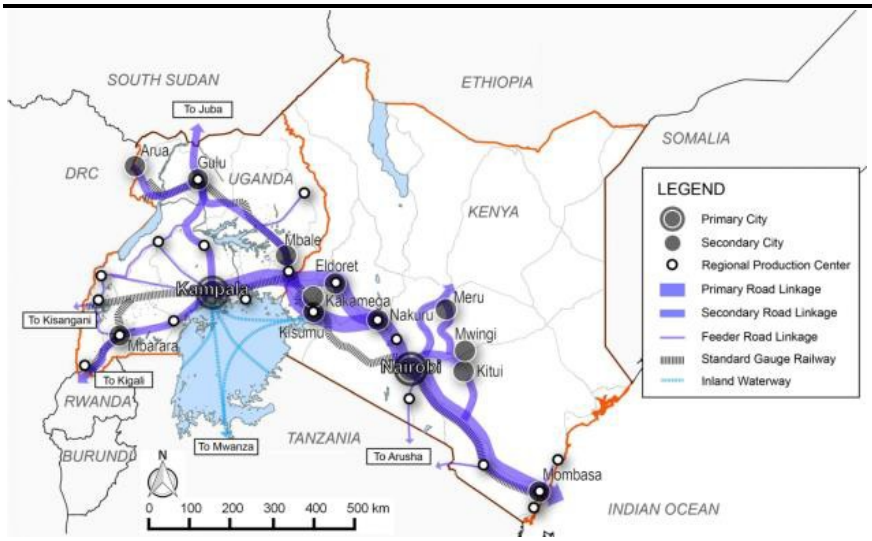
7.1.3 Alternative C: Multi-Core with Regional Industrial Development Type

The *Multi-Core with Regional Industrial Development Type* alternative aims at balanced growth and efficient logistics in the NEC region by promoting urban functions of 18 Secondary Cites, including 6 Secondary cum Regional Production Centres (see *Figure 7.3*).

This alternative promotes decentralizing urban functions to Secondary Cities, urbanization of them and concentration of population on them from surrounding region. Similar to Alternative B, it aims to promote Regional Production Centres, because demand for commercial and services in urban area (which results from surrounding regional area) will promote the demand of Secondary Cities.

These Secondary Cities will serve as regional urban centres supplying urban services and logistics hub connecting Regional Production Centres and Primary Cities as consumption areas. In this alternative, the involvement of local Government is also essential. The initial cost to realize this structure plan will be higher than the other alternatives because the area to be newly developed is larger. This structure plan needs more public engagement and management capacity for urban management and development control to avoid unnecessary development in a planned manner.

Figure 7.3 Alternative C: Multi-Core with Regional Industrial Development Type



Source, JST 2016

Table 7.3 below discusses the advantages and disadvantages of Alternative C.

Table 7.3 Advantages and Disadvantages of Alternative C

Advantages	Disadvantages
Expansion of export and replacement of imports by domestic products	Highest development costs
Balanced development	Longest development period

Source, JST 2016

This is the preferred alternative because it is consistent with Vision 2030, the MoTI Strategic Plan and the goals of the NEC Master Plan, which are to improve logistics for the NEC as well as provide an integrated regional development strategy consistent with sub-regional development plans and national development plans. ***This alternative is therefore the basis of this SEA.***

7.1.4 Alternative D: No Go Alternative

The no-go alternative means that the proposed Master Plan is not implemented in its entirety, leading to the following disadvantages:

- *Continuous Road Congestion* mainly around Mombasa, Nairobi, Nakuru, Eldoret, Kisumu and Malaba in Kenya. The congestion around these points is caused by cargo and passenger traffic, delays and high cost of running logistics.

- *Stretched Mombasa Port Operations Capacity*, as Mombasa Port is the only international seaport on the NEC and while the Port has implemented projects with capacity expansion and efficiency improvement, these developments have not matched the 10% average annual growth rate in demand for import cargo registered in the past five years.

- *Cross Border Delays*, for example in Malaba Town which is located between Kenya and Uganda, where queues of more than 3 km are commonly witnessed during the daytime. In addition, custom clearance procedures are still inefficient due to lack of human capacity, electricity, internet communication, inadequate parking lots and access road among others.

As such, this No-Go option alternative is not considered reasonable and will not be considered any further in this SEA.

7.2 ALTERNATIVE SCENARIO ANALYSIS

7.2.1 Overview

Scenario analysis was used to present alternative futures of the *Multi-Core with Regional Industrial Development Type*, i.e., the preferred alternative and the focus of the SEA Study. Scenario building focused on:

- Identifying the strategic issues associated with the Master Plan (i.e., identification of the critical success factors and key concerns). These are spurring production and regional development;
- Representing the current state of the environment (e.g., levels of biophysical, social and economic environments);
- Describing the key driving forces and what was inevitably giving the driving forces. These are agricultural, industrial mineral, tourism sectors;
- Identifying key uncertainties that could determine a different evolution of the future. These would be economic growth rates; and
- Outlining possible futures (given the key driving forces and uncertainties).

7.2.2 Economic Framework for the NEC and East Africa Community

The Kenyan economy is projected to experience a solid growth of 6-7% in the medium term, based on the following assumptions (1):

- crude oil export would start from the year 2020,
- import of refined oil products from the Middle East or Uganda due to the current outlook of low oil prices and economic reasons,

(1) JST, 2016, Master Plan on the Logistics in the NEC – Draft Final Report

- the impact of crude oil production may be more significant at the beginning of oil production and is projected to help attain a growth of 9% in the year 2020, but diminish gradually as the size of the economy grows

Table 7.4 Future Gross Domestic Product (GDP) Projection in Kenya 2015-2020

GDP/Sector	2015	2020	2025	2030
GDP growth (% base case)	5.6%	8,6%	7.9%	5.7%
Agriculture (% of total)	24.0%	22.5%	20.9%	20%
Industry (% of total)	21%	24.2%	25.9%	25.4%
Service (% of total)	55%	53.3%	53.3%	47.4%

Source: JST, 2016

7.2.3 *Scenario Analysis*

Scenario analysis presents several alternative future developments in order to determine a scope of possible future outcomes. Therefore, when analysing scenarios, it is useful to generate an optimistic, a pessimistic, and a most likely scenario, as discussed in the *Sections* below, where the possible outcomes of the NEC Master Plan depend on how the economy performs in the future.

Scenario 1: Status quo

For the purpose of this analysis, this scenario is defined by the Kenyan Growth Domestic Product (GDP) growing at the current rate of 6.5% based on the assumptions discussed in *Section 7.2.2.*

Scenario 2: Optimistic

This analysis of the outcomes of Master Plan is based on the national economy growing at higher rate than 6.5%

Scenario 3: Pessimistic

This scenario is based on an annual growth rate of less than 6.5%.

Scenario Analysis

Table 7.2 therefore shows the analysis of *the Multi-Core with Regional Industrial Development Type* in relation to the various scenarios expected within the 20-year implementation period of the NEC Masterplan, for the chosen alternative:

Table 7.5 Scenario Analysis of the Multi-Core with Regional Industrial Development Type

	SCENARIO 1 – Status Quo (i.e., GDP at a rate of 6.5%)	SCENARIO 2 – Optimistic (i.e., GDP growing at a higher rate than 6.5%)	SCENARIO 3 – Pessimistic (i.e., GDP growing at a slower rate than 6.5%)
Issues			
Transport	In the various cities, i.e. Nairobi, Mombasa and Nakuru, there shall be congestion leading to high operating costs for motor vehicles. We shall continue to experience accident on the roads especially the Mombasa-Nairobi road, due to the high number of Cargo trucks. At the port, the cargo clearance time shall remain to be high due to the lack of synergy amongst the clearing agencies. For the inland water ways, the operations shall remain at a low scale due to lack of modern berths and shallow channels restricting the size of vessels. If the status quo remains, the SGR may take a long time to complete, due to strained resources, and therefore the benefits may take a long time to be reaped. The airports shall continue to experience the inadequate warehouses to store goods and also delay in delivery of imported goods to their destination due to lack of last mile transport of the goods.	The high economic growth shall result in construction of better roads within the towns and also by passes, resulting in less congestion within towns, and subsequently low operation costs for motor vehicles. On the highways, there shall also be dedicated lanes for cargo trucks resulting in fewer accidents on the road. At the port of Mombasa, there shall be a reduction in the time taken to clear goods resulting from an integrated system of cargo clearance. At the port of Lake Victoria, there shall be construction of modern berths, state-of-the-art cargo handling equipment and dredging the access channel to enable the port to handle bigger vessels. An increase in economic growth shall lead to timely completion of the SGR construction. This shall lead to increased trade in areas served by the SGR due to decreased cost of doing business and therefore improved livelihood Expansion of existing airports due to increase in import and export, and also availability of resources for expansion.	There would be a deterioration of roads in the cities, since there shall be little or no maintenance of existing roads, and no construction of new roads. Therefore more congestion shall be experienced within the cities. Decreased economy growth shall lead in a decrease in cargo handled in Mombasa port, resulting in underutilisation of the port. A decrease in the rate of economic growth shall lead to inability to control the water hyacinth in lake Victoria, leading to collapse of the waterway transport, which shall lead to collapse of businesses which transport goods from Kenya to Uganda and vice versa For the SGR a, decrease in economic growth may lead to incompletion of the infrastructure and the inability to recover the investment already injected in the project. There will be underutilisation of the existing airports due to decreased exports.

	SCENARIO 1 – Status Quo (i.e., GDP at a rate of 6.5%)	SCENARIO 2 – Optimistic (i.e., GDP growing at a higher rate than 6.5%)	SCENARIO 3 – Pessimistic (i.e., GDP growing at a slower rate than 6.5%)
Issues			
Bio-physical	The magnitude and scope of impacts under this scenario will be as predicted in this Report. This scenario is the basis of this SEA's impact prediction and analysis. The significant potential negative impacts are found to include: • Habitat Alteration and Biodiversity Impacts; • Air Emissions; • Soil Alteration; • Hydrological Modifications; • Pollution Risk; • Natural Resources Demand, and • Health and Safety Risks. These impacts are fairly distributed in the target areas of the NEC MP. In general, this scenario has a mostly moderate outcome as compared to the other two scenarios.	In this scenario, there will be more growth in the target economic sectors of the NEC MP and others, promoting infrastructure development. Compared to other scenarios, this will create the most demand on the natural resources required for the development of the NEC MP's projects. In addition, landscape modifications would be more significant in contrast to the other scenarios. The pressure placed on sensitive ecosystems by the infrastructure projects and spurred human settlements linked to the NEC MP will be the highest in this scenario. This is because it is anticipated that the population will grow the most in industrial or economic centres targeted by the NEC MP. The magnitude and scope of impacts is therefore the highest in this scenario. In particular, the geographical scope of these impacts will be spread out more than the other scenarios due to a higher intensification of economic activities. On the other hand, financial and social capacities to manage environmental risks will be the highest in this scenario. Therefore, mitigation, monitoring and management measures will be easier to implement whereas there will be more potential for innovation.	Under this scenario there will be less growth in the sectors targeted by the NEC MP as well as others. There will be less infrastructure growth than Scenario 1 and thus less demand for natural resources. As such the scope of impacts is at most similar to Scenario 1. Compared to Scenario 2, there will be less pressure on sensitive ecosystems by the infrastructure projects and spurred human settlements linked to the NEC MP. Financial and social capacities to manage the risks of the NEC MP will be the least and therefore their magnitude will be higher on their receptors when compared to the other scenarios. Due to these lower capacities, there will be more pressure for innovation in environmental risk management.
Social	Archaeological and historical heritage sites would be threatened	Archaeological and historical heritage sites would be highly threatened	Archaeological and historical heritage sites may not be threatened

	SCENARIO 1 – Status Quo (i.e., GDP at a rate of 6.5%)	SCENARIO 2 – Optimistic (i.e., GDP growing at a higher rate than 6.5%)	SCENARIO 3 – Pessimistic (i.e., GDP growing at a slower rate than 6.5%)
Issues			
	Cultural state of affairs would gradually change	Cultural state of affairs would change significantly	Cultural state of affairs would not change much
	Public investments in socio-economic infrastructure (education, health, housing, water, energy) would be undertaken at the current rate	More public investments in socio-economic infrastructure (education, health, housing, water, energy) would be undertaken at higher rate	Less public investments in socio-economic infrastructure (education, health, housing, water, energy) would be undertaken at a lower rate than in scenario 1
	Rural urban migration would continue	Rural Urban migration would be minimized	Rural urban migration would escalate
	Unemployment will increase than presently is the case	Unemployment would decrease	Unemployment would increase more than in scenario 1
Economic	The economy will be growing at 6.5%	The average annual growth rate would be greater than 6.5%.	The average annual growth rate would be less than 6.5%.
	Current level of investments in agricultural, mineral, fisheries and tourist sectors would continue	More investments in agricultural, mineral, fisheries and tourism sectors will be made	Output in the drivers (The agricultural, mineral, fisheries and tourism sectors) would contract
	Current growth rates of the drivers (agricultural, mineral, fisheries and tourism sectors) would be maintained	Growth rates of the drivers (agricultural, industrial, mineral, fisheries and tourism sectors) would increase	Growth rates of the drivers (agricultural, industrial, mineral, fisheries and tourism sectors would decline
	More jobs would be created	Many more jobs would be created	Very few jobs would be created
	There would be enough cargo to be handled by the transport logistics infrastructure.	There may be too much enough cargo to be handled by the transport logistics infrastructure.	The transport logistics infrastructure would lack enough cargo to handle. It would operate below planned capacities
Land use	Less change of land use because the developments are moderate	More change of land uses due to rapid growth and development	No changes of land uses since there will be little to no developments
	Inadequate land use information	There will be land use database on a regular basis which will be categorized sufficiently and effectively	Lack of adequate land use information
	Insufficient land use framework and plan	There will be integrated land use framework and plan at national, regional and local level	Lack of integrated land use framework and plan
	Difficulty to achieve target land use cover of forest and wetland due to infrastructure development	Zoning of forest and wetland areas to protect them from further degradation	The target land use cover of forest and wetlands can be achieved since there will be no infrastructure development

	SCENARIO 1 – Status Quo (i.e., GDP at a rate of 6.5%)	SCENARIO 2 – Optimistic (i.e., GDP growing at a higher rate than 6.5%)	SCENARIO 3 – Pessimistic (i.e., GDP growing at a slower rate than 6.5%)
Issues			
Land values	Changes in land values due to speculation	Changes in land values due to speculation	No changes in land values
Land Tenure System	Secure land tenure system. Efficient system of land delivery with preparation and maintenance of cadastral information indicating not merely who owns what interest in land, but other details such as land capability, uses, size, distribution and topographical characteristics.	Secure land tenure system. Efficient system of land delivery with preparation and maintenance of cadastral information indicating not merely who owns what interest in land, but other details such as land capability, uses, size, distribution and topographical characteristics.	Insecure Land tenure systems
Land Acquisition and Resettlement	No clear regulations of land acquisition and resettlement e.g. croplands protection	Increase interests to safeguard issues like food security land which hold multi crop potential can be acquired and the owner be resettled in another area or compensated e.g. case of and irrigation scheme	Increased uncontrolled land acquisition and resettlement systems Increased uncontrolled compensation methods.
Settlement Patters	Insufficient frameworks to fully control settlement structure. Poor implementation of set guidelines governing or controlling settlements	Settlement patterns will be controlled through the implementation of plans and through zoning and building coding systems.	Increased uncontrolled settlements and developments Eruption of informal settlements
Urbanisation	No clear guidelines to control urbanization e.g. integrated plans.	Growth of urban centres and other growth drivers	Lack of integrated plans to control urbanization, Urban Sprawl

8 STAKEHOLDER ENGAGEMENT

8.1 OVERVIEW

This *Chapter* presents a summary of the stakeholder engagement undertaken as part of the SEA. It also serves as a summary of a more detailed Stakeholder Engagement Plan (SEP), which presents the engagement approach and identifies stakeholders and the mechanisms through which stakeholders have been engaged. The complete SEP is included in *Annex E.*

The engagement process has been designed to meet both Kenyan legal requirements for public participation in relation to a SEA and international requirements for engagement as outlined in the JICA Guidelines for Environmental and Social Considerations, 2010.

8.2 OBJECTIVES OF STAKEHOLDER ENGAGEMENT

The objectives of engaging stakeholders and the general public during the SEA process and beyond include:

- **Ensuring understanding:** An open, inclusive and transparent process of engagement and communication was undertaken to ensure that stakeholders were well informed about the Master Plan as it developed. Information was disclosed as early and as comprehensively as possible and appropriate.

- **Involving stakeholders in the assessment:** Stakeholders were included in the scoping of issues as well as the SEA Study. They also played an important role in providing local knowledge and information for the baseline to inform the impact assessment.

- **Building relationships:** Through supporting open dialogue, engagement helped establish and maintain a productive relationship between the Master Plan and stakeholders. This supports not only an effective SEA, but also strengthens the existing relationships and builds new relationships between MoTI and stakeholders.

- **Ensuring compliance:** The process was designed to ensure compliance with both national regulatory requirements and international best practice.

One of the key outcomes of engagement should be free, prior and informed consultation of stakeholders, where this can be understood to be:

- **Free**: engagement free of external manipulation or coercion and intimidation;

- **Prior**: engagement undertaken in a timely way, for example the timely disclosure of information; and

- **Informed:** engagement enabled by relevant, understandable and accessible information**.**

8.3 STAKEHOLDER IDENTIFICATION AND MAPPING

8.3.1 Stakeholder Identification

Stakeholder identification was undertaken through a brainstorming process and to guide the exercise, the following questions were asked:

- Which people/groups/institutions would be interested in the Master Plan development and implementation? What is/would be their role?
- Who are the potential beneficiaries of the NEC?
- Who might be adversely impacted? Who has constraints about the initiative?
- Who may impact the Master Plan? Who has the power to influence?

Thereafter, a list of stakeholder's organizations was developed and grouped as government, civil society, NGOs and private sector, as presented in *Table 8.1* below and the detailed Stakeholder Database is provided in *Annex E.*

The next step was to analyse the list of stakeholders to better understand their relevance and the perspective they offer, to understand their relationship to the issues and each other and, to prioritize based on their the relative usefulness for the SEA engagement. A list of criteria used to analyse each stakeholder is as follows:

- **Contribution** (value): does the stakeholder have information counsel or expertise on the issue that could be helpful to the SEA process?

- **Legitimacy**: how legitimate is the stakeholders claim for engagement?
- **Willingness to engage**: how willing is the stakeholder to engage?
- **Influence**: how much influence does the stakeholder have?
- **Necessity of involvement**: can the stakeholder derail or delegitimize the SEA process if they were not included in the engagement?

Table 8.1 List of Identified Stakeholders

Stakeholder Category	Stakeholder Group	Connection to the Master Plan
Government	• Government agencies • National regulatory bodies	National Government are of primary importance in terms of establishing PPPs
	• Key County Authorities	County government are also of primary importance as they are responsible for implementation of legislation, and development plans and policies at the County level. The NEC traverses 29 Counties.
Civil Society	• Community Based Organisations • Community of Other Associations • Research and Academic Institutions	Organisations with direct interest in the NEC and Master Plan, and its social and environmental aspects and that are able to influence the Master Plan directly or through public opinion. Such organisations may also have useful data and insight and may be able to become partners to the Master Plan in areas of common interest.
Non-Governmental Organisations (NGOs)	• National • Local	NGOs with direct interest in the NEC and Master Plan, and its social and environmental aspects and that are able to influence the Master Plan directly or through public opinion.
Private Sector	• Private Sector	Private Sector with direct interest in the NEC, and the impact it will have on their businesses.

8.3.2 Stakeholder Mapping

Stakeholder Mapping

Mapping stakeholders is a visual exercise and analysis tool used to establish which stakeholders are most useful to engage with. Mapping allows one to see where stakeholders stand when valuated by the same key criteria and compared to each other and helps to visualize the often complex interplay of issues and relationships created in then criteria chart above.

When developing stakeholder map, the SEA team considered the following questions:

1. **What is the stakeholder's level of influence?** Level of influence refers to the stakeholder's breadth of authority and influence (direct or indirect) to the success of the SEA, including positional authority, financial power, or persuasive power over decision-makers.
2. **What is the extent of the stakeholder's potential contributions?** For example, does the stakeholder have information, expertise, or resources (current or potential) that will facilitate the development and execution of the Master Plan? What perspectives or experiences does the stakeholder bring to the conversation that is unique to his or her community?
3. **What is the stakeholder's commitment level?** What would be the organization's role in executing the Master Plan? How committed is the organization's leadership to executing the Master Plan? How will the change associated with the Master Plan affect the organization?

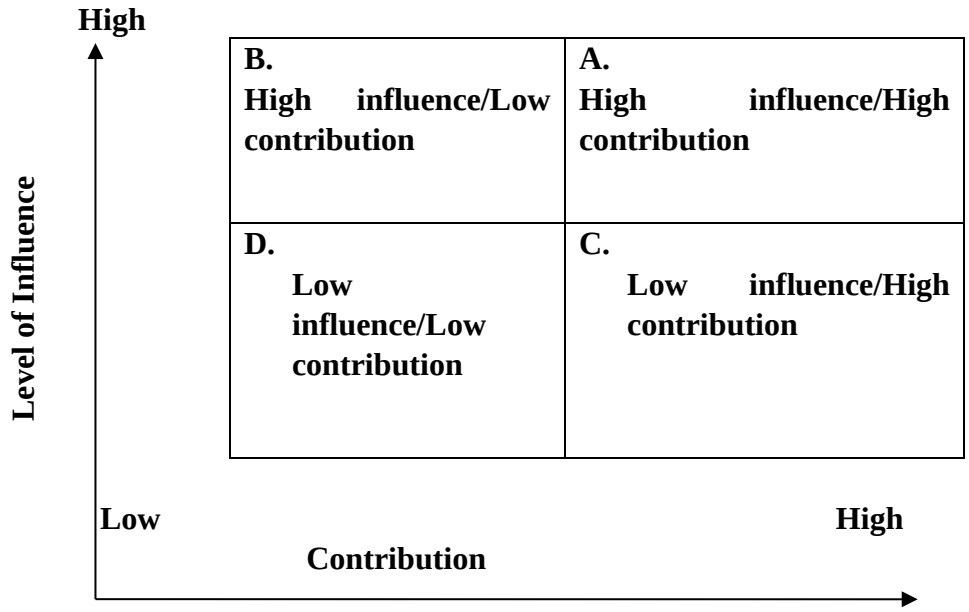
Creating a Stakeholder Map

After detailed information was gathered about the stakeholders, the next task was to create a Stakeholder Map. This is a visual exercise and analysis tool to help determine the extent to which different stakeholders could be engaged in the SEA process, based on their level of influence and potential contributions.

In order to create the stakeholder map, the SEA team classified each stakeholder as either high influence or low influence, and as either high contribution or low contribution. The stakeholders were then placed into the appropriate quadrant (group) on the stakeholder map: A, B, C, or D (see *Figure 8.1* below). Those that fell into groups B, C, and D were

considered key stakeholders because they had substantial influence, could make substantial contributions to the SEA process, or both.

Figure 8.1 Stakeholder Mapping



Stakeholder Groups

Group A (high influence, high contribution): These stakeholders appear to have a high degree of influence on the Master Plan and are of high importance to its success. Therefore, the SEA Team created good working relationships with these stakeholders, to ensure an effective coalition of support for the SEA.

Group B (high influence, low contribution): These are stakeholders with high influence, who can affect the outcomes of the SEA, but whose interests were not necessarily aligned with the overall goals of the Master Plan.

Group C (low influence, high contribution): These stakeholders are of high importance to the success of the Master Plan, but have low influence. This implies that they require special initiatives if their interests are to be protected. Because of their substantial contributions, they can help shape the implementation of the SEA and therefore, in some circumstances, be valued more highly than stakeholders in Group C.

Group D (low influence, low contribution): The stakeholders in this group have low influence and low importance to the Master Plan

objectives. Therefore they are of low priority and require limited engagement.

Approaches and Methods for Engaging Stakeholders

Table 8.2 Approaches and Methods for Engaging Stakeholders

Stakeholder/Organisation	Approach	Methodology
Group A (High Influence, High Contribution)	Engage and consult regularly Involve in decision-making of: • strategic priorities, • intervention selection, and • cost estimate	• Inclusion in strategy advisory group or SEA team consultations • Inclusion in thematic consultations • Key informant interviews, • Consensus-building and decision-making forums
Group B (High Influence, Low Contribution)	Consult on specific areas of expertise/Contribution Proactively engage	Same as Group A, plus: One-on-one consultations
Group C (Low Influence, High Contribution	Same as Group A, plus: Work with stakeholders to ensure that expressed needs and concerns are directly reflected in the SEA	Same as Group A, plus: • Dedicated stakeholder consultation during situation analysis to gather stakeholder input • Solicitation of recommendations for interventions • Review of planned intervention

This list of stakeholders mapped according to their levels of influence and contribution is presented in the SEP in *Annex E.*

8.4 STAKEHOLDER ENGAGEMENT

8.4.1 Stakeholder Meetings

Various stakeholder meetings were then held as shown in *Table 8.3* and *Table 8.4* below. The minutes and the list of participants in the meetings are attached in *Annex F*. It is important to note that since the coverage area of the Master Plan is so extensive:

- the target participants was limited to high level officials, and
- the places where the stakeholder meetings were conducted was limited to major cities/towns along the Corridor, namely Nairobi, Mombasa, Nakuru, Kisumu and Malaba (1) .

(1) This was agreed in consultative meetings between NEMA/JST/MoTI.

Table 8.3 Stakeholder Meetings at the Scoping Stage

Date	Location	Venue	Attendees
02nd November 2015	Nairobi	Silver Springs Hotel	JICA, various Government Ministries, PIEA, LAPSSET Authority, KURA, Traffic Police, NEMA, KPC, SP Advisory, Toyota Tsusho East Africa Ltd, KIFWA, KURA, KeNHA, KeRRA
04th November 2015	Mombasa	Best Western Creekside Hotel	Ministry of Lands, KIFWA, KPRL, NCTTCA, KPA
06th November 2015	Nakuru	Merica Hotel	Ministry of Industrialisation, NEMA, KAM, Ministry of Labour, Social Security and Services, County Government of Nakuru
09th November 2015	Kisumu	Imperial Hotel	Ministry of Energy, NEMA, KeNHA and Lake Victoria Basin Development Authority
09th November 2015	Kisumu	Kisumu County Government Offices	Kisumu County Government CEC-Information Communication and Technology
10th November 2015	Kisumu	Kenya Association of Manufacturers (KAM) Offices in Kisumu	KAM Western and Nyanza Region and the Kenya National Chambers of Commerce and Industry (KNCCI)-Western and Nyanza Region
10th November 2015	Kisumu	County Government Offices, City Hall, Kisumu	Kisumu County Government City Planner
10th November 2015	Kisumu	Kisumu County Government Offices	Kisumu County Government CEC- Industrialisation
10th November 2015	Kisumu	Tom Mboya Labour College, Kisumu City	Government Officials from Busia County

Date	Location	Venue	Attendees
11th November 2015	Malaba	Hotel Lavantes	Sub County Officers - Busia County, Kenya Urban Roads Authority (KURA), Kenya National Highways Authority (KeNHA), Kenya National Chambers of Commerce and Industry (KNCCI), NEMA, Customs and Revenue Business Owners Association, Amagoro Motor Cycle Boda-Boda Association, Community of Malaba.

Table 8.4 Stakeholder Meetings at the SEA Study Stage

Date	Location	Venue	Attendees
04th May 2016	Kisumu	Imperial Hotel	MoTI, JST, KeNHA, LBDA, NIB, Maseno University, NEMA, KMFRI, AFFA
06th May 2016	Malaba	Hotel Lavantes	MoTI, JST, County Government of Busia, KeRRA, Ministry of Agriculture, Livestock and Fisheries, FOPPS SACCO, Immigration Malaba Border. KeNHA, KeRRA, NEMA
09th May 2016	Mombasa	Best Western Creekside Hotel	MoTI, JST, Immigration Department, CORDIO East Africa, Coast Water Services Board, KPRL, KMA, NEMA, KeRRA, KNCC, KFS, NCTTCA
11th May 2016	Nakuru	Merica Hotel	MoTI, JST, KeNHA, MOEID, Department of Immigration, KeRRA, Egerton University, NEMA
13th May 2016	Nairobi	Silver Springs Hotel	MoTI, JST, KARA, AFIPEK, Kenya Water Institute, JICA Kenya, FEAFFA, KWS, PIEA, Green Belt Movement, LAPSSET, KeRRA, Nature Kenya. RVR, Kenya Pipeline Company, KNCCI, KFWG, Transport Union, National Museums of Kenya
01st September 2016	Nairobi	CS Board Room, Works Building, MoTI	Principal Secretary (PS) Representatives from the following State Departments: Planning and Statistics, Water, Devolution, Public Work, MoTI, JST
22nd September 2016	Nairobi	Panafric Hotel	Representative from the Council of Governors, Ministry of Devolution and Planning, MoTI, JST.

8.4.2 Baseline Phase Engagement

Opinion Surveys

Two sets of opinion surveys/questionnaires were administered during the stakeholder meetings. The results were used to inform the baseline data.

Key Informant Interviews

Key Informant Interviews (KIIs) were held with stakeholders in April and May 2016, where the interviewees were taken through a guided discussion. See *Table 8.5* for the discussion topics and *Table 8.6* for the interview schedule. The interviews were held one on one between Stakeholders and individual SEA team members.

Table 8.5 KII Discussion Topics

Subject	Question/Discussion Topic	Target Respondent/ Stakeholder
Environment		
Designated and Sensitive Areas	**Industrial corridors** Are there any gazetted or at least recognized industrial corridors in the PAs according to their management plans?	KWS, KFS
	PCAs and CCAs What are the sensitivities of the PCAs and CCAs intersected by the NEC? Do the authorities maintain any data or records on them?	KWS, KFS
	Unprotected Sensitive Areas Besides the priority ecosystems identified in KWS's website are there any other ecosystems in the NEC that are not protected?	KFS, KWS
	Threats Which threats face the protected areas intersected?	KWS, KFS
	Species of Commercial Value The species (flora and Fauna) of commercial value found in the NEC and their markets.	KWS, KFS, County Governments
Pollution and Air Quality	**Pollution and Air Quality** The main forms of pollution that occur in their respective counties, their causes, impacts and actions being taken in response.	County Governments, KPA
Regulatory Framework	**Adequacy of Current Framework** Any regulatory gaps in their jurisdictions or mandates with respect to management of natural resources.	All stakeholders
Hydrology	Are there any recently documented articles on the hydrological and hydrogeological conditions of all the counties? If yes where?	WRMA Kenya Metrological Department.
Geology and Soils	Do the authorities have recent soil surveys done along the corridor? How have the recent changes in land use affected the structures and composition of the soil along the corridor?	KARLO
Socio-Economic		

Subject	Question/Discussion Topic	Target Respondent/ Stakeholder
Effects/impact of implementing the NEC Master Plan on other organizations	How will implementation of the NEC Master Plan affect/impact on implementation of your policy, programs and plans and, vice versa?	All stakeholders
Socio-economic compatibility of NEC Master Plan and other intuitional policies, programmes and plans	What are the compatible socio-economic areas (actual and potential) between NEC Master Plan and your policy, programs and plans?	All stakeholders
Socio-economic conflicts between the NEC Master Plan and other institutional policies, programmes and plans	What are the socio-economic areas of conflict (actual and potential) between the NEC Master Plan and your policy, programs and plans?	All stakeholders
Strategic actions and recommendations	Propose specific strategic actions that the NEC Master plan should have to: a) enhance compatibility; and b) mitigate the conflicts.	All stakeholders
Archaeological sites	Are archaeological and historical sites documented in their respective counties? Do the authorities maintain any records on them?	National Museums of Kenya
Additional sources of information	Is there useful documentation that you know of, that the SEA Team should note, refer to, or guide them while assessing the NEC Master Plan? Do the authorities maintain any records on them	All stakeholders
Urban/Physical Planning		
Urban areas	How will the urban areas found along the corridor likely to be affected economically by the NEC?	Ministry of Lands, Housing and Urban Development
Transport		

Subject	Question/Discussion Topic	Target Respondent/ Stakeholder
Road Reserve	The NEC is looking at a 50km buffer on both sides of the infrastructure corridor where industrial and commercial investments and farms will be situated. Shall the reserve for infrastructure be available along the corridor? And if not what is the way forward?	KeNHA, KURE, KeRRA, KRB
Economic Growth Centres	Since the NEC infrastructure by-passes some of the proposed growth centres, are there plans to connect them to the NEC infrastructure?	KeNHA, KURE, KeRRA, KRB
Inter-modal transport efficiency.	There has been an increase in cargo transport on road rather than rail transport. What policies and plans are there to increase efficiency on inter-modal transport and prevent overuse and under use some means of transport?	MoTI

Table 8.6 Key Informant Interviews Schedule

Date	Location	Venue	Stakeholder/Representative
19th April 2016	Nairobi	KWS Headquarters Nairobi	KWS Warden in Charge of Nairobi National Park
	Kisumu	Kenya Railways Offices	Port Manager
	Mombasa	Kenya Maritime Authority (KMA) Headquarters	KMA Marine Safety Engineer
	Kisumu	County Government Officers	Chief Officer Communication, Planning and Development
20th April 2016	Nakuru	County Environment Offices	County Director Environment (NEMA, Nakuru)
	Mombasa	KWS Headquarters Mombasa	Assistant Director KWS Coast
	Kisumu	KPC Offices	KPC Assistant Director
	Nairobi	KNCCI Offices	KNCCI Manager in the Department of Trade
	Nakuru	KeRRA Regional Offices	, KeRRA Regional Manager
	Nairobi	KeRRA Headquarters	Director General and Senior Engineer
	Nakuru	County Government Offices	CEC Lands, Housing and Physical Planning
	Nakuru	County Government Offices	CEC in charge of Agriculture, Livestock and Fisheries
21st April 2016	Malaba	PALWECO Offices	Sub County Coordinator Malaba,
	Mombasa	KNCCI Offices	Executive Officer KNCCI Mombasa
	Busia	Busia County Offices	County Government Busia- Chief Officer Public Works and Energy
	Busia	Assistant County Commissioner Malaba Office	Assistant County Commissioner
22nd April 2016	Mombasa	KFS Headquarters	Assistant Director KFS Coast Region
	Mombasa	Kenya Ports Authority (KPA)	Environmental Officer
	Kisumu	KPA Inland Container Depot (ICD)	Port Manager

Date	Location	Venue	Stakeholder/Representative
	Kisumu	Kisumu City County Offices	Director City Planning, Kisumu City
26th April 2016	Nakuru	KeNHA Regional Offices	KeNHA Regional Manager- South Rift
	Nakuru	CEC Roads, Infrastructure and Public Works Offices	CEC Roads Infrastructure and Public Works and KURA Regional Manager- South Rift Region
05th May 2016	Busia	KeRRA Offices, Busia Town	Deputy Regional Manager- KeRRA Busia Region
	Busia	Busia County Government- Roads, Transport and Public Works- RT&PW Offices	County Chief Officer- Roads, Transport and Public Works, Busia County
	Busia	Busia County Government- Lands, Housing and Urban Development (LH&UD) Offices	County Executive Member- Lands, Housing and Urban Development, Busia County

8.4.3 *Website*

A website for the purpose of information disclosure of the activities related to SEA was also developed. The website has been used for the advertisement of events such as stakeholder meetings but also reports and documents related to the Master Plan and SEA are kept there for download and review by the public. This website is hosted on the server of the MoTI and as such will continue to be updated after the SEA study by the Ministry. The address for the website is: http://www.transport.go.ke/Projects.html

8.5 *OUTCOMES OF STAKEHOLDER ENGAGEMENT*

Overall, the development of a Master Plan for the NEC was highly welcomed and appreciated. Stakeholders pointed out that the Master Plan would guide the Country and Counties on matters of transport infrastructure and logistical development. If the Plan is implemented as envisaged, then it will increase communications, production, trade and employment in Kenya, as well as the neighbouring countries. The *Sections* below provide a summary of area specific as well as cross-cutting concerns:

8.5.1 *Area Specific Concerns*

Box 8.1 Comments and Concerns raised in Mombasa County

- Traffic congestion in the City of Mombasa and long roads leading to the City Centre
- Long cargo clearing time at the Port of Mombasa
- Limited packing space for trucks at the Port of Mombasa
- Corruption at the Port of Mombasa and Mariakani weighbridge
- Overloading of trucks
- Road damages caused by overloaded trucks
- Congestion of trucks at the weighbridge at Mariakani
- Long queues and delays at the Mombasa-Likoni Ferry Crossing
- Time taken to transport goods is longer by Kenya Railways than by road hence making the it relatively expensive
- Underutilization of Kenya Railways to transport cargo and passengers
- The collapse of the oil refineries at Changamwe
- Poor state of rural feeder roads

Box 8.2 Comments and Concerns raised in Nairobi County

- Traffic congestion within the City of Nairobi which is increasing the time and cost of travelling
- Unsatisfactory traffic flow control by the traffic police and traffic lights
- Public service vehicles (m*atatu*) disregard for traffic laws
- Traffic accidents
- Road damages caused by overloaded trucks
- High road maintenance costs
- Time taken to transport goods is longer by Kenya Railways than by road, making it comparatively expensive
- Underutilisation of the Kenya Railways to transport cargo and passengers
- Interference of the SGR with Nairobi National Park
- Lack of lanes for use by cyclists and hand carts on city roads
- Lack of road signage in some areas within Nairobi
- Congestion of trucks at the weighbridge at Mlolongo
- Corruption at the weighbridge at Mlolongo
- Overloading by trucks
- Failure by some trucks to use the Northern and Southern by-passes

Box 8.3 Comments and Concerns raised in Nakuru County

- Traffic congestion within the CBD
- Time taken to transport goods is longer by Kenya Railways than by road, making it comparatively expensive
- Congestion caused by trucks at the vehicle inspection near Gilgil
- Congestion caused by trucks at Salaga town
- Increase in number of traffic accidents
- Poor state of rural feeder roads

Box 8.4 Comments and Concerns raised in Kisumu County

- Underutilisation of the port of Kisumu and other smaller ports along Lake Victoria
- Traffic congestion within the CBD
- Time taken to transport goods is longer by Kenya Railways than by road hence making the railway transport more expensive
- Underutilisation of Kenya Railway to transport cargo and passengers. The Butere line is currently out of use
- Poor state of rural feeder roads
- Underutilisation of Mombasa International Airport in handling cargo

Box 8.5 Comments and Concerns raised in Busia County

- Traffic congestion at Malaba and Busia border points
- Most of Malaba Town sits on privately owned land
- Long clearing time of trucks crossing in and out of Kenya
- Poor state of rural feeder roads
- Loss of revenue to the County government if the cargo handled by the trucks is moved to the railway and pipeline
- Decline of businesses that directly and indirectly depend on trucks
- Increase of unemployment in the towns if the shift of cargo from trucks to the railways and pipeline is actualised

8.5.2 Cross-Cutting Issues

The following is a summary of issues and comments raised throughout the engagement process:

Table 8.7 Summary of Cross Cutting Engagement Raised During the SEA

Main Issue	Specific Concern
Road Furniture	• Speed bumps which are meant to reduce road accidents but end up reducing travelling time and causing traffic congestion along the roads • Vandalism of road furniture and road signage along the highways • Absence of climbing lanes in certain deserving parts of the roads
Health and Safety	• Road safety awareness creation should be incorporated into the Master Plan • The SEA should consider issues along the corridor such as communicable diseases, health, crime, social interests that will come about due to developments from the NEC
Alignment with other PPPs	• Whether PPPs developed by different government institutions in the country, would conflict or contradict with NEC Master Plan. • Need for the harmonization of the Master Plan with existing other national and county government PPP
Land Acquisition and Resettlement	• High cost of acquiring land for infrastructure development • Tendency for land speculation, especially when government plans to undertake major infrastructural developments are known. This makes project costs unnecessarily high. • Whether the Plan would develop a Land Bank
Economic Issues	• The cost of transporting goods and people is generally high for ordinary Kenyans • Stakeholders were concerned that the development of transport logistics infrastructure would increase the cost of doing business in Kenya. • An increase in the volume of internal cargo to be handled by the transport infrastructure depends largely on how the economy performs (especially within the agricultural, industrial and mining sectors). Stakeholders expressed reservations on how MoTI will ensure that the Master Plan implementation is not frustrated by slow/no growth in these vital sectors of the economy. • How the Master Plan would deal with the problem of insufficient cargo to sustain the infrastructure in order to avoid the situation Kenya Railways, Kisumu International Airport and Kisumu Port are currently experiencing. • The cost to Kenyans of implementing the Master Plan

Main Issue	Specific Concern
Challenges in the County	• The controversy resulting from the recent re-classification of rural roads (Class D and below) under Kenya Rural Roads Authority and County - Counties expressed concern that it was a move to deny them development funds to develop roads under their jurisdiction.
Corruption	• Corruption by some elements in law enforcing agencies i.e. traffic police, customs, KRA and KPA • Corruption in project procurement and implementation making infrastructure projects unnecessarily expensive.
Political Will	• There are many sound development plans have been developed since independence. Most of them have not been implemented but remain on shelves. Stakeholders wanted to know what will do differently so that the Master Plan is implemented intended in terms of projects, time and cost. • Implementation of large projects like the ones envisaged by the Master Plan would require strong committed political will at National and County Governments. Stakeholders expressed reservations about the existence of that kind of political will, at least presently.
Disease Transmission	• Prevalence of sexually transmitted diseases and HIV especially at the stop-over points for trucks along the Mombasa-Busia/Malaba highway
Vulnerable Groups	• Physically challenged people experience difficulty in using some of the transport infrastructure already developed. New projects should be weary of the existence of physically challenged people in the country.
Unemployment	• Moving of cargo from the road to the railway and pipeline may lead to loss of jobs in the truck transportation businesses and truck-dependent business especially along highways and border posts.
Insecurity	• Considering the increase in number of terrorist and banditry activities in the country in the recent past, the Master Plan should consider the security of cargo and people who will be using the transport logistics infrastructure.

Main Issue	Specific Concern
Legal Framework	• It was observed that although Kenya Railways has the mandate for managing inland water ways and ports, it does not have the capacity to do and to develop new ports. Many previous piers on Lake Victoria are vandalized and the only existing Kisumu port is underutilized. Since Kenya Ports Authority has the capacity and experience to manage marine ports, the law should be amended to give it additional mandate of manage and develop inland water ways and ports.
Feasibility Studies	• Stakeholders raised the concern of developing huge infrastructure projects without undertaking comprehensive feasibility studies. If that had been done, Uganda would have not chosen the southern against the northern route to develop a petroleum pipeline from Hoima to sea or Rwanda preferring to develop a railway link with Tanzania Railway rather than the Kenya-Uganda Standard Gauge Railway.
Litigation	• Development projects having a tendency of delaying implementation through long and winding litigations. This does delays project implementation and increases the project cost.
Gender	• That gender issues should be integrated into the Master Plan

9 KEY ENVIRONMENTAL IMPACTS AND MITIGATION STRATEGIES

9.1 INTRODUCTION

In this *Chapter* the potential environmental impacts of the NEC Master Plan are predicted and assessed, and mitigation strategies are proposed. This prediction and assessment is focused on the *Multi-Core with Regional Industrial Development Type* Master Plan Alternative. Insights and feedback received from stakeholders during the preparation of this Study also inform this impact assessment process.

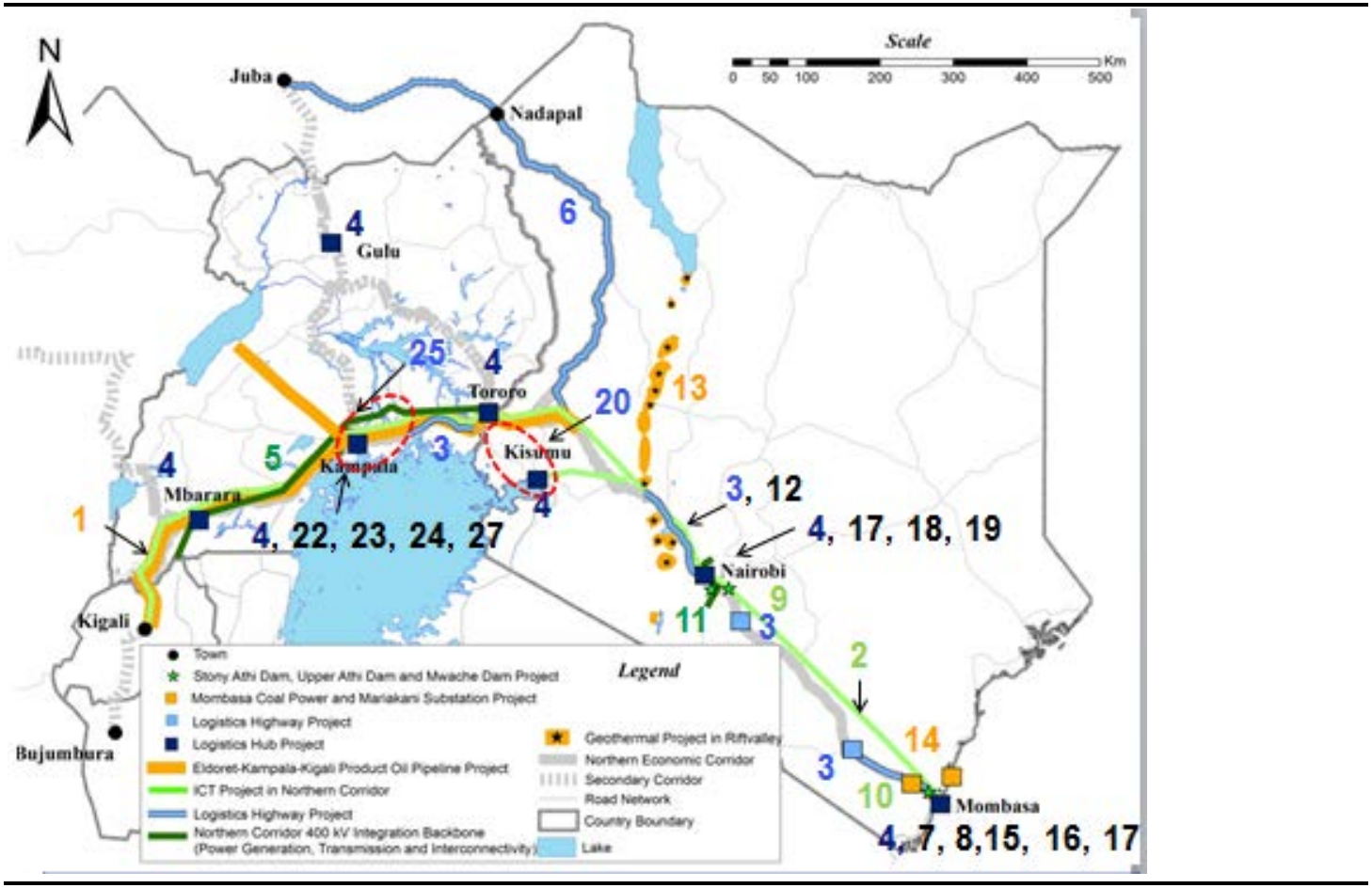
This chapter addresses two items, namely:

- Environmental Impacts, and
- Cumulative Environmental Impacts.

9.2 NEC MASTER PLAN

As discussed in *Chapter 2* of this Report, the development vision for the NEC is to be the leading economic corridor with integrated transport and logistics systems in Africa. The Master Plan therefore aims at balanced growth and efficient logistics in the NEC region by promoting urban functions of 18 Secondary Cites, including 6 Secondary cum Regional Production Centres (see *Figure 9.1* and *Table 9.1* below), which also cascade into specific sectoral infrastructure projects (Table 9.2).

Figure 9.1 The NEC Master Plan



Source: JICA, 2016

Table 9.1 Location of Flagship NEC Projects in Kenya and Uganda

No.	Sector	Project Title
1	Mining	Eldoret-Kampala-Kigali Oil Pipeline Project
2	Mining	ICT Project in Northern Corridor
3	Road	Logistics Highway Project
4	Logistics	Logistic Hub Project
5	Power	Northern Corridor Integration Backbone (Power Generation, Transmission and Interconnectivity)
6	Road	Eldoret-Juba Highway Project
7	Port	Mombasa Port Development Project
8	Urban Dev't	Project for Support of Re-organizing Logistics Facilities around Mombasa Port Area
9	Water	Stony Athi Dam and Upper Athi Dam Project
10	Water	Mwache Dam Project
11	Power	Isinya-Nairobi East Transmission Line Project
12	Industry	Geothermal Energy Based Regional Industrial Development in Rift Valley
13	Power	Geothermal Project in Rift Valley

14	Power	Mombasa Coal Power and Mariakani Substation Project
15	Power	Dongo Kundu-Mariakani Transmission Project
16	Industry	Mombasa Special Economic Zone Project
17	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Kenya
18	Agriculture	Agricultural Financing Improvement Project in Nairobi
19	Agriculture	Value Chain of Agriculture Development Pilot Project in Kenya
20	Urban Dev't	Logistics Based Kisumu-Kakamega Metropolitan Area Development Project
21	Mining	Study on Mining Master Plan in Uganda
22	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Uganda
23	Agriculture	Value Chain of Agriculture Development Pilot Project in Uganda
24	Power	Kampala-North-Namungona-Mutundwe 132 kV Transmission Line Refurbishment
25	Urban Dev't	Great Kampala (including Jinja) Logistic Based Urban Development Project
26	Urban Dev't	Study on master Plan for Urban Transport Development for Regional cities
27	Industry	SEZ Development Project in Kampala

Source: JST, 2016

Table 9.2 NEC MP Sectoral Distribution of Infrastructure Projects

Sector	Number of Projects
Road	12
Railway	10
Border Post	7
Marine Port	5
Airport	1
Inland Waterway/Port	1
Logistics Hub	3
Oil and Mining	3
Agriculture and Fishery	9
Manufacture	3
Power	3
Water	9

Source: JST, 2016

The NEC Master Plan will ultimately result in the development of a multitude of projects. The potential impacts of these projects are predicted and assessed at a strategic level on the receptive baseline and its constraints discussed in *Chapter 5* (Environmental Baseline) and *Chapter 6* (Socio-Economic Baseline).

9.3 IMPACT PREDICTION

The impact prediction process entails grouping issues associated with the different sectoral projects being developed. These issues are identified through an iterative process. In order to achieve this, prediction matrices have been used. This process is also informed by:

- Good International Industry Practice Guidelines (GIIPs),
- research,
- environmental and social risks of similar projects and plans, and
- Stakeholder engagement.

9.4 SUMMARY OF ENVIRONMENTAL IMPACTS

Table 9.3 below provides a summary of the environmental impacts that may occur as a result of the Master Plan.

Table 9.3 Environmental Impact Identification Matrix

Sector	Impacts and Risks[1]									
	Habitat Alteration (Biodiversity Impacts)	Air Emissions	Landscape Modifications	Soil Alteration	Hydrological Modifications	Pollution Risk			Natural Resources Demand	H&S Risks
						Solid Waste	Liquid Waste	Hazardous Materials		
Road	X	X	X	X	X	X	X	X	X	X
Railway	X	X	X	X	X	X	X	X	X	X
Border Post	X	X	X	X	X	X	X	X	X	X
Port	X	X	X		X	X	X	X	X	X
Airport	X	X	X	X	X	X	X	X	X	X
Inland Waterway/Port	X	X	X		X	X	X	X	X	X
Logistic Hub	X	X	X	X	X	X	X	X	X	X
Oil and Mining	X	X	X	X	X	X	X	X	X	X
Agriculture and Fisheries	X	X	X	X	X	X	X	X	X	X
Manufacture	X	X	X	X		X	X	X	X	X
Power	X	X	X	X		X	X	X	X	X
Water	X	X	X		X	X	X	X	X	X

[1] 'X' denotes impact.

9.5 HABITAT ALTERATION AND BIODIVERSITY IMPACTS

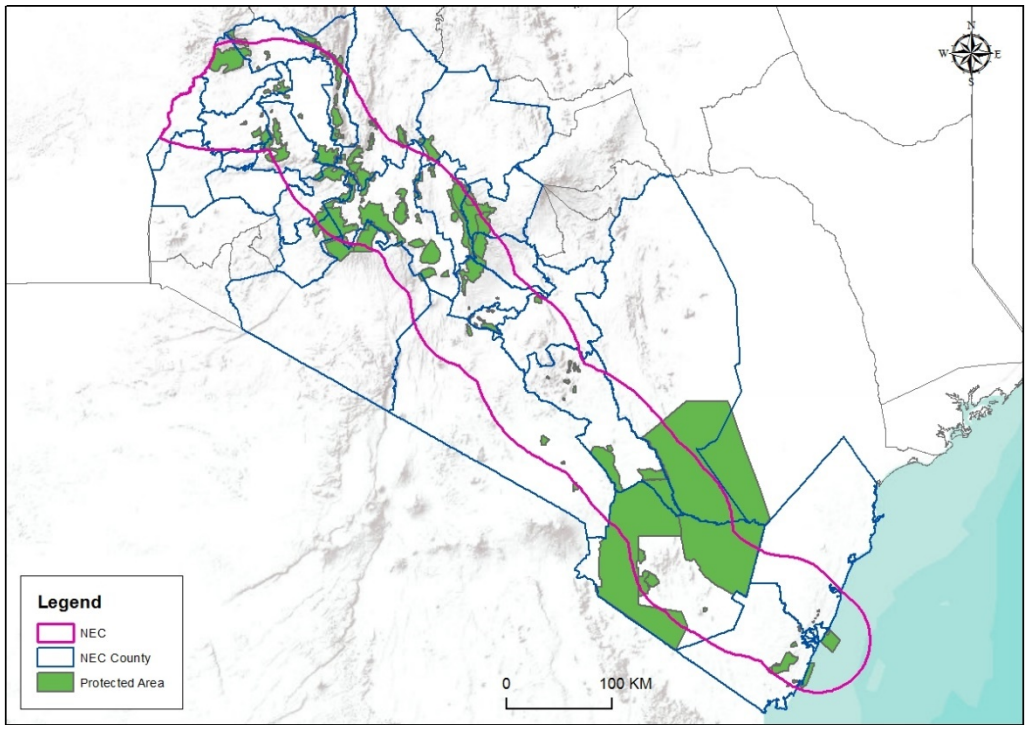
9.5.1 Summary of Applicable Constraints

Applicable constraints to Habitat Alteration and Biodiversity impacts include:

- Protected Areas,
- Internationally Designated Areas,
- Wetlands,
- Rivers and lakes, and
- Sensitive ecosystems (Water Towers, Forests, Corals, Sandy beaches, Mangrove forests, and Sea Turtle Nesting Beaches).

Protected areas are particularly susceptible to impacts of habitat alteration and on biodiversity. Their location in the NEC is shown by the map below.

Figure 9.2 Protected Areas in the NEC



9.5.2 Impact on Habitats

The implementation of physical infrastructure within the NEC will involve:

- Conversion of land uses via the establishment, rehabilitation and expansion of rights of way (RoW) and

- Development of projects on Greenfield sites.

Habitat alteration induced by the development of Greenfield sites for infrastructure can potentially reduce the ecological integrity of these habitats. This will lower the economic value obtained from both protected and unprotected ecosystems. In addition, human activities already place the sensitive ecosystems in the NEC under pressure. Particular cases worth noting are Protected Areas such as Nairobi National Park, Tsavo Conservation Area, Lake Nakuru National Park, Lake Naivasha National Parks and Mau Forest Human activities such as tourism, agriculture, excisions, development of infrastructure (settlements included) and pollution place these ecosystems and others at risk of degradation. Furthermore, the establishment of new RoWs in these ecosystems can lead to habitat fragmentation. *Figure 9.2, Figure 9.3* and *Figure 9.4* illustrate the pressures from human activities in Nairobi NP, Nakuru NP and TCA respectively. Another example is Hells Gate NP in which exploitation of geothermal resources has compromised the ecological integrity of the protected area and its ecosystem services.

Promoting growth drivers such as mining and agriculture will increase the area of land under those uses and the transportation of people and goods will also increase during the construction and operation of the sectoral projects.

It is anticipated that the land under the uses of settlements, agriculture and mining in the NEC will increase in competition to others. Inadvertently this will alter habitats (2) from their prevailing states. Moreover, habitats that are not protected under national and international designations, such as county managed forests, buffer regions around protected areas and sandy beaches, will be most vulnerable.

(2) Habitats in this context refers to marine, terrestrial and aquatic habitats that are protected/designated as well as those that are not

Figure 9.3 Nairobi NP Neighbouring Settlements and Infrastructure

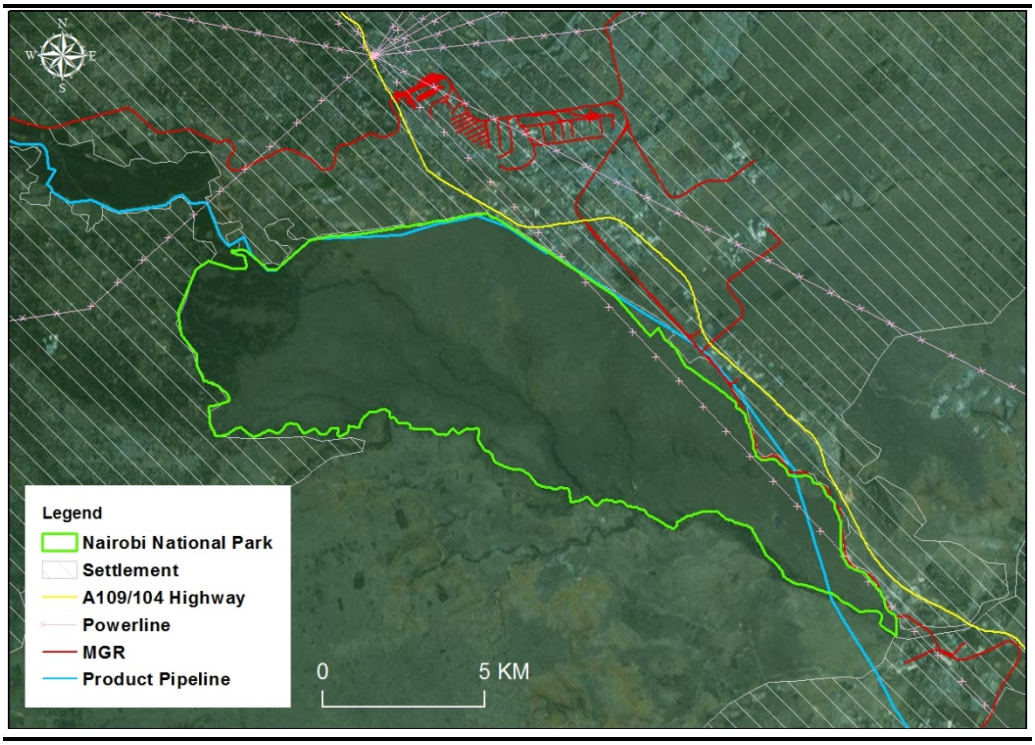


Figure 9.4 Lake Nakuru NP Neighbouring Settlements and Infrastructure

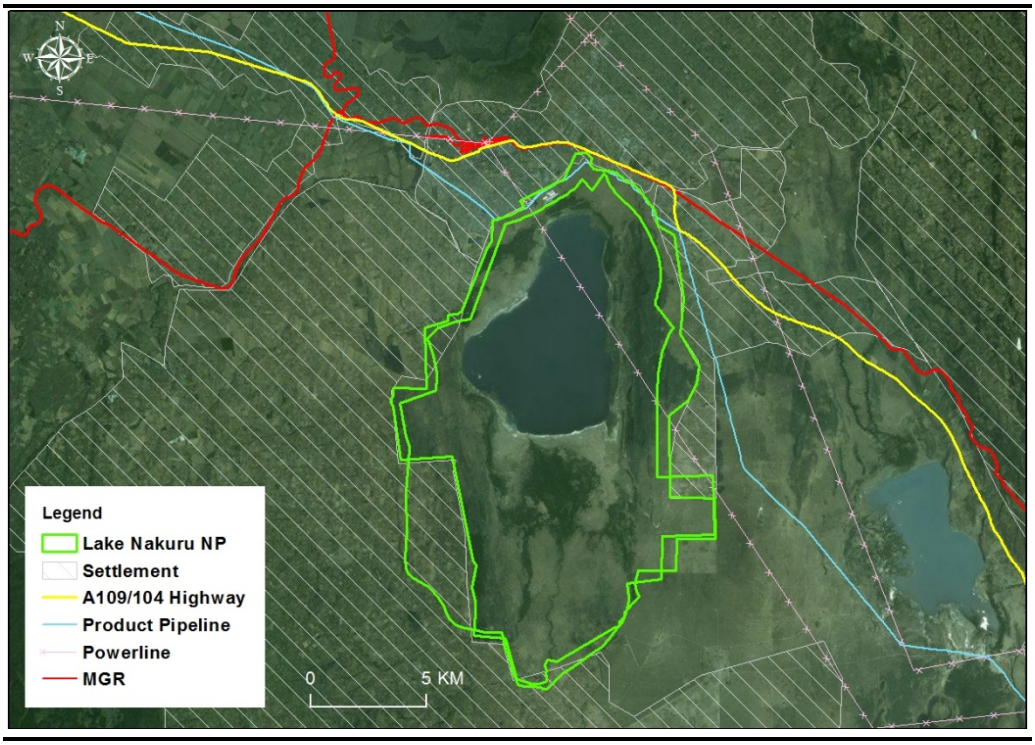
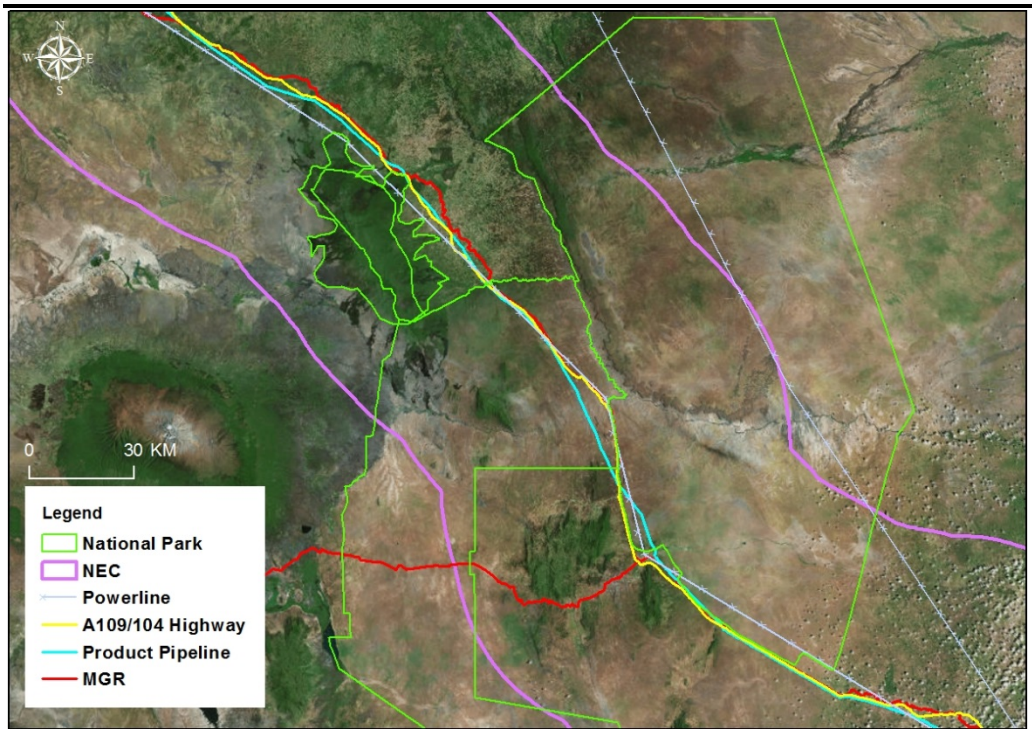


Figure 9.5 Right of Ways in Tsavo Conservation Area (Habitat Fragmentation)



9.5.3 *Impacts on Fauna and Avifauna*

Habitat alteration, primarily losses, can affect animal biodiversity since floral communities and the habitats themselves support fauna by providing nesting sites, breeding grounds and nutrition. The risk of impacts on fauna is increased by the fact that there are 166 globally threatened species supported by the ecosystems in the NEC, and to which habitat loss is amongst the factors that already places them under threat. Fauna can be affected as follows:

Firstly, faunal species will be affected negatively when their habitats are converted during the establishment of infrastructure. This will be the case when Greenfield sites are converted. Deforestation can also happen when forested or vegetated areas are cleared for development. Apart from loss of carbon stock, the effective habitat for faunal species will be reduced from deforestation. Stakeholders in Mombasa informed this study that due to dredging which causes beach erosion, sea turtles have migrated away from Kenyan beaches to as far as Somalia. The aquatic environment will also be susceptible to changes since infrastructure such as the pipeline, roads and rail will establish river crossings whose development will alter characteristics of each receptive riverine and riparian ecosystem. Aquatic and riparian ecosystems are rich in diversity and ecosystem services. Thus they are protected by the

Water Act, WCMA and EMCA. It is for this reason that this SEA study has classified them as constraints.

Secondly, the increase in transportation (rail, road, water and air) can disrupt migration and breeding of faunal species (behaviour). This increase in movement can lead to mortality when collisions with animals occur. Additionally, transmission lines can also lead to avifauna fatalities through electrocution. In totality, these accidents and establishment of infrastructure components in proximity or within the natural habitats (species ranges) of wild fauna can increase human-wildlife conflict. Introduced noise generated by vehicles, crafts, machinery, equipment and civil processes can also become a disturbance to fauna and affect their behaviour (3).

9.5.4 Summary of Impact on Habitats, Fauna and Avifauna

The impact of the NEC MP on habitats and biodiversity is amongst the concerns of stakeholders. Kenya's economy greatly depends on natural resources (tourism, agriculture and mining amongst others) which in some cases are not managed sustainably. Thus, without adequate management plans the NEC MP has the potential of increasing the pressures and threats on the sensitive ecosystems and biodiversity in the NEC. These potential impacts will be against the conservation strategies and objectives proposed by Vision 2030, EMCA, WCMA, KWS's species conservation strategies and ecosystem management plans.

9.5.5 Transboundary Resources, Activities and Invasive Species

The entire NEC is a transboundary area which intersects several resources of a similar nature such as: Tsavo-Mkomazi ecosystem, Mt Elgon ecosystem, Sio-Siteko wetland, the Indian Ocean and Lake Victoria catchment. Impacts on biodiversity and habitats have a transboundary context wherein the linked resources are managed under different regimes in the countries involved. Particular transboundary resources of concern are identified as constraints in *Chapter 5* of this Report.

As the implementation of the NEC Master increases trade in East Africa, and therein movement of goods and people across borders, this creates a risk of more invasive species being imported into, or exported from Kenya intentionally or unintentionally. Apart from self-

(3) Radle A., (2007). The Effect of Noise on Wildlife: A Literature Review.

proliferation, some commonly known modes through which invasive species can enter the country via the NEC MP include the transport of bulk agricultural produce and other goods; vehicles, crafts and vessels; and ballast water.

Cumulatively, with the impacts of other projects and without proper natural resource management, the potential direct negative impacts of the NEC MP have the potential of contributing to land and habitat degradation and climate change. These two cumulative impacts are known to have the potential of leading to the proliferation of invasive species. This is since they can create harsh conditions only which invasive species can thrive in, since they are usually more resilient than indigenous species. This study finds that there are already 61 invasive species in Kenya which have negative economic effects and thus proliferation preceptors already exist. Invasive species are amongst the concerns raised by stakeholders from the consultation process.

9.5.6 Mitigation Strategies

The following mitigation strategies can be implemented against the potential risks on habitats and biodiversity:

- Avoiding PAs,
- Aligning new infrastructure with existing RoWs or defined corridors,
- Limiting the size of construction RoWs where possible, and
- Complying with existing land use and PA management plans.

9.6 AIR EMISSIONS

9.6.1 Summary of Applicable Constraints

Applicable constraints to air emissions include:

- Protected Areas
- Internationally Designated Areas,
- Sensitive ecosystems,
- Biodiversity (flora and fauna),
- Rivers, lakes and wetlands,
- Agricultural areas,
- Settlements, and
- Existing infrastructure.

9.6.2 *Air Pollutants*

The NEC Counties face the challenge of managing emissions of air pollutants even though Kenya has still not fully implemented its recently gazetted Air Quality Regulations nor developed a comprehensive national baseline on air quality. Studies however, estimated that the Country produced at least 59.1 Tons of emissions in 2010. The implementation of the NEC Master Plan is anticipated to increase these emissions in all phases of its projects. The direct potential sources of these increased emissions are indicated in *Table 9.4* below.

Table 9.4 Potential Air Emissions from the NEC MP

Activity/Source/Facility	CO_x	O_3	Pb	SO_x	NO_x	VOCs	CFC	PM_x	NH_3
Civil construction activities	X					X		X	
Land conversion and excavation	X							X	
Exhaust generated from the use of fossil fuel engines in vehicles, crafts and generators	X	X	X	X	X	X		X	X
Friction between tyres and road surfaces								X	
Industrial and manufacturing processes	X	X	X	X	X	X		X	X
Agricultural processes						X		X	X
Storage and transport of hydrocarbons, coal and agricultural products						X		X	
Use of refrigeration systems							X		
Waste disposal	X			X	X	X		X	X

Sources: EEA, (2016), IFC (2007).

The benefits of implementing the NEC MP will promote development in different sectors of the economy. This will however result in an increase in the magnitude of activities in each sector in addition to population growth. This would in turn lead to more emissions

generated by each sector and through the support and domicile activities of the increased population. Moreover, more air pollutants will be emitted since this population will require energy, of which in Kenya 68% is sourced from biomass and 21% from petroleum (4). Exacerbation of microclimate modifications such as urban heat islands and lowering of air quality can then occur particularly in the economic centres and industrial zones.

Air pollutants have different impacts on humans and the environment depending on their concentrations and exposure. Each pollutant has its own lethal dose and dose response limits. On humans, low doses albeit pollutant dependent, exposure to air pollutants can cause irritation of the eyes, nose, and throat, and wheezing, coughing, chest tightness, and breathing difficulties. Moderate effects include worsening of existing lung and heart problems, such as asthma, and increased risk of heart attack. Long-term exposure and high doses can cause cancer and damage to the immune, neurological, reproductive, respiratory systems and death (5).

This SEA Study predicts that without adequate mitigation, at the project level and cumulatively, there is potential of air pollutants such as O_3, NO_2, PM_X and SO_2 being released beyond WHO's guidelines (6). National studies have pointed out that industrial and urban centres generally have poorer air quality against the WHO guidelines as compared to rural and some background areas. Air pollution is attributed to be a contributing factor to the prevalence of respiratory infections and complications in Kenya as a cause of morbidity and mortality.

Environmentally, the transport and disposition of air pollutants can have the following effects:

- **Acid Rain**: This is caused by the chemical reactions of NO_X and SO_X with water during precipitation or in the atmosphere. It either falls as wet or dry precipitation with a pH of about 4.3. It damages flora, and acidifies soils and water bodies in turn affecting fauna. Acid rain also corrodes infrastructure shortening their lifespan or increasing maintenance costs. This is evident in

(4) Institute of Economic Affairs, (2015). Situational Analysis of Energy Industry, Policy and Strategy for Kenya
(5) Department of Environmental Protection, (n.d). Health and Environmental Effects of Air Pollution
(6) WHO, (2005). WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. Global update 2005.

Webuye in the NEC whereas acid rain can also damage cultural heritage sites (7),

- **Haze and Smog**: Haze is formed when small particles in the air (PM_X and smoke) are exposed to sunlight. It can also be caused when NO_X and SO_X form particles that are transported by wind. Smog is a yellowish fog consisting of fine particles and ozone. These fine particles are often produced from the chemical reactions that produce SO_2 and NO_X. Ozone in the lower atmosphere is typically a product of the reaction of NO_X and VOCs. Smog and haze are observable indicators of poor air quality or presence of pollutants. In addition to lowering visibility, the ozone in smog is linked to health effects ranging from minor aches to deadly pulmonary diseases (8). They mostly occur in urban areas such as Nairobi, Nakuru and Mombasa due to the higher concentrations of industries and motor vehicles (9),

- **Eutrophication**: Whilst this naturally occurs with the aging of lakes and estuaries, NO_X emissions can accelerate the rate at which it occurs. This is because they increase the effective amount of nutrients in the water bodies including oceans. Eutrophication stimulates blooms of algae which can kill fish and lead to losses of aquatic biodiversity, (10)

- **Impacts on Fauna and Flora**: Air pollutants are similarly as toxic to fauna when exposed as they are to humans, when the pollutants are deposited on land, flora or water. Studies have shown that air pollution can cause death, debilitating industrial-related injury and disease, stress related physiological changes and population declines (11). Persistent pollutants in the aquatic environment can bio-accumulate up the food chain. On flora, pollutants such as ozone affect membrane function, leading to reduction in photosynthesis, slower growth, and in severe cases death (12). Acid rain can also damage flora through corrosion as

(7) EPA, (2016). Effects of Acid Rain
(8) EPA, (1999). Smog—Who Does It Hurt?
(9) Gouvernement du Québec, (2007). Formation and Origin of Smog. Info-Smog
(10) Huijbregts M., (1999). Life Cycle Impact Assessment of Acidifying and Eutrophying Air Pollutants, Barret K. and Eerens H., (2008). Air Pollution and the Eutrophication and Acidification of European Seas. Discussion Paper. ETC/ACC Technical Paper 2008/17
(11) Newman, J., (1980). Effects of Air Emissions on Wildlife Resources. US Fish and Wildlife Service, Biological Services Program, National Power Plant Team: FWSJOBS-80/40.1.
(12) Lovett M. et al., (2009). Effects of Air Pollution on Ecosystems and Biological Diversity in the Eastern United States. The Year in Ecology and Conservation Biology, 2009: Ann. N.Y. Acad. Sci. 1162: 99–135 (2009).

mentioned above. Effects on flora would not only directly affect fauna but also livelihoods through agriculture and forestry.

- **Ozone depletion**: This is caused by CFCs and halons which, among others, are generally known as ozone depleting substances. The depletion of ozone results in more UV radiation reaching the earth's surface. This in turn can increase skin cancers, cause cataracts and lower human immunity to diseases.

9.6.3 Greenhouse Gases

Amongst the potential emissions anticipated from the implementation of the NEC Master Plan are greenhouse gases (GHG), specifically CO_2, N_2O, CH_4 and Fluorinated Hydrocarbons (HFs). GHG will be primarily emitted from:

- land conversion processes,
- wastes,
- combustion of fossil fuels, and
- bio-agricultural processes.

Land conversion and increase of industrial activity in water bodies can reduce the effective carbon sinks in the NEC. This will be a negative reinforcement which can compromise commitments on reducing Kenya's emissions proposed by, and agreed in the National Climate Change Response Strategy (NCCRS), United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Parties (COP) 21 (2015); and enshrined in Article 42 of the Kenyan Constitution. The anticipated population growth associated with the NEC Master Plan will also contribute to this. This is because this population will require more land, materials, energy and services, which are currently mostly not provided through low carbon modes.

According to Kenya's 2nd National Communication to the UNFCCC, the Country's total emissions in 2000 were 55 $MTCO_2eq$. These were shared amongst economic sectors as follows:

- energy (17.8%),
- industries (1.5%),
- agriculture (41.0%),
- land use,
- land use change and forestry (37.6%), and

- waste (2.2%)[13].

This SEA Study anticipates that, even though Kenya is a low emitter of GHGs, total emissions will increase on implementation of the NEC Master Plan. In a 'business as usual' scenario, this increase of emissions will drive the Country closer towards its projected emissions of 140 $MTCO_2eq$ by 2030.

9.6.4 Mitigation Strategies

Mitigation strategies that can employed to manage the risks of air emissions include:

- Complying with the Air Quality Regulations (2014) and emission standards as provided in KS 1515,
- Using cleaner energy sources and promoting their use,
- Limiting land conversion to only necessary areas, and
- Managing wastes according to regulations in addition to employing the 3Rs to ensure they are managed sustainably.

9.7 LANDSCAPE MODIFICATIONS

9.7.1 Summary of Applicable Constraints

The following are the constraints which will be susceptible to landscape modifications:

- Nationally Protected Areas,
- Internationally Designated Areas,
- Settlements,
- Recreational areas, and
- Cultural heritage sites.

9.7.2 Landscape Modification

Greenfield projects of the NEC Master Plan will cause direct modifications of terrestrial landscapes. As discussed in *Section 9.4.2*, these projects will involve the development of new facilities and settlements, establishment of RoWs and land conversion.

[13] NEMA, (2015). Kenya Second National Communication to the United Nations Framework Convention on Climate Change.

There will also be changes in brownfield sites, for example the expansion and development of new facilities such as: Dualling of the Mariakani-Mombasa Road; Nairobi-Nakuru Logistics Highway Project; Mariakani-Voi Logistics Highway Project; Standard Gauge Railway and OSBPs amongst others, as well as to the maritime environment including: container berths No.20, 21, 22 (Reitz), No.4 (Lighter Area) and Bulk Cargo (Mbaraki) and Container berth No.19 all at Mombasa, and Rehabilitation of 3 to 6 ports at Lake Victoria.

These changes in landscape (visual impacts) will also entail changes in activities (character) presently carried out in the target areas of these projects. Such changes include expansion or intensification of agriculture, generation of wastes during construction, increased transportation through vehicles, vessels and crafts ferrying people, materials and equipment, as well as general increases in human activities. Apart from the direct infrastructure projects, the secondary cities are amongst the primary areas where this impact is anticipated.

Landscape modifications are also expected in areas where construction materials will be sourced, such as quarries and forests. Combined with changes at project target areas, these modifications and activities will distinctively alter the social character of the affected areas.

Landscape modifications have varying interconnected social and environmental effects which are not always benign. Potential impacts on ecosystems are covered in *Section 9.4.2*.

Lastly, changes in landscape can lead to loss of serene ecosystems or the serenity of ecosystems. Such ecosystems are those identified to be Category A constraints by this study (See *Figure 9-2*). A reduction in the option and or existence value of such ecosystems would then result. Industries such as tourism and recreation activities can be compromised by these changes since they hedge on natural environments as attractions. Some of these attractions in the NEC include amongst others: Kakamega Forest Reserve (FR) which is Kenya's only tropical rainforest; Mt Elgon ecosystem which is transboundary, a UNESCO Man and Biosphere Reserve and an Alliance for Zero Exinction site; Nairobi National Park (NP) which is an IBA and Kenya's most visited NP; and the Great Rift Valley Lakes which feature Ramsar site, IBAs and World Heritage Sites (WHS).

9.7.3 Mitigation Strategies

Mitigation strategies that can lower the magnitude or avoid this impact include:

- Locating infrastructure with existing land use plans,
- Complying with ecosystem management plans of protected areas,
- Limiting the size of construction RoWs, and
- Avoiding protected areas and settlements.

9.8 IMPACTS ON SOILS

9.8.1 Summary of Applicable Constraints

The constraints which are vulnerable to impacts on soils include:

- Settlements,
- Protected Areas,
- Internationally Designated Areas,
- River, lakes and wetlands,
- Agricultural areas, and
- Areas with a high Soil Erosion Potential (SEP).

There are two methods through which the implementation of the NEC Master Plan can alter soil characteristics, as presented in the *Sections* below:

9.8.2 Soil Erosion

Soil erosion has a high potential of occurring in the 42% of the land mass comprising the NEC which has a high Soil Erosion Potential (SEP). Developing infrastructure, increasing crop agriculture or mining activities has the potential to result in soil erosion, as follows:

- Land clearing and excavation for the development of physical infrastructure such as roads, railways, dams and buildings. This construction will also involve increased movement of vehicles and people resulting in the loss of topsoil;

- Increasing crop agriculture will involve disturbances to topsoil layers during tilling, planting and harvesting leading to erosion and loss of soil carbon. The use of irrigation to promote

agricultural production without adequate soil conservation measures can also result in erosion;

- Sourcing of construction materials through extractive and destructive means can result in increased SEP in the source areas. This commonly occurs in Kenya due to the demand for building materials and the Master Plan projects are anticipated to increase this demand; and

- Land conversion for Greenfield projects will increase the total area in the NEC under infrastructure and settlements. This will result in increased run-off from those areas since less water will be able to percolate underground. The excess run-off will in turn erode more soil.

9.8.3 Altering Soil Physical, Chemical and Biological Characteristics

This can occur due to the following:

- contamination by solid and liquid wastes;
- acid rain from air pollution;
- civil processes such as compaction;
- extraction of groundwater; and
- use of fertilizer and inundation by water (dams and irrigation).

Amongst the potential effects of altering soil and land characteristics will be increasing the SEP of affected areas. Primarily, this will be by the removal of vegetation and increasing susceptibility by the creation of pilings during construction as well as increased run-off. Increased erosion can also affect other infrastructure systems such as drains in urban areas which can become clogged with the eroded/transported material. Sedimentation and turbidity can also be increased with this material when transported into water bodies.

Soil alteration can lead to loss of soil nutrients. These nutrients can be lost through eroded topsoil thereby reducing the eventual land potential for agriculture, which is Kenya's main economic activity, and lowering the ecological productivity of affected ecosystems.

Furthermore, inundation and deposition of pollutants can contribute to nutrient loss via replacement through ion exchange reactions. Deposition of pollutants can also lead to land contamination.

9.8.4 Summary

Ultimately, without mitigation both methods of soil alteration have the potential of reducing land productivity or economic potential in the regions that can be affected. This is already recognized as a national problem and it was estimated by 2004 that at least USD 390 million or 3.8% of GDP is lost to erosion[14].

9.8.5 Mitigation Strategies

The following mitigation strategies can be employed against soil impacts:

- Limiting excavations to only necessary areas,
- Implementing soil conservation strategies in areas with high Soil Erosion Potential,
- Complying with waste management regulations,
- Complying with regulations and guidelines on soil conservation such as those provided by land use plan, ecosystem management plans and those gazetted by the Agriculture and Food Authority, and
- Implementing run-off and water management measures.

9.9 IMPACTS ON HYDROLOGY AND HYDROGEOLOGY

9.9.1 Summary of Applicable Constraints

Applicable constraints to the potential impact on hydrology and hydrogeology include:

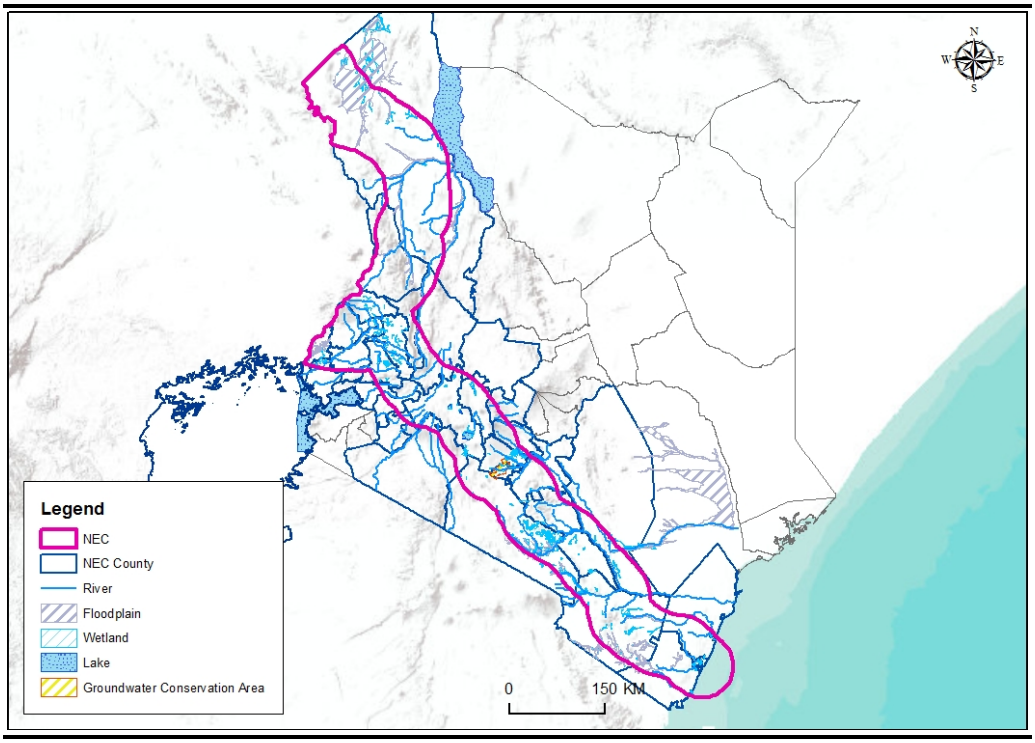
- Protected Areas,
- Internationally Designated Areas,
- Sensitive ecosystems,
- Settlements,
- River, lakes, aquifers, floodplains and wetlands,
- Physical infrastructure, and

[14] Cohen J., Brown T. and Shepherd D., (2004). Estimating the Environmental Costs of Soil Erosion at Multiple Scales in Kenya Using Emergy Synthesis. Agriculture, Ecosystems and Environment 114 (2006) 249–269. Elsevier.

- Agricultural areas.

The map below shows the location of the hydrological and hydrogeological constraints amongst those mentioned above.

Figure 9.6 ***Hydrological and Hydrogeological Constraints***



9.9.2 Overview

Kenya is classed as a water scarce Country, making water resources vitally important to its development. On this basis the Master Plan's potential impacts on hydrological regimes are considered to be significant. These potential impacts can be caused by increased water demand, wastes, projects in the water sector and the interaction of the physical infrastructure with the hydrological regimes at their target areas.

Water demand and wastes are covered in *Sections 9.4.7* and *9.4.8* respectively. This *Section* therefore addresses:

- water sector projects; and
- the interaction of the physical infrastructure with hydrological regimes.

9.9.3 NEC Water Sector Projects

The NEC Master Plan's water sector infrastructure projects are mainly multi-purpose dams aimed at providing water to support livelihoods and other industries. The environmental impacts of dams are summarised in *Box 9.1*.

Box 9.1 Environmental Impacts of Dams

- Dams hold back sediment by increasing the retention through their reservoirs. This prevents sediment feeding downstream in addition to decreasing sediment loads downstream. This results in: corrosion/erosion causing deepening of river beds downstream, and degradation of floodplains in deltas ( ) ,
- Dams restrict the egg laying zone and migration of fish by creating a barrier. Reproduction of migrating fish is hindered by floods that harm egg beds while egg gravel beds can be damaged by the excavation and coating works on stream beds
- Storage of water in reservoirs alters its physical, chemical and biological characteristics. The discharged water consequently has different quality as compared to inflows
- Water quality is also affected by farm run-off or effluents which often drains back to the reservoir when they provide water for irrigation
- Dams may increase of prevalence of water sourced illnesses typhus, malaria, fever, malaria and cholera amongst others
- Dams results in inundation of upstream ecosystems and low flows downstream. They also alter the thermal regimes of rivers thereby affecting growth of freshwater organisms
- Increase in water surface area at the reservoir leads to increased evaporation. This contributes to microclimatic modifications due to changes in air moisture percentage, air temperature, air movements in big scale and the changes in the region topography caused by the stagnant, large scaled mass of water

9.9.4 Interaction of Physical Infrastructure with Hydrological Regimes

The NEC Master Plan infrastructure projects will involve land clearing or deforestation for construction which will reduce the amount of evapotranspiration. Consequently, this would mean less rainfall potentially contributing to microclimatic modifications. This currently

occurs and is one of the challenges faced by Kenya's water towers including those in the NEC. Other factors such as air emissions would add to the microclimatic modifications.

Other potential modifiers of hydrological regimes are the impermeable surfaces of the physical infrastructure that will be established by the NEC Master Plan. These surfaces will cause less water to percolate underground. Groundwater recharge will thus be reduced thereby affecting groundwater availability. On the other hand, the impermeable surfaces will increase surface run-off potentially increasing soil erosion and flood risk. The development of these impermeable surfaces in, and other physical alterations to, wetlands can compromise the ecosystems services they provide such as flood retention and water purification.

Another potential modification is in the coastal region where the establishment of foundations such as berths can increase saltwater intrusion. One modelling study showed that this can occur because after foundations are added, the overall seawater and fresh groundwater interface moves landward[15]. In the agriculture sector, irrigation and agricultural extension can result in:

- Degradation of irrigated lands through salinization, alkalization, waterlogging and soil acidification[16].
- Poor water quality of the irrigation water and for downstream users in the case of rivers. Biodiversity at the project area and downstream will be affected by this
- Groundwater depletion when wells are the water source. It can also lead to saline intrusion in coastal areas and reduced base flow
- Other changes to the low flow and flood regime as well as changes to the level of the water table

The effects of these potential changes to hydrological regimes will include negative reinforcement of soil erosion. Water availability can also be reduced or segregated within river basins. Such changes can become contributing factors to resource conflicts since they would affect agricultural and ecological productivity.

[15] Ding G., Jiao J. and Zhang D., (2007). Modelling Study on the Impact of Deep Building Foundations on the Groundwater System. Hydrol. Process. (2007). Wiley InterScience.
[16] Dougherty T. and Hall W., (1995). Environmental Impact Assessment of Irrigation and Drainage Projects. FAO. Natural Resource Management and Environment Department.

9.9.5 Mitigation Strategies

Mitigation strategies that the NEC MP can implement include:

- Avoiding wetlands, water towers, groundwater conservation areas and flood plains,
- Implementing water ingress management measures as appropriate, and
- Controlling run-off from infrastructure and implementing sustainable drainage systems (SUDS) which mimic or allow natural percolation of water.

9.10 RISK OF POLLUTION

9.10.1 Summary of Applicable Constraints

The following are the applicable constraints to this risk:

- Settlements,
- Protected Areas,
- Internationally Designated Areas,
- Sensitive ecosystems,
- Rivers, lakes, aquifers and wetlands, and
- Agricultural and high productivity areas.

9.10.2 Pollution

The implementation of the NEC Master Plan will introduce and or generate materials, such as waste, hazardous materials and chemicals. These materials will require to be properly managed as required by the Waste Management Regulations (2006) or they would otherwise cause pollution. *Table 9.5* below identifies the nature of these materials as risk agents while linking them to their potential sources.

Emissions to air and emergencies such as spills are covered in *Section 9.4.10.*

Table 9.5 NEC MP Pollution Risk Factors

Source	Risk Agents		
	Solid Wastes	**Liquid Wastes**	**Hazardous Materials**
1. Construction, rehabilitation operation (use) and maintenance of transport infrastructure and related activities			
1.1. Roads	• Construction waste • Road surfacing waste • Road litter • Domestic and office waste • Waste tyres	• Wastewater (black and grey water) • Construction effluents • Stormwater (including sediments and sludge)	• Petrochemicals (asphalt, tar and bitumen) • Paint (may contain lead and heavy metals)
1.2. Railways	• Construction waste • General solid waste (domestic and office waste (MSW)) from passengers and terminals	• Stormwater • Wastewater (including construction effluents, black and grey water) • Black water from passenger cars and terminal lavatories	• Petrochemicals and petroleum • Cargo may include hazardous materials • Solvents, acids, coolants and alkalis (rolling stock maintenance) • PCBs may be found in old electrical equipment
1.3. Power Transmission Infrastructure	• Construction waste	• Construction effluent	• Petrochemicals and petroleum (including mineral oils used as coolants) • PCBs and SF6 • Wood preservation chemicals (Creosote, PCP and CCA)
1.4. Logistic Hubs	• Construction waste • Domestic and office waste	• Construction effluents • Wastewater (black and grey) • Stormwater	• Cargo can include hazardous materials
1.5. OSBPs			-
1.6. Inland Ports	• Construction waste	• Wastewater (black	• Petroleum and petrochemicals

Source	Risk Agents		
	Solid Wastes	**Liquid Wastes**	**Hazardous Materials**
1.7. Marine Ports (Container berths)	• Dredged materials • Domestic and office waste including those from vessels	and grey including those from vessels) • Stormwater • Ballast and bilge water • Sludge	• Liquid wastes with noxious properties • Degreasing solvents • Cargo can include hazardous materials
1.8. ICDs	• Construction waste	• Wastewater (black and grey) • Stormwater	• Cargo can include hazardous materials
1.9. Airport Expansion	• Construction waste • Domestic and office waste including those from aircraft	• Construction effluents • Stormwater • Wastewater (black and grey including those from aircrafts)	• Petroleum and petrochemicals • Cargo can include hazardous materials • Paints (may contain heavy metals) and solvents
1.10. Pipeline (including telecommunication and SCADA system)	• Construction waste • Domestic and office waste	• Construction effluents • Stormwater • Wastewater (black and grey including water containing oil) • Tank sludge	• Petroleum and petrochemicals
1.11. Shipping	• Domestic and office wastes including those from vessels (MSW)	• Wastewater (black and grey including those from vessels) • Ballast water • Bilge water and tank wash water • Sludge • Stormwater	• Petroleum and petrochemicals • Cargo can include hazardous materials • PCBs, CFCs, asbestos and lead containing batteries and paint, from ship decommissioning and maintenance activities (these may be present in old vessels) • Antifouling paint

Source	Risk Agents		
	Solid Wastes	**Liquid Wastes**	**Hazardous Materials**
			• Solvents • Incinerator ash (presence depends on vessel type)
2. Coal Transportation	• Coal debris (solid waste)	• Wastewater (including cleaning water containing coal)	-
3. Sourcing of construction materials and mining	• Mining wastes (spoils, soil and rocks) • Domestic and office waste (MSW)	• Wastewater (black and grey) • Mining effluents (including acid rock drainage, metals leaching and tailings) • Stormwater	• Hazardous materials vary with mining methods • Petroleum and petrochemicals • Explosive wastes
4. **Agriculture and fisheries sector activities**			
4.1. Promotion of crop and livestock agriculture	• Farm wastes	• Farm run-off (High BOD) and irrigation effluent	• Pesticides • Herbicides • Fertilizers
4.2. Food processing hub	• Food/crop waste • Construction waste • Office and domestic waste (MSW)	• Stormwater • Construction effluent • Facility effluent (High BOD) • Wastewater (black and grey)	• Petroleum and petrochemicals
4.3. Commercial crop distribution facility			
4.4. Irrigation	• Construction waste • Farm waste	• Irrigation effluent • Wastewater (black and grey)	• Petroleum and petrochemicals • Pesticides • Herbicides

Source	Risk Agents		
	Solid Wastes	**Liquid Wastes**	**Hazardous Materials**
			• Fertilizers
5. Water Sector Infrastructure	• Process residues, membranes and spent media • Construction waste • General solid waste (office and domestic waste)	• Stormwater • Treatment works effluents • Sludge • Wastewater (black and grey)	• Treatment/process chemicals (these vary with methods used)

Kenya faces challenges in managing wastes due to (17):

- Lack of awareness and knowledge,
- Political influence and lack of good will to particularly implement long-term waste management solutions,
- Limited availability of disposal facilities,
- Limited availability of funding,
- High poverty levels,
- Limited technical competencies, and
- Low level of technological advancement and adoption.

These factors are compounded by a growing population which seeks to develop through consumptive modes. Perennial increases in the amount of waste generated have been observed, contributing to the problem of pollution. This is because wastes generated, in most cases Municipal Solid Waste (MSW), are often not always managed as required by law or standard good practice.

It is observed in Kenya that hazardous wastes are at times disposed through MSW and the management of the liquid waste stream is limited by access to the sewer reticulation networks and the capacities of existing treatment works. Practices such as sorting and separation, and the 3Rs (Reducing, Reusing and Recycling) are deployed selectively as influenced by waste generators' capacities.

On this background, the implementation of the NEC projects will contribute to the challenges faced in managing waste by generating additional waste. Kenya lacks a single sanitary landfill (18) and most waste is disposed through dumpsites in towns and cities.

Therefore, without proper management the waste generated by the NEC Master Plan will cause pollution and the effects are discussed in *Box 9.2*:

(17) Source: NEMA, (2015). The National Solid Waste Management Strategy.
(18) A sanitary landfill in this case refers to one that is compliant with international standards on landfill design and operation

Box 9.2 Effects of Pollution in Kenya:

- Lowering the quality of life through morbidity and increasing mortality rates. This results in lost time due to the former and lost years due to the latter.
- Contributing to land degradation in combination with poor natural resource management. Land degradation will in turn lower land productivity affecting economic activities such as agriculture.
- Limiting access to resources such as water and land.
- Reducing the ecological integrity of ecosystems. This involves compromising the economic value gained from these ecosystems.
- Creating an opportunity cost due to remediation costs. These resources can be used to address other development needs instead.
- Creating service disruptions on infrastructure networks such as drains and roads.

9.10.3 Mitigation Strategies

The following mitigation strategies can be implemented against the risk of pollution:

- Developing complementary waste management facilities including a sanitary landfill and a hazardous waste disposal facility,
- Integrating Life Cycle Assessments into the project level environmental risk management,
- Managing wastes (collection, transport and disposal) in accordance to the provisions of the Waste Management Regulations (2006) and providing adequate equipment and facilities to do so, and
- Integrating the 3Rs (Reduce, Reuse, Recycle) of waste management in NEC MP and at the project level.

9.11 NATURAL RESOURCE DEMAND

9.11.1 Summary of Applicable Constraints

The features listed below are the applicable constraints to natural resource demand:

- Protected Areas,
- Internationally Designated Areas,

- Sensitive ecosystems,
- Resource extraction areas (forests, sand harvesting sites and mines),
- Agricultural and high productivity areas, and
- Rivers, lakes, wetlands and aquifers.

9.11.2 Overview

The NEC Master Plan projects will require natural resources to be exploited or utilised. These resources include energy, water and materials which will be used in the construction and operation of infrastructure and the population anticipated to grow as a result of the projects (19). Therefore, additional demand on these resources will be created and there is potential that the increased demand is negative as explained in the *Sections* below:

9.11.3 Energy

Energy will be required to operate construction equipment, offices, camps, homes and even in the use/operation of the infrastructure components. For construction, the most common source of energy is diesel, a fossil fuel whose use releases GHGs and other emissions (see *Section 9.4.3*). Transportation on the constructed infrastructure through crafts, vessels and vehicles will also rely on other fossil fuels. This is demonstrated by the fact that electric cars constitute less than 1% of vehicles in Kenya; and the rail, aviation and maritime sectors use diesel and jet fuel primarily. Further, to sustain the population a combination of energy sources will be used including fossil fuels and biomass. Biomass, the most commonly used energy source in Kenya, leads to deforestation (which result in habitat and carbon stock losses), and air emissions (on thermal conversion) which include GHGs and PM_X. These emissions are associated with global climate change and respiratory diseases.

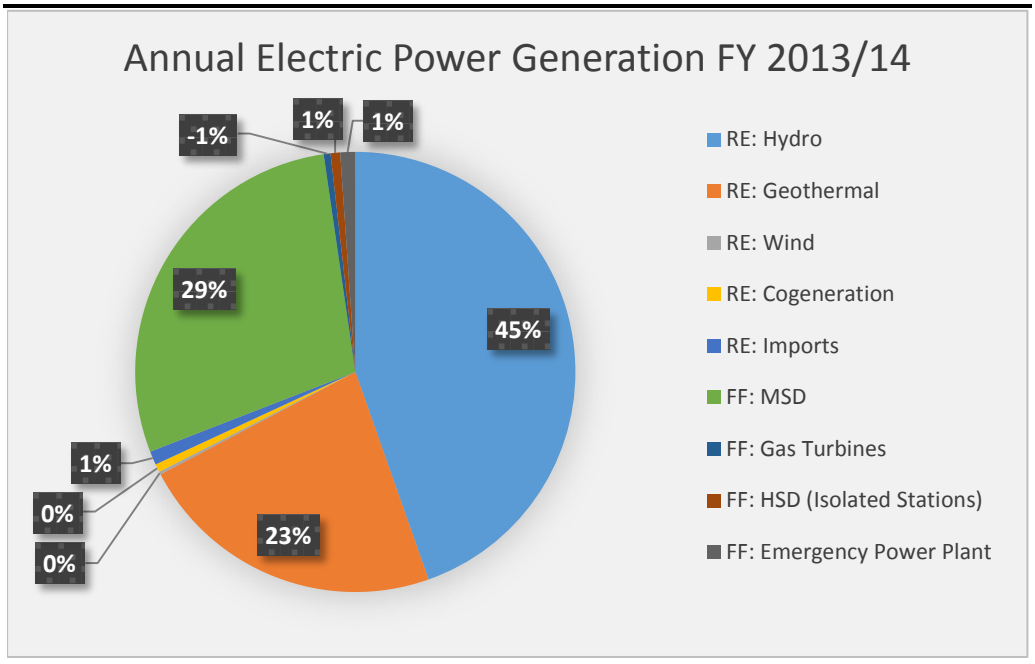
The NEC Master Plan will establish fixed facilities such as at the port, airport, food processing, distribution, logistics hubs and OSBPs. These facilities will require electrical energy to operate and where feasible the national grid will be used. However, it may be beyond the facility owners' or occupiers' discretion to select which source of electricity generation is used to supply the national grid. Therefore, fossil fuel sources which are known to have negative environmental impacts will be used as is observed in *Figure 9.5* which shows that by 2014, 31% of Kenya's electricity was generated from these fuels.

(19) It is anticipated that the NEC Master Plan will lead to population growth through influx and promoting the economic drivers of population growth through its positive impacts

The NEC Master Plan's facilities will also require backup power - due to the intermittent nature of the supply from the national grid – which is often provided through fossil fuel powered generators. Additionally, some of the target areas of the NEC infrastructure have limited or no connectivity to the national grid since by 2014 only 35% of Kenya was connected (20). The development of infrastructure and ancillary activities in such areas will mainly be powered by fossil fuels and biomass.

The supply of construction and other livelihood sustenance materials will add to energy demands on top of their own demand as natural resources. This is because the sourcing, processing and transportation of these materials requires energy.

Figure 9.7 Annual Electric Power Generation FY 2013/14



Source: Ministry of Energy and Petroleum, 2015 (21)

9.11.4 Water

The NEC Master Plan projects will create additional demand for water in all the areas that they will be implemented. Water will be required for construction of infrastructure projects, ancillary services/activities,

(20) Ministry of Energy and Petroleum (2015). Draft National Energy and Petroleum Policy
(21) RE = Renewable Energy, FF = Fossil Fuel, MSD = Medium Speed Diesel Generator and HSD = High Speed Diesel Generators.

as well as facility maintenance and operation. Water sector infrastructure projects, multi-purpose dams, will also create shifts water availability by adding additional water rights in their respective sheds. Furthermore, the NEC MP has the potential of increasing the risks on water quality and subsequently reducing water availability by altering ecosystems such as wetlands and water towers, and causing pollution of water resources.

Whilst the additional demand on water resources will be typical except in the case of storage dams and those dams with an irrigation component, the demand is both a potential opportunity and negative impact. The latter is significant since Kenya is a water scarce country whose land is classified as over 80% Arid and Semi-Arid Lands. Distribution and access of water resources is uneven, and is a potential preceptor of conflict. Conflict in this context is includes social, economic and human-wildlife conflict.

The NEC traverses both urban and rural areas whose water sources range from groundwater, piped water, rainwater and rivers amongst others surface sources (See *Figure 9-6*). The Master Plan projects will create an opportunity for service providers to capitalize on its additional demand. But, without adequate investments into infrastructure and Integrated Water Resource Management (IWRM), it can contribute to intermittent service on piped supply and/or increase competition on both surface and groundwater sources. This SEA study deems the water sector projects are mainstream strategies aimed at solving sectoral challenges in the country.

9.11.5 Materials and Goods

The infrastructure projects proposed by the NEC MP will create a demand for construction materials and goods. This will not only create an economic opportunity for supplying those materials but also a threat on natural resources that can be sourced or converted to goods through unsustainable means. These means of sourcing and converting these materials/goods are usually either extractive, destructive or generate the most emissions. The NEC MP projects can thus contribute to the development challenges associated with unsustainable resource consumption in Kenya and beyond. This risk compounds the potential pressure that the NEC MP can add to PAs and other sensitive ecosystems. Stakeholders of the NEC MP raised this amongst their concerns and some common examples include extraction of building materials, notably sand, concrete and bricks.

9.11.6 Mitigation Strategies

Mitigation strategies that can be implemented against natural resource demand include:

- Integrating Life Cycle Assessment into the project level environmental risk management,
- Complying with regulations governing resource extraction such as Forests Act (2005), EMCA (2014), Sand Harvesting Guidelines (2009), Water Resource Management Rules (2006) and Water Act (2014) amongst others,
- Adopting sustainability standards at the project level such as those pertaining to green building and energy efficiency (LEED),
- Ensuring building materials are sourced from sustainable sources, and
- Implementing demand management and resource efficiency measures for water, electricity and materials.

9.12 HEALTH AND SAFETY (H&S) RISKS

A risk is defined as the probability of hazard occurrence and its potential consequences on exposure to a receptor[22]. This study distinguishes potential H&S risks as follows:

Construction and Decommissioning Hazards

These hazards are associated with the processes, equipment and materials of the construction and decommissioning phase of projects (see Table 9.6). Dependent on the spatial nature of the hazard, potential receptors will include project staff and neighbouring communities.

[22] The World Bank (1997). Environmental Hazard and Risk Assessment. Environment Department. Number 21.

Table 9.6 Construction and Decommissioning H&S Hazards

Hazard Category	Potential Hazards
Physical	• Rotating and moving equipment • Noise and vibration • Electricity • Vehicular transport • Material conveyance or carousels • Working with heat and hot equipment • Ergonomic hazards (repetitive motion and handling) • Working in lowly lit areas • Working at height • Working over water • Working in confined spaces • Slippery surfaces • Stuck by objects • Falling objects • Elevated and stacked loads • Tunnels and excavations • Emissions and ejected materials
Chemical	• Gaseous and particulate emissions • Fires and explosions • Flammable materials and chemicals • Explosive materials and chemicals • Oxidizing and corrosive chemicals
Biological	• Wastes (solid and liquid) and other agents of disease ecology including social ones • Hazardous and toxic chemicals
Radiological	• Electromagnetic Fields and Interference (non-ionizing radiation).

Source: IFC, 2007 Environmental, Health and Safety General Guidelines; ILO 1992, Safety and Health in Construction: An ILO Code of Practice.

Industry Specific Hazards

Industry specific hazards are those that are associated with the specific activities of either the industry associated with the Master Plan projects or the type of project itself. *Table 9.6* identifies them according to their respective sectors or projects, and they can be further identified and assessed at the project level when project details are more defined.

Table 9.7 Industry Specific H&S Hazards

Sector/Project/Activities	Hazards			
	Physical	**Chemical**	**Biological**	**Radiological**
Roads	• Moving equipment • Vehicular collisions (accidents), elevated work and loads • Working over water • Noise and vibration • Slips and falls.	• Hazardous chemicals (bitumen, asphalt, solvents and other chemicals) • Air emissions (exhaust and dust) • Transportation of hazardous/dangerous cargo.	• Solid and liquid wastes (pathogens)	-
Railway	• Train/worker collisions (accidents - derailment and at level crossings) • Noise and vibration • Electricity • Worker fatigue • Moving equipment • Working in confined spaces.	• Diesel exhaust • Hazardous chemicals and substances (VOCs, PCBs, asbestos, paints, solvents and heavy metals) • Fires and explosions • Transportation and handling of hazardous/dangerous cargo.	• Solid and liquid wastes (pathogens) • Cargo can include biologically hazardous materials.	• Cargo may include radioactive materials.
Power Transmission Infrastructure	• Electricity (live power lines) • Working at height • Air traffic obstacles • Noise (HV lines and transformers).	• PCBs in transformers • Ozone (produced from corona).	• Solid and liquid wastes (pathogens)	• EMFs and EMI.
Logistic Hubs	• Vehicular collisions (accidents)	• Transportation and handling of	• Solid and liquid wastes	• Cargo may

Sector/Project/Activities	Hazards			
	Physical	**Chemical**	**Biological**	**Radiological**
	• Elevated and stacked loads • Working at height • Slips and falls • Noise • Electricity	hazardous/dangerous cargo • Fires and explosions	(pathogens) • Cargo can include biologically hazardous materials.	include radioactive materials.
OSBPs	• Vehicular collisions (accidents) • Working at height • Slips and falls • Electricity (fire risk)	• Transportation and handling of hazardous/dangerous cargo	• Solid and liquid wastes (pathogens) • Cargo can include biologically hazardous materials.	-
Inland Ports Marine Ports (Container berths)	• Maritime collisions and capsizing/sinking • Working and transport over water (falling overboard – drowning) • Confined spaces • Electricity • Slips and falls • Working at height and dock work • Noise and vibration • Elevated and stacked loads • Moving equipment	• Air emissions (exhaust and dust) • Transportation and handling of hazardous/dangerous cargo • Fire and explosions (flammable cargo e.g. coal, grain dust and petroleum).	• Solid and liquid wastes (pathogens) • Cargo can include biologically hazardous materials.	• Cargo may include radioactive materials.

Sector/Project/Activities	Hazards			
	Physical	**Chemical**	**Biological**	**Radiological**
	• Vehicular collisions (accidents) • Train collisions (accidents) • Visual intrusion (permanent illumination at night).			
ICDs	• Elevated and stacked loads • Moving machinery • Electricity • Slips and falls • Noise and vibration • Traffic collisions (accidents) • Confined spaces • Working at height	• Air emissions (exhaust and dust) • Transportation and handling of hazardous/dangerous cargo • Fire and explosions (flammable cargo).	• Solid and liquid wastes (pathogens) • Cargo can include biologically hazardous materials.	• Cargo may include radioactive materials.
Airport Expansion	• Vehicular collisions (accidents) • Air crashes and aircraft collisions (including ground accidents and Foreign Object Damage (FOD)) • Wake vortices • Elevated loads • Working at height • Confined spaces • Moving equipment	• Air emissions (exhaust, VOCs and dust) • Transportation and handling of hazardous/dangerous cargo • Fire and explosions (flammable cargo, electricity, heating and cooking equipment) • Petroleum and petrochemicals (handling	• Solid and liquid wastes (pathogens) • Cargo can include biologically hazardous materials • Food contamination potential.	• Cargo may include radioactive materials

Sector/Project/Activities	Hazards			
	Physical	**Chemical**	**Biological**	**Radiological**
	• Slips and falls • Visual intrusion (permanent illumination at night) • Noise and vibration • Electricity • Heat and cold stress	and storage of fuel)		
Pipeline (includes telecommunication and SCADA system)	• Open trenches and excavations • Moving equipment • Confined spaces • Elevated loads • Hot work (welding) • Electricity • Noise and vibration • Traffic collisions (accidents) • Flying/ejected objects (glass fibre shards) • Laser light exposure	• Fires and explosions • Air emissions and dust (fuel vapours and exhaust fumes) • Petroleum and petrochemicals (transport and storage)	• Solid and liquid waste (pathogens)	-
Shipping	• Work and transport over water • Confined spaces • Working at height and dock work • Slips and falls • Elevated and stacked loads	• Air emissions (exhaust and dust) • Petroleum and petrochemicals • Fires and explosions, transportation and • Handling of dangerous/hazardous	• Solid and liquid wastes (including ballast water) (pathogens) • Food contamination potential	• Cargo may include radioactive materials

Sector/Project/Activities	Hazards			
	Physical	**Chemical**	**Biological**	**Radiological**
	• Moving equipment • Electricity • Noise and vibration • Maritime collisions and capsizing/sinking (accidents)	cargo • Shipbreak and maintenance hazardous chemicals (asbestos, toxic paint, PCBs, heavy metals and VOCs)		
Coal Transportation	• Noise and vibration, • Train/worker collisions (accidents - derailment and at level crossings) • Moving equipment	• Fire and explosions (coal dust) • Air emissions (exhaust fumes, coal dust and general dust)	• Solid and liquid waste (pathogens)	-
Food processing hub Crop distribution facility	• Electricity • Slips and falls • Elevated and stacked loads • Traffic collisions (accidents) • Moving equipment • Confined spaces • Noise and vibration • Heat and cold stress • Flying/ejected objects • Sharps	• Residual pesticides and fertilizers • Petroleum and petrochemicals • Fires and explosions • Preservative chemicals/agents and other hazardous substances	• Solid and liquid waste (pathogens) • Food/produce contamination potential • Transmission of infectious and parasitic diseases (zoonoses)	-
Irrigation	• Open trenches/canals • Working over and presence of water (drowning risk) • Flooding	• Pesticides and fertilizers (bioaccumulation can also occur in waterbodies)	• Waterborne and vector-borne diseases • Solid and liquid wastes	-

Sector/Project/Activities	Hazards			
	Physical	**Chemical**	**Biological**	**Radiological**
	• Traffic collisions (accidents) • Slips and falls		(pathogens)	
Dams	• Working over and presence of water (drowning) • Flooding and dam failure • Working at height • Traffic collisions (accidents) • Electricity (HEP multipurpose dams)	• Pesticides and fertilizers (bioaccumulation can also occur in water bodies)	• Waterborne and vector-borne diseases • Solid and liquid wastes (pathogens)	• EMF and EMI (applies for HEP multipurpose dams)
Water Treatment and Supply	• Electricity • Confined spaces • Traffic collisions (accidents) • Moving machinery • Open water • Slips and falls • Working at height	• Water treatment chemicals (can include strong acids and bases e.g. Cl, Na, NaOCl and NH_3) • Heavy metals • Air emissions (exhaust and dust) • Chemical water contamination	• Solid and liquid wastes (pathogens and treatment waste) • Biological water contamination	Water may contain radioactive substances

9.13 UNPLANNED EVENTS

The following *Section* presents the assessment of impacts resulting from unplanned or non-routine events and those which are as a result of accidents. These are *different* to impacts from effects that would reasonably be predicted to occur in the normal course of activities.

9.13.1 Accidents

The risk of transportation accidents will be increased as a result of the implementation of the Master Plan projects. In the roads sector, which is most commonly used transportation mode in the NEC, there were 3,093 fatal accidents per year in Kenya between 2005 and 2015. In 2015, there were 6.4 deaths or road fatalities per 100,000 people in the country. In the same year, 18% of road fatalities in Kenya occurred within the NEC – which is Kenya's most important transport corridor. The NEC also has 72 documented accident hotspots (blackspots) which is significantly more than the rest of the country[23]. The number of Road and Traffic Accidents (RTAs) has also in recent times been influenced by an increase in the number of motor cycles in the country.

In the aviation sector, there have been 198 accidents/crashes in Kenya between 1926 and 2016. Of these, 66 have been fatal causing 235 fatalities[24]. Maritime and rail accidents are more common than aviation accidents but less common than RTAs.

The following mitigation strategies can be implemented to prevent accidents:

- Complying with industry guidelines and regulations in the design of infrastructure,
- Implementing and supporting programs to ensure vehicles and crafts are maintained to regulatory approved standards,
- Implementing and supporting programs that ensure drivers and pilots are adequately trained to operate their respective vehicles and crafts,
- Implementing and supporting programs aimed at raising public awareness in the pertinent industries, and
- Developing project level emergency/disaster preparedness and response plans.

[23] Kenya Police Service, (2014). Accident Blackspots in Kenya.
[24] Aviation Safety Network, (2016). Statistics on Air Crashes in Kenya 1926 – 2016.

9.13.2 Spills

Spills or accidental release of hazardous materials can occur from their storage, use and transportation. Whilst their nature will be largely industry specific, there will be a higher risk of spills from road transportation as compared to other potential causes. This is because road transportation has the most human factors (interaction with other users and accidents). Maritime transportation of liquids including petroleum and oil will also present a risk of spills. This form of transportation is the most common cause of oil spills globally when compared to all other potential causes.

With respect to pipelines, poor maintenance and the age of the current product pipeline has resulted in spills some of which have been fatal. It is deemed that the Master Plan interventions in the oil and gas section aim to solve challenges in this sector.

Lastly, risks of spills from storage and use of hazardous materials is specific to projects and the facilities concerned. These facilities will include: logistic hubs, ports and local storages at the project level.

The mitigation strategies below can be implemented against the risk of spills:

- Developing project level emergency/disaster preparedness and response plans as well as spill contingency plans and providing resources to respond to spills,
- Complying with the National Oil Spill Response Plan by integrating its provisions to any project level contingency plans,
- Implementing and supporting monitoring programs at the project level,
- Providing training to project staff on spill prevention and management, and
- Adhering to industry guidelines on the design and maintenance of any fluid storage, loading and conveyance equipment and infrastructure.

9.13.3 Fire

Fires can occur on implementation of the Master Plan projects due to:

- the introduction, generation, storage and use of flammable materials (including wastes),

- emergencies such as accidents and spills,
- use of heating and burning equipment, and
- electric faults.

Microclimatic modifications can also increase the preceptors of wild fires. This will be through increasing local dry periods and temperature maxima particularly in the ASAL and grassland regions. These regions are predominant in the low-lying regions in the eastern section of the NEC (ASALs), and the southern and central regions of the Rift Valley in Nakuru, Laikipia, Kiambu, Baringo, Kajiado and Narok counties.

9.13.4 Electrocution

The use of electricity in the different Master Plan projects and its transmission through powerlines can cause electrocution. This can occur when people and animals are exposed to uninsulated conductors or if electric faults occur. Avifauna and other large animals such as primates which can scale power infrastructure will be particularly at risk of electrocution from powerlines. Induced faults, including those from animals, can result in loss of service affecting related economic activities in service areas.

9.13.5 Product Safety Risk

The Master Plan projects include 8No. Water Supply Projects (WSPs) as part of the multi-purpose dams, a food processing hub and agricultural produce distribution centre. These will produce or handle consumable goods and will thus have to adhere with health and safety standards. This is because risks of contamination and transmission of zoonoses (25) will be present at these facilities. Contamination and transmission of zoonoses can have negative health impacts on the receptors and compromise the economic and social objectives of these facilities/projects.

9.13.6 Human Wildlife Conflict

Human-wildlife conflict can occur via any of the following modes:

(25) a disease that can be transmitted to humans from animals.

- Increasing the interactions between humans and wildlife through the development of infrastructure in Greenfield areas or increase of human activity.

- Increasing the risk agents of accidents which include collisions with wildlife.

- Reducing access to natural resources such as water due to development of dams.

- Increasing or concentrating wildlife attractions in settled areas. These attractions include agricultural produce, crops and organic wastes amongst others.

- Increasing other hazards to wildlife such as wastes and electricity from power transmission infrastructure.

9.14 NATURAL HAZARDS

9.14.1 Summary of Applicable Constraints

Pertinent constraints to natural disasters include:

- Faults and seismic zones,
- Flood plains,
- Arid and Semi-Arid Lands, and
- Areas susceptible to landslides.

9.14.2 Floods

Hydro meteorological hazards, including floods, are the most prevalent type of hazard in Kenya as discussed in *Chapter 5* of this report. Flood risk can be exacerbated by the NEC through the predicted changes in hydrological regimes and land use changes. Amongst the modes through which this can occur is by increasing run-off in watersheds, dam burst and irrigation. On the other hand, particularly in urban areas, improper management of the anticipated solid wastes can lead to clogging or blockage of drainage systems resulting floods during deluge and or rainy seasons. This has been observed in urban centres such as Nairobi recently in 2015 and 2016. Other factors contributing to these urban floods include land use changes, construction in riparian areas and diversion of watercourses.

9.14.3 Dam Burst

Under abnormal circumstances, dam bursts or breakage (failures) can occur on the dams which are intended to be developed by the Master Plan. Dam bursts pose a risk on downstream communities because of the destructive force of the resulting flood wave and sudden inundation of large areas. The flood wave and inundation can cause loss of life through drowning as well as destruction of property and displacement of communities.

9.14.4 Landslides

The risk of landslides can increase in the highland areas of the NEC as a result of road and rail cut, hillside farming and land use changes. Road and rail cut change slope angles thereby reducing their stability and increasing susceptibility to mass wasting. Hillside farming and land use change in hillsides contribute to this risk through a variety of way which include: increasing run-off on slopes, altering slope angles and stability and increasing the weight of overburden on the slopes.

9.14.5 Mitigation Strategies

The following are the mitigation strategies that can be implemented against natural hazards:

- Avoiding construction in flood plains in line with industry guidelines,
- Integrating considerations for seismicity in the engineering design of infrastructure in seismically active areas,
- Complying with industry guidelines for the design and maintenance of dams such as those published by the International Commission for Large Dams (ICOLD),
- Avoidance of fault zones,
- Incorporating landslide prevention measures for any construction in landslide prone areas,
- Implementing and supporting disaster/emergency preparedness and response plans and programs at the project level,
- Implementing and supporting programs aimed at raising personnel and public awareness on potential hazards, and
- Integrating the provisions of the National Disaster Response Plan into project level disaster/emergency preparedness and response plans, and coordinating with the pertinent authorities.

9.15 CLIMATE CHANGE

As discussed in *Chapter 5*, climate change poses a threat to each economic sector of Kenya. These threats can challenge the achievement of Master Plan strategic objectives. Whilst GHGs are considered to be the cause of global anthropogenic climate change, the NEC MP can only mitigate emissions within its projects. Climate change can still occur as a result of emissions from other activities. Notably these include: other sectors in Kenya not in the NEC MP, other projects in the NEC not under the management or influence of the NEC MP implementers, and activities of other countries. This study notes that Kenya remains vulnerable to the impacts of climate change despite being amongst the lower quantiles of GHG emitters. In connection, the NEC MP will be vulnerable as well.

9.16 ASSESSMENT OF ENVIRONMENTAL IMPACTS

Table 9.7 presents the findings of the assessment exercise on the identified impact using the methodology described in Chapter 4 (*Section 4.5*).

Table 9.8 Impact Significance Assessment

Impact	Sensitivity	Magnitude	Significance
Habitat Alteration and Biodiversity Impacts	High	Moderate	Large
Air Emissions	Medium	Moderate	Moderate
Landscape Modifications	Low	Moderate	Slight
Soil Alteration	Medium	Moderate	Moderate
Hydrological Modifications	High	Minor	Moderate
Pollution Risk	High	Moderate	Large
Natural Resources Demand	High	Moderate	Large
Health and Safety Risks	High	Large	Large

9.17 CUMULATIVE ENVIRONMENTAL IMPACTS

9.17.1 Overview

This Cumulative Impact Assessment (CIA) has been prepared as per the ERM Impact Assessment Standard which addresses the evaluation of cumulative impacts and is based on current international practice and guidance, specifically:

- European Union (EU), 1999, Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions,

- Canadian Environmental Assessment Agency, 2012, Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act,

- International Finance Corporation (IFC), 2013, Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, and

- National Environmental Policy Act (NEPA) Council on Environmental Quality (CEQ), 1997, Considering Cumulative Effects under the National Environmental Policy Act.

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones

This cumulative assessment uses five classes to define the resulting significance of these cumulative impacts. These are described in *Table 9.9*.

Table 9.9 Determining the Effects of Cumulative Impacts

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised
Major	Effects that may become a key decision-making issue
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performances
Minor	Effects that are locally significant
Not Significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

9.17.2 Cumulative Environmental Impacts

Table 9.10 presents the findings of the identification and assessment of the cumulative environmental effects/impacts of the NEC MP.

10 KEY SOCIO-ECONOMIC IMPACTS AND MITIGATION MEASURES

10.1 INTRODUCTION

In this *Chapter* the potential social, cultural, economic and human health impacts of the NEC Master Plan are predicted and assessed, and mitigation strategies are proposed. Similar to *Chapter 9*, the prediction and assessment is focused on the *Multi-Core with Regional Industrial Development Type* Master Plan Alternative. Insights and feedback received from stakeholders during the preparation of this Study also inform this impact assessment process.

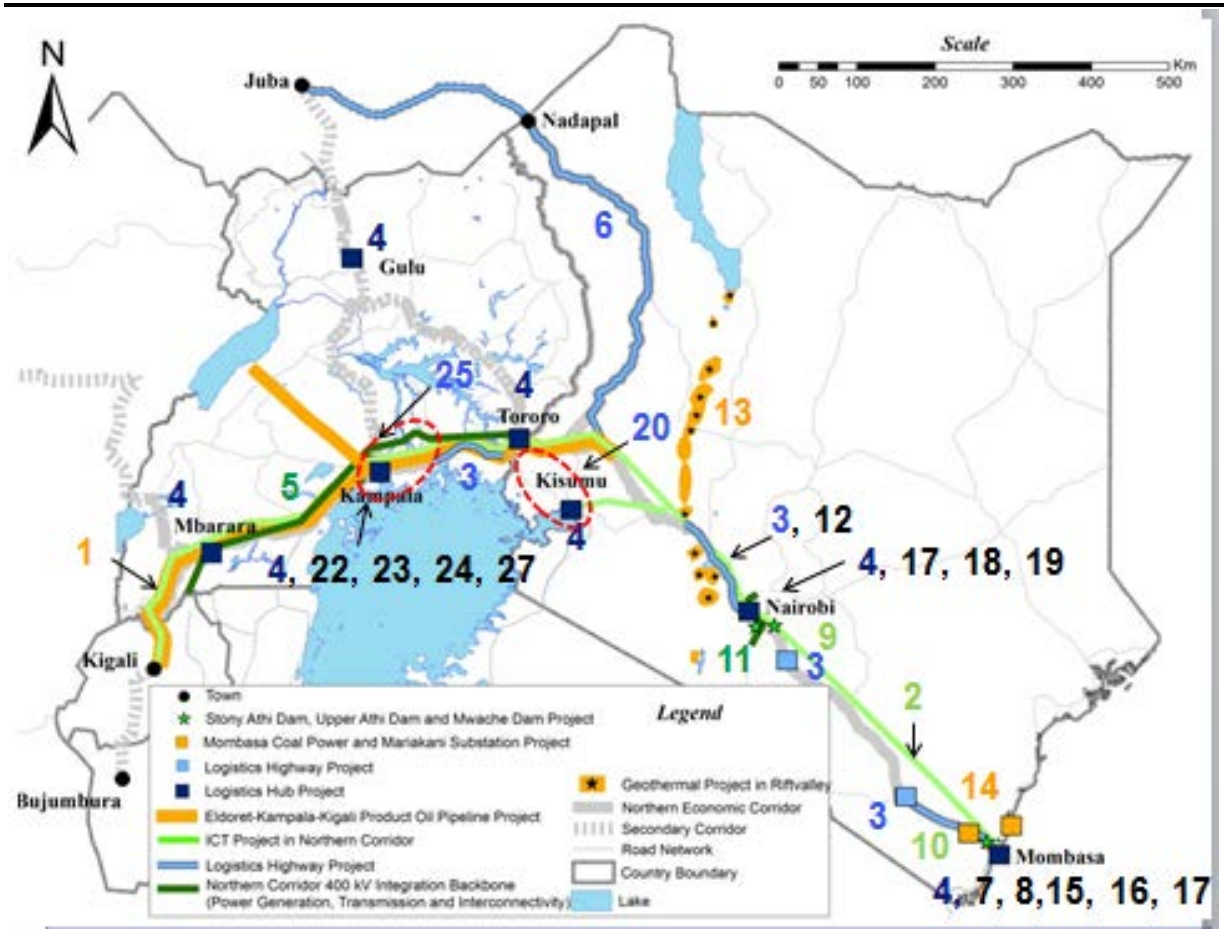
This *Chapter* addresses two items, namely:

- Socio-economic impacts, and
- Cumulative socio-economic impacts.

10.2 NEC MASTER PLAN

As discussed in *Chapter 2* of this Report, the development vision for the NEC is to be the leading economic corridor with integrated transport and logistics systems in Africa. The Master Plan therefore aims at balanced growth and efficient logistics in the NEC region by promoting urban functions of 18 Secondary Cites, including 6 Secondary cum Regional Production Centres (see *Figure 10.1* and *Table 10.1* below), which also cascade into specific sectoral infrastructure projects (*Table 10.2).*

Figure 10.1 The NEC Master Plan



Source: JICA, 2016

Table 10.1 Location of Flagship NEC Projects in Kenya and Uganda

No.	Sector	Project Title
1	Mining	Eldoret-Kampala-Kigali Oil Pipeline Project
2	Mining	ICT Project in Northern Corridor
3	Road	Logistics Highway Project
4	Logistics	Logistic Hub Project
5	Power	Northern Corridor Integration Backbone (Power Generation, Transmission and Interconnectivity)
6	Road	Eldoret-Juba Highway Project
7	Port	Mombasa Port Development Project
8	Urban Dev't	Project for Support of Re-organizing Logistics Facilities around Mombasa Port Area
9	Water	Stony Athi Dam and Upper Athi Dam Project
10	Water	Mwache Dam Project
11	Power	Isinya-Nairobi East Transmission Line Project
12	Industry	Geothermal Energy Based Regional Industrial Development in Rift Valley
13	Power	Geothermal Project in Rift Valley
14	Power	Mombasa Coal Power and Mariakani Substation Project

15	Power	Dongo Kundu-Mariakani Transmission Project
16	Industry	Mombasa Special Economic Zone Project
17	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Kenya
18	Agriculture	Agricultural Financing Improvement Project in Nairobi
19	Agriculture	Value Chain of Agriculture Development Pilot Project in Kenya
20	Urban Dev't	Logistics Based Kisumu-Kakamega Metropolitan Area Development Project
21	Mining	Study on Mining Master Plan in Uganda
22	Industry	Project for Building Up Competitiveness of Construction Materials and Machinery Industry in Uganda
23	Agriculture	Value Chain of Agriculture Development Pilot Project in Uganda
24	Power	Kampala-North-Namungona-Mutundwe 132 kV Transmission Line Refurbishment
25	Urban Dev't	Great Kampala (including Jinja) Logistic Based Urban Development Project
26	Urban Dev't	Study on master Plan for Urban Transport Development for Regional cities
27	Industry	SEZ Development Project in Kampala

Source: JST, 2016

Table 10.2 NEC MP Sectoral Distribution of Infrastructure Projects

Sector	Number of Projects
Road	12
Railway	10
Border Post	7
Marine Port	5
Airport	1
Inland Waterway/Port	1
Logistics Hub	3
Oil and Mining	3
Agriculture and Fishery	9
Manufacture	3
Power	3
Water	9

Source: JST, 2016

The NEC Master Plan will ultimately result in the development of a multitude of projects. The potential impacts of these projects are predicted and assessed at a strategic level on the receptive baseline and its constraints discussed in *Chapter 6* (Socio-Economic Baseline).

10.3 IMPACT PREDICTION

The impact prediction process entails grouping issues associated with the different sectoral projects being developed. These issues are identified through an iterative process. In order to achieve this, prediction matrices have been used. This process is also informed by:

- Good International Industry Practice Guidelines (GIIPs),
- research,
- environmental and social risks of similar projects and plans, and
- Stakeholder engagement.

10.4 SUMMARY OF SOCIO-ECONOMIC IMPACTS

Table 10.3 below provides a summary of the socio-economic impacts that may occur as a result of the Master Plan.

Table 10.3 Socio-Economic Identification Matrix

	Improved Logistics	Regional development	Growth drivers	Capacity Development	Employment	Procurement	Economy	Cultural Heritage	Livelihoods	Rural – urban migration	Public Health	Insecurity	Land acquisition	Land use	Urbanisation	Land Tenure
Sector																
Road	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Railway	X	X	X	X												
Border Post	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Port	X	X			X	X	X	X	X	X	X	X	X	X	X	
Airport	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Inland Waterway/ Port	X	X	X	X	X	X	X		X	X	X	X	X	X	X	
Logistic Hub	X	X	X	X	X	X	X									
Oil and Mining	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Agriculture and Fisheries	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Manufacture	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Power	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Water	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

10.5 POSITIVE SOCIO-ECONOMIC IMPACTS

The overall objective of the Master Plan is to improve logistics for the NEC as well as to provide an integrated regional development strategy consistent with sub-regional and national development plans. As per *Chapter 2* of this Report, it is hoped that this will:

- spur regional economic development within Kenya, as well as Uganda,
- improve the development of the industrial, agricultural, mining, petroleum, manufacturing and tourism sectors,
- lead to transport and logistics infrastructure development,
- result in an efficient and integrated multi-modal transportation system,
- result in the diversification of financial sources for infrastructure through PPP arrangements and infrastructure bonds, and
- reduce the bottlenecks to efficient cargo transportation, such as road and port congestion, as well as cross border delays.

The following *Sections* detail the positive socio-economic impacts of the NEC Master Plan.

10.5.1 Logistics Improvements

Summary of Bottlenecks:

Current bottlenecks result in:

- high transport costs, and
- Long delays of cargo at customs, at the port and at border posts.

Logistics Improvements

Cost reducing factors of inland transport as a result of the Master Plan have been identified as:

- reduction of truck charges,
- reduction of costs of various procedures and formalities,
- reduction in the cost due to the use of the SGR for returning empty containers, and
- Reduction in the time it takes for imports to clear customs, the Mombasa Port, and at Border posts.

As a result, JST (2016) estimate that approximately 15% of the total inland transport cost will be reduced in the case of transport from Mombasa to Nairobi and to Kampala as shown below in *Table 10.4* and *Table 10.5.*

Table 10.4 Summary of Estimated Reduction of Inland Transport Cost (per container)

From Mombasa	Item	Current cost	Reduction of truck charge	Reduction of cost for procedures	Returning empty containers by rail
To Nairobi	Reduction rate(USD)	0	45	200	180
	Amount(USD)	1,915	1,870	1,670	1,490
	Degree of Reduction (%)	100%	98%	87%	78%
To Kampala	Reduction rate(USD)	0	50	400	450
	Amount(USD)	3,600	3,550	3,150	2,700
	Degree of Reduction (%)	100%	98%	87%	75%

Source: JST 2016

Table 10.5 Projection of Reduction of Inland Transport Cost and Production Cost

	Cost of inland transportation per container (USD)		Total cost of production using one container of raw materials (USD)		Percentage of reduced cost in total cost
	Before	After	Before	After	
To Nairobi	1,000	780	25,000	24,780	0.9%
To Kampala	4,250	3,188	28,333	27,271	3.8%

Source: JST 2016 (1)

The current transport and logistics situation for the NEC is that the movement of cargo is heavily influenced by road traffic congestion, the operation of the Mombasa Port, and cross border operations. In Kenya, approximately 1% cost reduction of the total production can be realized through the NEC Master Plan. It should be noted that the impact of transportation and procedural streamlining will also improve the

(1) The inland transportation cost per container is calculated using the lowest price per ton per container obtained through interview. One container is assumed to be 25t of raw materials

logistics between the factories to customers, and sometimes across borders. Therefore, the impact should not be limited to the above-mentioned volume.

10.5.2 Regional Development

Summary of Applicable Opportunities

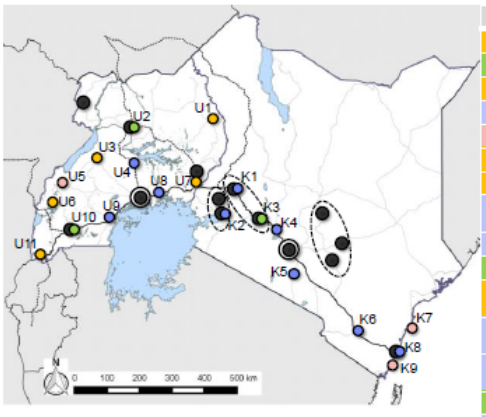
- Admission of Rwanda, Burundi and South Sudan in the East African Community (EAC) has expanded the market for products and services produced in this region. As a result, Kenya's industries are bound to produce and sell more in the region.

- Competition from neighbouring countries will enable the proposed projects in the NEC (as identified in *Figure 10.1*) to be undertaken efficiently. That way, the NEC will not only be ahead of its competitors but ensure that Uganda, Rwanda, South Sudan and DRC remain within this route.

Regional Development

The Regional Production Centres proposed in the Master Plan will generate key industries and products, including growth drivers. In addition, primary and secondary cities will serve as centres of urban service or/and key logistic hubs for the regions. The Regional Production Centres as well as primary and secondary cities are illustrated in *Figure 10.2* below.

Figure.10.2 Proposed Regional Centres



Legend: Regional Production Center
- Mining
- Agriculture
- Manufacture
- Tourism
- Primary City
- Secondary City

No.	Place	Industry	Key Product
U1	Moroto	Mining	Limestone
U2	Gulu	Agriculture	Coffee, Maize Sesame, Rice
U3	Hoima	Oil	Crude Oil and Natural Gas
U4	Nakasongola	Manufacture	Agro-and food processing
U5	Fort Portal	Tourism	Wildlife
U6	Kasese	Mining	Limestone, Copper, Cobalt, Gold
U7	Tororo	Mining	Limestone, Phosphate, Rare Earth
U8	Jinja	Manufacture	Construction materials, agro- and food processing, consumer goods
U9	Masaka	Manufacture	Agro-and food processing
U10	Mbarara	Agriculture	Coffee
U11	Kabale	Mining	Gold, Columbite /Tantalite, Wolfram (Tungsten), Tin, Hematite
K1	Eldoret	Manufacture	Agro- and food processing, agricultural inputs, construction materials
K2	Kisumu	Manufacture	Agro- and food processing, consumer goods, construction materials
K3	Nakuru	Agriculture	Vegetable, Tea, Coffee
K4	Naivasha	Manufacture	Agro- and food processing, agricultural inputs (agro-machinery, agro-chemicals etc), construction materials
K5	Kajiado-Machakos	Manufacture	Garment, consumer products, leather industries, construction materials, agro- and food processing
K6	Voi	Manufacture	Agro-processing, construction materials, livestock-related industries
K7	Malindi	Tourism	Beach
K8	Mombasa	Manufacture	Food processing, garment, construction materials
K9	Diani	Tourism	Beach

Source: JICA Study Team

Source: JST, 2016

Enhancement Strategies

- Deepening regional integration in the Eastern Africa region implies creating the appropriate conditions for guaranteeing factor mobility, the free movement of people, goods and services

10.5.3 Development of Growth Drivers

Summary of Applicable Opportunities

As per *Section 2.6* of this Report, sources of growth include:

- Expanding domestic and regional, and international markets for net profit,
- Strategic products or industries which provide significant solutions for industrial structure upgrading,
- Industries with strong forward and backward linkages

The above growth drivers have the potential to:

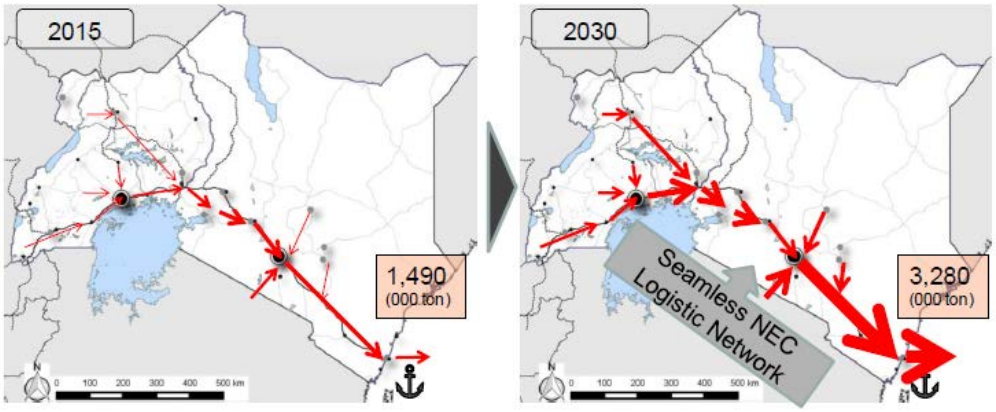
- increase exports to the East African region (or international markets),
- decrease imports through the expansion of domestic production, and
- increase the contribution to add value to the local economy.

Development of Growth Drivers

Export-oriented growth drivers produced at production centres are tea, coffee, textile and apparel products, niobium, soda ash, processed fruits and vegetables, palm oil products, and oil seed products. Those are expected to contribute to high growth in volumes of export cargo in the future.

The export-oriented growth drivers will have a more competitive advantage through effective and efficient logistical system including improved border post logistic hubs etc. (see *Figure 10.3*).

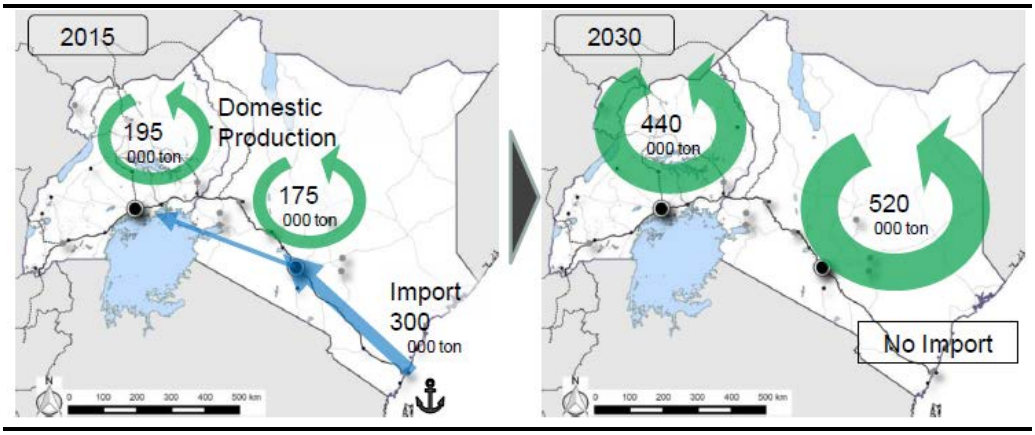
Figure 10.3 Flow of Export-oriented Growth Drivers through Mombasa Port



Source: JST 2016

Some of the growth driver products from the production centres can replace import goods. Those are rice, oil products, phosphate fertilizer and maize. The total reduction will be 3.5 million tonnes by 2030 and that will be 10% increase of freight import in 2030 at Mombasa port. *Figure 10.4* below shows the rice products flow as an example.

Figure 10.4 Flow of Rice Products



Source: JST 2016

10.5.4 *Capacity Development*

Capacity Development

Through the Master Plan study, the following three items have been identified as necessary for capacity development,

- Public Private Partnership (PPP),
- Land Acquisition and Resettlement, and
- Single Custom Territory (SCT).

Table 10.5 shows the current issues and necessity actions for capacity development.

Table 10.6 Necessary Actions for Capacity Development

Item	Action
PPP	• Arrangement of technical and financial support during the formulation of PPP projects • Formulation and issuance of specific guidelines on where the jurisdiction of county government ends and that of the central government in PPP • Formulation and issuance of guidelines for joint agreements among the countries for cross border infrastructure projects

Item	Action
Land Acquisition and Resettlement	• Formulation and implementation of a land title management project to establish a land title database with cadastral map information • Arrangement of technical assistance for a land acquisition and resettlement program
SCT	• Expansion of goods to be adapted by the SCT • An increase in trained staff and equipment for the customs office in the Mombasa port • Installation and expansion of ICT through a cross border ICT project along the Standard Gauge Railway (SGR), transmission lines, oil pipelines, etc.

Source: JST 2016

The above positive economic impacts (Sections *10.5.1 - 10.5.4*) will therefore result in the following positive social impacts (Sections *10.5.5 - 10.5.7*).

10.5.5 Impacts on Employment

Summary of Applicable Opportunities and Constraints

Applicable opportunities related to employment include:

- The increasing population can result in an increase in labour force, if the rise in population has resulted from an increase in the birth rate or immigration. The expanding economy industries can therefore recruit new workers from this labour force,
- Domestic challenges in the manufacturing sector can present opportunities for the industrial sector to plan and address them, specifically through the improvement of the investment environment, increasing the market size, increasing employment and incomes and providing raw materials from the agricultural and mineral and oil sectors.

However, potential constraints also include:

- An increase in the number of people of working-age without a corresponding increase in appropriate skills and jobs will result in unemployment

- As the population moves to the urban areas, unemployment can increase, resulting in an increase in crime rates as well as the development of slums or shanties.
- Unemployment and underemployment have both been identified as Kenya's difficult and persistent problems. Over 13% of the working age population is unemployed. About 67% of Kenya's unemployed are youths between 15 and 34 years of age. The highest unemployment rates are for people around 20 years old at 35%. This makes unemployment in Kenya a youth problem.

Impacts on Employment

The growth of secondary cities will attract new investments and businesses. As these cities will also be governance and economic centres, their growth will create new jobs and reduce rural-urban migrations to the major cities.

The growth of agricultural and mineral sectors will create employment opportunities in the rural areas. This will increase the incomes, investments, growth of the rural sector and reduce rural poverty.

Jobs will also be created by freight rail, related logistics industries, and the manufacturing businesses served by freight rail. The sub-sectors will offer good entry level jobs with career potential for more skilled workers.

Employment opportunities will be created from logistic activities which range from low to high skilled jobs to support the logistic operations. A diversified logistics service market will strengthen local expertise and improve the performance of freight distribution.

The existing infrastructure facilities will employ more people once there is improvement in their utilization. More people will be employed as result of increasing operations at inland water ports and Mombasa port.

Reducing imports and reliance on home-grown food and processing thereof will also serve as a massive boost to employment

Enhancement Strategies

The objective of enhancement measures is to optimise the opportunity for direct employment and training for the work force at a local, provincial or national level. Proposed strategies include:

- Skills development and adult education programs will be required to maximise the benefits associated with formal employment opportunities.

- Representatives from the various County Governments should be informed of the specific jobs and the skills required for the NEC projects, prior to the commencement of construction of these projects. This will give the local populations time prior to the commencement of construction to enable them to attain the relevant skills to be employable on these projects. This is applicable to un-skilled and semi-skilled workers.

- NEC projects should prioritise the employment of unskilled labour from local communities in the first instance.

- NEC projects developing a fair and transparent employment policy and process that manages out any potential nepotism. The policy should be shared with nearby communities.

10.5.6 Impact on Procurement

Impact on Procurement

The risk of losing money on investments in developing transport and logistics infrastructure will be reduced. This is because the Country will depend on many sectors i.e. agriculture, industry, mining, tourism etc. to pay, in the long run, for the investment

Enhancement Strategies

- Due to the viability, some of the proposed projects should be undertaken by the private sector or public-private partnerships (PPP). Such projects include establishment of industries, production centres and transport hubs, mining, etc.

10.5.7 Impact on the Economy

Summary of Applicable Constraints

Potential constraints include:

- In recent years, there has been a surge of terrorist attacks in Eastern Africa and Kenya has had a share of these attacks. Terrorists are motivated to disrupt the economy, to cause personal injury to concentrations of people, to strike at symbolic targets, and transport tools of terror using transport infrastructure,
- Not all regions within the NEC produce adequate cargo necessary to sustain the transport infrastructure. The undeveloped areas need to be developed before they can produce goods for handling by the transport modes. Developing underdeveloped regions requires a lot of resources to be dedicated to these regions before they may be able to produce more goods,
- Recent experiences show that Kenya's economic growth rate has been fluctuating, giving the impression that economic growth is not steadily occurring. In situations where the actual economic growth rates fall below the planned rates (at an average annual growth rate of 6.6%) as envisaged by the Master Plan, implementation of the development strategies would be slowed down, delayed, or even frustrated,
- Implementation of the Development Strategies requires a lot of funds which Kenya may not have or have in limited amounts. The Government needs to reform the tax system so as to maximize revenues. Even when funds are available, the Government would have to prioritize its expenditure among competing interests. Funding can limit the Government to spend money on big infrastructure projects, and
- Corruption can adversely affect implementation of the development strategies by making infrastructure project expensive, delay or, even fail. A country suffering from corruption cannot implement sound plans and thus is not expected to benefit from sustainable development despite embarking upon economic growth from time to time for some reason or the other.

Impact on the Economy

Local production of goods will be stimulated. This would result in more goods and cargo being produced to support the transport logistics infrastructure investments.

Industrial business sectors will be anchored in the COD. It will attract and retain logistics and manufacturing operations that depend on proximity to the railway lines, trans-load facilities, or intermodal terminal to minimize transportation costs while gaining ready access to urban markets.

Regional competitiveness will be improved. A strong multimodal freight transportation system is a prerequisite for development of industrial clusters in a region and a key to energy-efficient transportation. COD will enable regions to create more efficient national freight transportation networks, with the benefits of COD in multiple regions flowing up to strengthen the national economy.

There will be improved system condition and performance in terms of modal connectivity and safety. There will be benefit-cost and cost effectiveness in terms of time and cost, system accessibility, short-term jobs and operational costs.

Work practices will be integrated: the integration of labour force work practices required to move cargo most efficiently through a supply chain, including at ports and intermodal/ trans-load facilities. It will require sound organizational (managing labour as a group) and management skills (managing individual workers) competencies.

Information will be integrated: the inter-connectedness of information systems to allow for improved management of supply chains. Systems that provide electronic data interchange will be included.

There will be planning and funding integration: the planning and funding of infrastructure from an integrated multimodal, total logistics chain perspective. Freight transportation bottlenecks are a potentially significant hindrance to economic growth and the integration of transport chains. It will also recognize the concerns in government and industry that established institutional and financial arrangements have not adequately responded in recent decades to the demands imposed by growing volumes of freight and passenger traffic and to fundamental shifts in regional and global patterns of trade.

There will be customs integration which will aim at moving goods more efficiently across Kenya's borders, including pre-screening and inspections.

Security will be integrated which will emphasize the interconnectedness or harmonization of security procedures that

protect cargo from theft or damage and protect the public from risks posed by dangerous cargo or threats posed by illicit cargo.

The infrastructure would be optimally utilized. Presently some of it is underutilized or redundant. For example, Kisumu Port and other smaller ports on Lake Victoria currently handle lower volume of cargo than they used in 1960s and 1970s. If they are fully utilized, they will improve trade within the lake region and, between Kenya, Uganda and Tanzania.

All components of logistics will be efficiently coordinated to promote value addition under the least cost principle.

Well-coordinated logistics will benefit both producers and consumers. The net effect will be reduction of costs of doing business for producers and lower prices for consumers in Kenya.

Infrastructure will be integrated: the physical connectedness and interoperability of hard infrastructure, such as the ability to move containers efficiently from ship to truck to rail. The transport terminal– port, rail, or airport – is the key infrastructure where physical flows of goods will be reconciled with the requirements of supply-chain management.

Commerce will be integrated: the development of commercial arrangements to promote a better integrated logistics system, including service-level agreements and performance targets and penalties as well as management processes, for example, between main-line railways and short lines, or between railways and ports (or terminal operators). This will include the elements of cost, time, and reliability as commercial goals that are benchmarked and included in commercial supply-chain decisions.

There will be regulatory integration: the structuring of regulations to promote a better-integrated freight distribution system. Regulations will promote efficient modal choice, avoid subsidized modal preferences, and favour the harmonization of regulation across jurisdictions. Since supply-chain management will involve modes and processes across several nations, regulatory integration will become increasingly important because it will transcend modes and jurisdictions.

Agricultural and mineral cargo will easily reach the markets. Farmers will produce and earn more from agricultural produce and minerals

like coal in Makueni will be exploited. Conversely, manufactured cargo from the industries will easily reach the rural areas which will stimulate consumption. The combined impact would result in increased employment, incomes, improved well-being of the people and development of the rural areas.

More agricultural and mineral raw materials will be produced for local consumption, industrial use and exports. Consequently, the county's GDP, revenues and foreign exchange will increase. In addition, there will be industrial growth when raw materials are turned into manufactured goods.

Increased trade will enhance regional cooperation and integration between the five countries and other African countries. The people and governments in these countries will have increased need to work together for their own benefit.

A wide range of goods for exports would be produced than presently is the case. This would reduce the country's over-reliance on a few crops for exports and produce new different products and increase the volume of the export cargo.

Import-substitution industries will be developed which will reduce the volume of some of the current imports and the foreign earnings spent for importing them. This would create jobs in the country and save the country substantial foreign exchange.

Tax bases for the logistical hubs will grow and raise government revenue. More business created in the hubs and beyond will be taxed to raise government revenue.

Trade between Kenya, Uganda, South Sudan, Ethiopia and Djibouti will be enhanced. This will encourage production and consumption of goods and services in these countries because of expanded market

10.6.1 Loss of Cultural Heritage

The term cultural heritage encompasses several main categories of heritage (1):

- **Cultural heritage,** which includes *tangible cultural heritage* such as movable cultural heritage (paintings, sculptures, coins, manuscripts), immovable cultural heritage (monuments, archaeological sites), underwater cultural heritage (shipwrecks, underwater ruins and cities), as well as *intangible cultural heritage* (oral traditions, performing arts, rituals); and
- **Natural heritage**: natural sites with cultural aspects such as cultural landscapes, physical, biological or geological formations

Summary of Applicable Constraints and Opportunities

- Along the NEC there are a number of archaeological sites that have to be preserved. Development of the NEC transport infrastructure is likely to disturb or disrupt these sites (see *Annex F*), and
- However, the NEC Master could also plan for these sites and boost tourism by making these sites more accessible.

Loss of Cultural Heritage

The development of projects within the NEC may interfere with the existing archaeological and historical heritage sites (see *Section 6.12.2* and *Annex F*). These sites are therefore susceptible to degradation and at the worst case, permanent destruction. Loss of cultural assets can impact on community networks, structures and traditional practices and can negatively affect the ability of a project to achieve a social licence to operate and establish good relationships with neighbouring communities.

Mitigation Strategies

To avoid and reduce the significance of the above mentioned impacts, the following mitigation and management measures should be implemented by the projects developed within the NEC.

(1) http://www.unesco.org/new/en/culture/themes/illicit-trafficking-of-cultural-property/unesco-database-of-national-cultural-heritage-laws/frequently-asked-questions/definition-of-the-cultural-heritage/

- The presence of cultural heritage assets would need to be confirmed in detailed studies associated with each potential project; this could influence the design and location of infrastructure, commercial enterprises and industrial facilities.

- Incorporation of heritage sites into tourism master plans as a way of preserving such sites

- Projects associated with the construction and operation of infrastructure should be subject to Environmental and Social Impact Assessment (ESIA) commensurate with the scale of the project and impacts which includes consideration of cultural heritage and the development of appropriate mitigation and management plans.

- In terms of locally important cultural heritage sites, any loss or alteration to such sites should be consulted on, and agreed, with the National Museums of Kenya (NMK) as well as the local communities and the custodians of the site. If necessary, appropriate rituals should be undertaken to move the cultural asset, or to otherwise expiate disturbance or loss of the site.

- A framework "chance finds procedure" should be developed to support the Master Plan which involves and references all relevant ministries, other agencies and major cultural heritage stakeholders in the country. The framework procedure should be deployed within the construction and management planning for all developments implemented under the auspices of the Plan.

10.6.2 Impact on Livelihoods

Impact on Livelihoods

There will be unemployment for those previously transporting cargo by trucks. Businesses and livelihoods that also depend on trucks will be adversely affected by the modal shift from truck to rail. Stakeholders consulted in the border towns of Malaba and Busia raised this concern, as they wanted to know what would be the alternative livelihoods for those that depend on truck cargo transportation. JST responded that the demand for human capacity would increase due to the modal shift and as the economy grows, and gave examples from Japan.

Mitigation Strategies

- Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation.

10.6.3 Rural-Urban Migration

Summary of Applicable Constraints

- Rural areas are deprived of labour in the agricultural sector leading to a decline or slow growth of agricultural output; and families and cultural bonds break or weaken as the population moves to the urban areas, and

- As the population moves to the urban areas, unemployment increases, crime rates rise, slums or shanties develop and social services become inadequate.

Rural – Urban Migration

The growth of secondary cities will encourage rural-urban migration. Workers will compare the expected incomes, job opportunities and standard of living in the urban sector with the rural areas and migrate if the former exceeds the latter. Rural-urban migration would also exacerbate urban unemployment in the secondary cities, resulting in an increase in anti-social behaviour (e.g., crime).

An increase in urban immigration would result in pressure on the social amenities and infrastructure in the cities. City and county governments would have to spend more funds to develop and maintain the schools, health, housing, and recreational facilities.

Finally, rural-urban migration will deprive the rural areas of the young and able-bodied people necessary to provide labour and skills for increased agricultural productivity. This may then hamper the growth of the agricultural/rural sector.

Mitigation Strategies

Specific measures include:

- Infrastructure projects should be subject to Environmental and Social Impact Assessment (ESIA) undertaken in line with

international standards such as those of the World Bank or the International Finance Corporation (IFC). The scope of the ESIA should always include consideration of rural – urban migration.
- Urban development plans / CIDP should also cater for rural-urban migration.

10.6.4 Public Health

Summary of Applicable Constraints

Applicable constraints within the Country as a whole include:

- Poor access to basic primary health care;
- High mortality rates;
- Low staffing levels of doctors and nurses;
- Prevalence of communicable disease in the country; and
- Poor health affects the quality of labour.

Impact on Public Health

The link between transportation and the spread of sexually transmitted diseases (STI) as well as HIV/AIDS is well documented. Incidences of STI/HIV/AIDS may increase as a result of setting up construction camps, and resultant social interaction with local communities. It is important to note, however, that the modal shift from truck to railway and pipeline may reduce the cases of STI/HIV/AIDS.

Construction activities have also been associated with increased transmission of malaria, if NEC project sites are not appropriately managed, breeding grounds can be created leading to increased prevalence of mosquitos and therefore potential for transmission. The presence of external workforces can also contribute to the transmission of other communicable diseases including TB and respiratory tract infections.

Those with pre-existing health conditions, the elderly and children are usually worse affected by any changes in the disease profile in an area or in changes in access to health care facilities.

Mitigation Strategies

Specific measures include:

- Infrastructure projects should be subject to Environmental and Social Impact Assessment (ESIA) undertaken in line with international standards such as those of the World Bank or the International Finance Corporation (IFC). The scope of the ESIA should always include consideration of health related impacts. For large Projects this may require that appropriately qualified international experts are appointed to address impacts on health.

- The development and implementation of HIV/AIDS/malaria policies and information documents for all workers directly related to NEC projects. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS as well as malaria.

- All projects should have a Worker Code of Conduct for all project personnel that include guidelines on worker-worker interactions, worker-community interactions and development of personal relationships with members of the local communities. As part of the Worker Code of Conduct, all project personnel should be prohibited from engaging in illegal activities including the use of commercial sex workers and transactional sex. Anyone caught engaging in illegal activities will be subject to disciplinary proceedings. If workers are found to be in contravention of the Code of Conduct, which they will be required to sign at the commencement of their contract, they will face disciplinary procedures that could result in dismissal.

- Working in conjunction with relevant partners (eg health authorities, NGOs, development agencies), information, education and communication campaigns around diseases and health practices should be developed as part of the Master Plan implementation

10.6.5 Insecurity

Summary of Applicable Constraints

- The economic growth and development anticipated in Vision 2030 can only be achieved and sustained in a peaceful, stable and secure environment. In the recent years, there has been a surge of terrorist attacks in Eastern Africa and Kenya has had a share of these attacks.

Terrorists are motivated to disrupt the economy, to cause personal injury to concentrations of people, to strike at symbolic targets, and transport tools of terror using transport infrastructure. A secure transportation system is critical to overall national security from terrorism. There are also instances where intermittent insecurity, conflicts and tensions occur thereby threatening movement of cargo, and

Insecurity

Security concerns in some sections of the corridor could jeopardize linking of NEC with the LAPSSET, central corridor and Kampala-Juba-Addis -Djibouti.

Mitigation Strategies

- The successful implementation of the NEC Master Plan Strategies will require the active participation of the Ministry of Interior and Coordination of National Government.

10.6.6 Land Acquisition and Resentment

Summary of Applicable Constraints

- Resettlement and compensation will be highest especially in Nairobi and Mombasa Counties, as well as all proposed secondary growth nodes and identified projects; and

- Speculation may drive the land prices even higher.

Land Acquisition and Resettlement

The development of the NEC projects will require changes in existing land uses which can result in physical and economic resettlement and changes in social structures of communities. This could be due to either temporary or permanent land take, where land is required for infrastructure purposes (for example construction camps, expansion of railway yards), or where people are required to move out of rights of way (ROWs) in order to allow infrastructure to be built, or where additional land is required for a widened ROW. The risk of relocation and involuntary resettlement is therefore high.

The consequences of acquisition and/or involuntary resettlement are severe, as they cause major upheavals to livelihoods, loss of income, loss of property and assets, and social defragmentation.

Mitigation Strategies

As part of capacity development, JST have already identified the following with regards to resettlement and land acquisition:

- Formulation and implementation of a land title management project to establish a land title database with cadastral map information, and

- Arrangement of technical assistance for a land acquisition and resettlement program

In addition:

- Any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation.

- Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation

- The budgeting process for any of the NEC initiatives must also include a budget for resettlement and compensation, as these costs can be quite significant.

10.6.7 Land Use and Settlement Patterns

Summary of Applicable Constraints

Implementing the Master Plan Development Strategies could result in land use conflicts. Use of certain areas/parcels of land such as national parks, wetlands, protected areas etc., to implement the Development Strategies will need trade-off with other existing and potential uses (e.g. developing transport infrastructure in certain sections of the NEC would require converting agricultural and conservation land for such a purpose). In sections where conversions of landuse are resisted, land

use conflicts and litigations may occur which can delay and increase the cost of a project.

Land Use and Settlement Patterns

Land uses will be affected by providing or increasing accessibility to and from activity centres through the opening up of formerly inaccessible areas. The NEC Master Plan will also lead to redistribution of metropolitan growth to highway corridors and decentralization of population and employment.

Settlement patterns have always been affected by the technology available to the dwellers and especially by methods of transportation. Along the corridor and around the growth drivers, settlement patterns will change. The introduction of new roads will attract linear settlement while primary and secondary cities will lead to clustered settlement patterns.

Mitigation Strategies

- Institutions responsible for land use plans should ensure that they contain measures relating to infrastructure provision that are robust and fit for purpose, with a focus on the poorest and most vulnerable communities

- Avoidance of conservation areas, national parks, wetlands, protected areas

10.6.8 Urbanisation

Summary of Applicable Constraints

Urbanization will encourage rapid inflows of rural populations to urban areas that give rise to housing problems and the development of slums. An increase in urban areas will therefore put pressure on existing water and sanitation facilities and potentially result in environmental pollution, as well as increased unemployment in urban areas

Mitigation Strategies

- Any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation.

- Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation.

- Regional and/or County Integrated Development Plans (CIDP) to plan for such urbanisation

10.7 CUMULATIVE SOCIO-ECONOMIC IMPACTS

10.7.1 Overview

This Cumulative Impact Assessment (CIA) has been prepared as per the ERM Impact Assessment Standard which addresses the evaluation of cumulative impacts and is based on current international practice and guidance, specifically:

- European Union (EU), 1999, Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions,

- Canadian Environmental Assessment Agency, 2012, Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act,

- International Finance Corporation (IFC), 2013, Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets, and

- National Environmental Policy Act (NEPA) Council on Environmental Quality (CEQ), 1997, Considering Cumulative Effects under the National Environmental Policy Act.

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity

when added to other existing, planned, and/or reasonably anticipated future ones

This cumulative assessment uses five classes to define the resulting significance of these cumulative impacts. These are described in *Table 10.6*.

Table 10.7 Determining the Effects of Cumulative Impacts

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised
Major	Effects that may become a key decision-making issue
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performances
Minor	Effects that are locally significant
Not Significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

10.7.2 Cumulative Socio-Economic Impacts

Table 10.7 presents the findings of the identification and assessment of the cumulative environmental effects/impacts of the NEC Master Plan.

Table 10.8 Cumulative Socio-Economic Impacts

Cumulative Impacts	Primary Impacts							Significance
	Employment	Procurement	Economy	Livelihood	Social disturbance	Public Health	Labour & working conditions	
Livelihood								
Loss of jobs								Moderate
Possibility of high transport costs								Minor
Corruption								Moderate
Social								
Increased pressure on the social amenities								Minor
Deprivation of able-bodied people necessary to provide labour and skills in agriculture								Moderate
Health								
Diseases								Minor
Pressure on provision of health services								Minor
Economic								
Low production of transportable goods								Moderate
External debt servicing & burden								Severe
Labour and working conditions								
Insecurity								Minor

11 ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK

11.1 INTRODUCTION

As discussed in *Chapter 2,* the overall objective of the Master Plan is to improve logistics for the NEC as well as to provide an integrated regional development strategy consistent with sub-regional and national development plans. Although the proposed NEC development will certainly result in positive socio-economic impacts, the SEA assessment has also identified some unforeseen and potentially significant negative impacts that will need to be addressed, as identified and discussed in *Chapters 9* and *10*.

The following *Chapter* presents the recommended measures to mitigate these negative environmental and social consequences of implementing the Master Plan, and also to enhance its positive benefits wherever possible. It also includes recommendations for strengthening the institutional and measures and arrangements within the Plan with a view to enhancing its environmental and social performance overall.

11.2 ENVIRONMENTAL AND SOCIAL MANAGEMENT FRAMEWORK

Table 11.1 presents the recommended Environmental and Social Management Framework (ESMF) for the NEC Master Plan that contains the strategic level mitigation and enhancement measures for addressing the biophysical and socio-economic negative impacts that have been identified in respect to the Plan in *Chapters 9* and *10*. *Table 11.1* also provides the recommended indicators for monitoring the effectiveness of these measures and the overall sustainability of the Master Plan.

The measures themselves are not costed, since the vast majority have already been identified and costed in detail within the Master Plan itself. Likewise the Master Plan already contains detailed timelines for their implementation, which are not reproduced here. However, the ESMF does provide approximate timeframes for the various additional measures that have been identified. The incremental cost of these SEA measures is considered to be negligible in comparison to the cost of the Plan measures themselves.

Table 11.1 Environmental and Social Management Framework

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Habitat Alteration and Biodiversity Impacts	Major (negative)	• Avoiding PAs and other Category A Constraints (*see Annex D*). This is the key mitigation measure, and is of paramount importance given the pressures such areas are currently facing given rampant urbanisation and unplanned developments. • Where avoidance is unavoidable, consider offsets • Aligning new infrastructure with existing RoWs or defined corridors. • Limiting the size of construction RoWs where possible. • Complying with existing land use and PA management plans. • Supporting conservation strategies in the NEC. • Enforcing regulations on transboundary movement of species and establishing monitoring systems. • Engaging stakeholders in project design particularly where constraints are involved. • Phasing construction as to avoid any sensitive periods.	• Number of Human-Wildlife Conflict Incidents. • Ratio of composite area of PAs and sensitive ecosystems in the NEC. • Number of species at risk in the NEC (Species Richness Index). • Species mortality rates.	• MoTI • NEMA • KFS • KFC • Kenya Water Towers Agency (KWTA) • Water Resources Authority (WRA) • Kenya Marine and Fisheries Research Institute (KMFRI) • Kenya Plant Health Inspectorate (KEPHIS) • Agriculture and Food Authority (AFA) • National Museums of Kenya (NMK) • County Governments • NEC Projects' Implementing Agencies	Short term

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Air Emissions	Moderate (negative)	• Complying with the Air Quality Regulations (2014) and emission standards as provided in KS 1515. • Using cleaner energy sources and promoting their use. • Limiting land conversion to only necessary areas. • Managing wastes according to regulations in addition to employing the 3Rs to ensure they are managed sustainably. • Supporting the development of an air quality baseline through monitoring. • Supporting climate change response and adaptation strategies as guided by national strategies. • Promoting resource efficiency programs. • Avoiding the use of toxic or hazardous materials through engineering design measures where feasible. • Monitoring air quality in the target areas of the NEC Projects.	• Air emissions per capita. • GHG emissions per capita. • Prevalence rates of morbidity causes linked to air pollution. • Concentration of criteria pollutants in the NEC.	• MoTI • NEMA • National Climate Change Council (NCCC) • Department of Occupational Safety and Health (DOSH) (MoLSS&S) • County Governments • NEC Projects' Implementing Agencies	Short

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Landscape Modifications	Minor (negative)	• Locating infrastructure in compliance with existing land use plans. • Complying with ecosystem management plans of protected areas. • Limiting the size of construction RoWs. • Avoiding protected areas and settlements. • Involving stakeholders in the design phase of projects particularly those located in or close to settlements and/or protected areas.	• Ratio of composite areas of different land covers in the NEC.	• MoTI • NEMA • KFS • KWS • County Governments • NEC Projects' Implementing Agencies	Short

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Impacts on Soils	Moderate (negative)	• Avoidance of areas listed as constraints (see *Chapter 5* and *Annex D)* • Implementing run-off and water management measures. • Limiting excavations to only necessary areas. • Implementing soil conservation strategies in areas with high Soil Erosion Potential. • Complying with waste management regulations. • Complying with regulations and guidelines on soil conservation such as those provided by land use plan, ecosystem management plans and those gazetted by the Agriculture and Food Authority. • Supporting other soil conservation and management strategies in the NEC. • Completing erosion modelling studies at the project level and taking necessary action according to those studies. • Monitoring soil quality in the target areas of the NEC Projects.	• Amount of soil erosion loss per year. • Concentration of pollutants in the soil in the project target areas (Soil quality).	• MoTI • NEMA • AFA • County Governments • NEC Projects' Implementing Agencies	Short

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Impacts on Hydrology and Hydrogeology	Moderate (negative)	• Avoiding wetlands, water towers, groundwater conservation areas and flood plains (see *Chapter 5* and *Annex D*). • Implementing water ingress management measures as appropriate at the project level. • Controlling run-off from infrastructure and using sustainable drainage systems (SUDS) which mimic or allow natural percolation of water. • Supporting Integrated Water Resource Management Strategies. • Monitoring water quality in water bodies that could be affected by the NEC.	• Concentration of pollutants in water resources (water quality). • Ratio of composite area of water bodies in the NEC. • Prevalence rates of morbidity causes linked to water pollution.	• MoTI • NEMA • WRA • KFS • KWTA • County Governments • NEC Projects' Implementing Agencies	Short

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Risk of Pollution	Major (negative)	• Developing complementary waste management facilities including a sanitary landfill and a hazardous waste disposal facility. • Integrating Life Cycle Assessments into the project level environmental risk management. • Managing wastes (collection, transport and disposal) in accordance to the provisions of the Waste Management Regulations (2006) and providing adequate equipment and facilities to do so. • Integrating the 3Rs (Reduce, Reuse, Recycle) of waste management in NEC MP and at the project level. • Avoiding the use of toxic and hazardous substances where possible. Where this won't be possible they should be manged according regulations such as EMCA and OSHA, as well as industry best practice as guided by manufacturers of the substances and institutions such as WHO, FAO and International Commission on Non-Ionizing Radiation Protection amongst others. • Implementing resource efficiency strategies at the project level to minimize waste generation.	• Wastes generated per capita, per annum and per type of waste. • Ratio of waste collected and disposed in regulatory approved disposal facilities in the NEC. • Amount of waste generated by the NEC Projects per annum and ratio of the amount disposed in approved disposal facilities. • Number of pollution incidences per annum. • Number of sanitary landfills per capita. • Prevalence rates of morbidity causes associated with pollution.	• MoTI • NEMA • DOSH • Ministry of Health (MoH) • County Governments • NEC Projects' Implementing Agencies	Short

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Natural Resource Demand	Major (negative)	• Integrating Life Cycle Assessment into the project level environmental risk management. • Complying with regulations governing resource extraction such as Forests Act (2005), EMCA (2014), Sand Harvesting Guidelines (2009), Water Resource Management Rules (2006) and Water Act (2014) amongst others. • Adopting sustainability standards at the project level such as those pertaining to green building and energy efficiency (LEED). • Ensuring building materials are sourced from sustainable sources. • Implementing demand management and resource efficiency measures for water, electricity and materials.	• Total energy demand of the NEC Projects per annum. • Ratio of energy obtained from sustainable sources. • Number of transgressions related to resource extraction regulations.	• MoTI • NEMA • NEC Projects' Implementing Agencies • County Governments • Ministry of Energy and Petroleum • WRA • Ministry of Mining	Short

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Loss of Cultural Heritage	Major (negative)	• The presence of cultural heritage should be considered as part of the site selection process for all potential developments in the NEC and a framework for the site selection process should be included in the Plan as part of a Cultural Heritage Management Plan. • Incorporation of heritage sites into tourism master plans as a way of preserving such sites • Confirm presence of heritage assets through detailed studies • ESIAs to include consideration of cultural heritage and the development of appropriate mitigation and management plans. • In terms of locally important cultural heritage sites, any loss or alteration to such sites should be consulted on, and agreed, with the local communities and the custodians of the site. If necessary, appropriate rituals should be undertaken to move the cultural asset, or to otherwise expiate disturbance or loss of the site	• Development of a cultural heritage management plan including a chance finds procedure • ESIAs (developed to World Bank/IFC environmental and social standards) including consideration of cultural heritage. • Reports detailing approach to managing locally important cultural heritage and agreements with the owners of these sites over change in use.	• NMK • MoTI • NEMA • Project Developers • County Government	Long term

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Impact on Livelihoods	Major (negative)	• Conduct ESIA that include consideration of livelihood impacts • Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation	• LRP/RAP conducted • Number of ESIA that include livelihood impacts	• NEMA • Ministry of Lands • County Governments	Long term
Rural-Urban Migration	Major (negative)	• Conduct ESIA that include consideration of rural-urban migration • Ensuring that rural-urban migration is updated in County Integrated Development Plans (CIDP) as well as Urban Master Plans.	• % increase in number of young people living and working in rural areas • High urban population • Number of ESIA that include rural-migration impacts	• County Governments • NEMA	Long term
Public Health	Minor (negative)	• Conduct ESIA that include consideration of health impacts • Develop and implementation of HIV/AIDS/malaria policies and information documents for all workers directly related NEC projects • Working in conjunction with relevant partners (eg health authorities, NGOs, development agencies), information, education and communication campaigns around diseases and health practices should be developed as part of Plan, implementation.	• Number of ESIA that include health impacts • Number of NEC projects that have HIV/AIDS/malaria policies • Number of NEC projects that have worker code of conduct	• Ministry of Health • NEMA • County Government • Local NGOs and development agencies	Long term

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Insecurity	Minor (negative)	• Capacity building for security agencies	• Number of security workers trained and number equipment	• Ministry of Interior and Coordination of National Government.	Long term
Land Acquisition and Resettlement	Major (negative)	• Formulation and implementation of a land title management project to establish a land title database with cadastral map information, and • Arrangement of technical assistance for a land acquisition and resettlement program • Any physical or economic resettlement be subject to RAP/LRP • Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation • The budgeting process for any of the NEC initiatives must also include a budget for resettlement and compensation, as these costs can be quite significant.	• Number of RAP/LRP conducted within the NEC	• Ministry of Lands • MoT&I • County Government	Long term
Land Use and Settlement Patterns	Moderate (negative)	• Proper land use planning & appropriate settlement patterns within Urban Master Plans/CIDP • Avoidance of conservation areas, national parks, wetlands, protected areas	• Land use land cover change and change in settlement patterns	• County government • Ministry of Lands	Long term
Urbanisation	Moderate	• Modification of urban development process through zoning and urban planning	• Rapid urbanisation, urban sprawl and urban decay	• County/National Government	Medium term

Impact	Impact Significance	SEA Mitigation Measure	Key Indicator	Institutions Involved	Approximate timeframe (short, medium, long term)
Land Tenure	Minor	• Proper assignment of land rights	• Change in ownership rights of land • Formulation and implementation of a land title management project to establish a land title database with cadastral map information • Resettlement Action Plans/ Livelihood Restoration Plans should be prepared in line with national regulations and international best practice (e.g. the World Bank or International Finance Corporation) for all resettlement activities, without exception.	• Ministry of Land • County Government	Medium term

11.3 ORGANISATIONAL AND POLICY STRATEGY

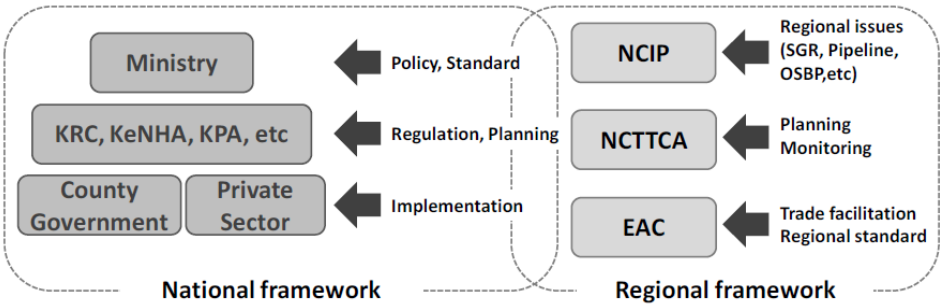
11.3.1 Regional Coordination for Logistics Improvement

As per JST's (2016) recommendation, the organisational and regulatory framework for logistics and multi-modal transportation needs to be established at the regional level.

So far, regional coordination for planning and monitoring of the NEC in both Kenya and Uganda has been carried out by the Northern Corridor Transit and Transport Coordination Authority (NCTTCA), while regional coordination mechanisms and private sector involvement has been developed through the Northern Corridor Integration Projects (NCIP).

Figure 11.1 below illustrates a potential national and regional institutional framework for both logistics promotion and multimodal transport.

Figure 11.1 Proposed Institutional Framework for Logistics Promotion and Multimodal Transport



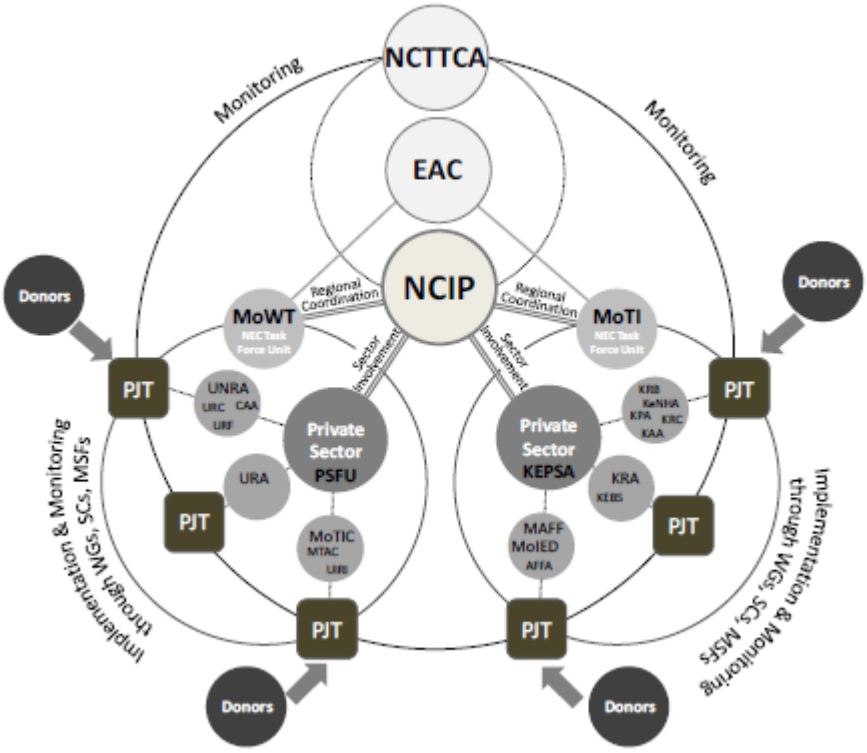
Source: JST 2016

11.3.2 Proposed Organisational Framework

If the Master Plan is approves and implementation commences, there must be a monitoring and evaluation mechanism. JST (2016) recommend that under the initiative of MoTI, a taskforce be established to cover the various ministries and agencies in charge of transport, finance, trade, industry, agriculture, mining, energy, water as well as the private sector and NCTTCA. It is recommended that the taskforce be maintained after the JICA study as a further monitoring and implementation mechanism (see *Figure 11.2*).

It is however recommended, that for this taskforce to be effective, it would have to be bestowed with an appropriate mandate, be sufficiently funded, supported by technical staff and should comprise of key policy makers from the respective sectors.

Figure 11.2 Proposed Organisational Structure



Source: JST 2016

11.3.3 Inter-Governmental Coordination (Local, Regional and National Level)

Intra-governmental coordination (i.e. between different levels of government) will be hampered in the absence of the appropriate coordination mechanisms.
To that end, the various countries traversed by the NEC will have to cooperate with the National Government and, the National Government in turn would have to cooperate with other national governments in the region such as Uganda, Rwanda, Southern Sudan and DRC.

Future County Integrated Development Plans (CIDP) would have to be harmonized with that of NEC Master Plan goals and objectives, while the Master Plan goals and objectives would have to be sensitive to

national policies and plans of Counties expected to use the NEC for their exports and imports.

Consequently two additional mechanisms to the national inter-sectorial coordination agency would have to be put in place: one at county and the other at regional levels to coordinate implementation of Master Plan.

12 CONCLUSION AND RECOMMENDATIONS

12.1 INTRODUCTION

This SEA Report is an independent assessment submitted to the National Environment Management Authority (NEMA), to enable the Authority to make an informed decision in accordance with the Environmental Management and Coordination Act, 1999 (EMCA) as well as the National Guidelines for SEA in Kenya (2012).

Through the SEA process, which included various stakeholder input, ERM has identified and assessed a number of potential impacts relating to the NEC Master Plan. This *Chapter* therefore provides an overview of the SEA findings and makes recommendations regarding key mitigation measures.

The potential impacts associated with the Master Plan are summarised below and should be considered both in the context of the Master Plan rationale as well as in the discussion of cumulative impacts.

12.2 CONCLUSION

12.2.1 *Environmental and Social Sensitive Features*

This SEA study identifies environmental and social sensitive features as constraints and classed them into three categories, representative of their sensitivity or mitigation requirement. These are low, moderate and high constraints in order of increasing sensitivity. *Table 12.1* and *Table 12.2* provide a summary listing of the specific features comprising each environmental and socio-economic constraint category respectively.

Table 12.1 Summary of Environmental Constraints

Subject	Low	Moderate	High
Physical	• Faults • Mountains and Extinct/Inactive Volcanoes • Seismic Zones/Epicentres of Past Earthquakes	• Active Volcanoes • Lakes • Flood Prone Areas (Flood plains) • Soil Erosion Prone Areas	• Rift Valley Crossings • Water production areas • Rivers • Groundwater Conservation Areas
Biological	• Private Reserves and Ranches • Community Conservancies • Endemic Bird Areas • Eastern Afromontane Biodiversity Hotspots Terrestrial Key Biodiversity Areas (Mau Narok-Molo Grasslands and Kinangop Grasslands) • Transboundary Resources (Lake Victoria Catchment and The Western Indian Ocean)	• Wetlands • National Parks (Chyulu Hills, Longonot, Ol Doinyo Sabuk and Tsavo East) • National Reserves (Ngai Ndethya Game Reserve, Kakamega and Kerio Valley) • Marine National Reserves • Wildlife Sanctuary (Mwaluganje Elephant Sanctuary) • Forest Reserves (Coastal Zone (East African Coastal Forests), Eastern Region, North Rift Valley and Western Region Forests) • Nature Reserves	• Ramsar Sites • UNESCO World Heritage Sites • UNESCO Man and Biosphere Reserves • National Parks (Aberdares, Hell's Gate, Lake Nakuru, Mount Elgon, Nairobi and Tsavo West) • National Reserves (Shimba Hills and Lake Bogoria) • Marine National Parks • Wildlife Sanctuaries (Taita Hills Wildlife Sanctuary and Ngulia Rhino Sanctuary) • Forest Reserves (Nairobi Region, Kikuyu Escarpment, Aberdares Ecosystem, Mau Escarpment (Mau Forest Complex) and Cherangani Hills Forests) • Important Bird Areas • Alliance for Zero Extinction Sites • Eastern Afromontane Biodiversity Hotspot Terrestrial Key Biodiversity Areas (Lake Bogoria NR, Aberdare Mountains, Kikuyu Escarpment Forest, Mau Forest Complex, Taita

Subject	Low	Moderate	High
		• Locally Managed Marine Areas • Eastern Afromontane Biodiversity Hotspot Terrestrial Key Biodiversity Areas (Mukurweini Valleys) • Eastern Afromontane Biodiversity Hotspot Biodiversity Corridors • Sandy Beaches	Hills Forests, Cherangani Hills, South Nandi Forest, Lake Ol' Bolossat, Chyulu Hills and Mount Elgon (Kenya)) • Eastern Afromontane Biodiversity Hotspots Freshwater Key Biodiversity Areas • Mangrove Forests • Coral Reef • Sea Turtle Nesting Sites • Transboundary Resources (Mt Elgon Ecosystem, Sio-Siteko Wetland and Tsavo West-Mkomazi Ecosystem)

Table 12.2 Summary of Social Constraints

Subject	Low	Medium	High
Social	-	• Rural areas are deprived of labour in agricultural sector leading to decline or slow growth of agricultural output; and families and cultural bonds break or weaken as the population moves to the urban areas, and • As the population moves to the urban areas, unemployment increases, crime rates rise, slums or shanties develop and social services become inadequate.	• Public health issues include: poor access to primary health care, high mortality rates, the prevalence of communicable disease in the country and low staffing of doctors and nurses • There has been a surge of terrorist attacks in Eastern Africa. A secure transportation system is critical to overall national security from terrorism. There are also instances where intermittent insecurity, conflicts and tensions occur thereby threatening movement of cargo
Cultural	-	-	• Along the NEC there are a number of archaeological sites that have to be preserved. Development of the NEC transport infrastructure is likely to disturb or disrupt these.

Subject	Low	Medium	High
Economic	• Implementation of the Development Strategies requires a lot of funds which Kenya may not have or have in limited amounts. Even when funds are available, the Government would have to prioritize its expenditure among competing interests. Funding can limit the Government to spend money on big infrastructure projects. • The implementation of government major projects and programs largely depends on the political willingness of the government of the day. There are many experiences in Kenya where good plans have been shelved or postponed or overtaken by time for lack of political will. This is because prioritizing of national projects is not only economic but also a political decision • The successful implementation of the NEC Master Plan Strategies will require the active participation of other government agencies that	• Not all regions within the NEC produce adequate cargo necessary to sustain the transport infrastructure. The undeveloped areas need to be developed before they can produce goods for handling by the transport modes. Developing underdeveloped regions requires a lot of resources to be dedicated to these regions before they may be able to produce more goods • Recent experiences show that Kenya's economic growth rate has been fluctuating, giving the impression that economic growth is not steadily occurring. In situations where the actual economic growth rates fall below the planned rates (at an average annual growth rate of 6.6%) as envisaged by the Master Plan, implementation of the development strategies would be slowed down, delayed, or even frustrated	• Corruption will thus adversely affect implementation of the strategies by making infrastructure project expensive, delay or, even fail. A country suffering from corruption cannot implement sound plans and thus is not expected to benefit from sustainable development despite embarking upon economic growth from time to time for some reason or the other.

Subject	Low	Medium	High
Urban/Physical Planning	-	• Urbanization will encourage rapid inflows of rural populations to urban areas that give rise to housing problems and the development of slums. An increase in urban areas will therefore put pressure on existing water and sanitation facilities and potentially result in environmental pollution, as well as increased unemployment in urban areas • Implementing the Master Plan Development Strategies could result in land use conflicts. • Use of certain areas/parcels of land to implement the Development Strategies will need trade-off with other existing and potential uses e.g. developing transport infrastructure in certain sections of the NEC would require converting agricultural and conservation land for such a purpose. • In sections where conversions are resisted, land use conflicts and litigations may occur which	• Resettlement and compensation will be highest in Nairobi and Mombasa Counties and speculation may drive the land prices even higher

12.2.2 Key Impacts and Mitigation Measures

Table 12.3 below provides a summary of the key environmental and social impacts as well as mitigation measures identified during the SEA Study.

Table 12.3 Key Environmental and Social Impacts and Mitigation Measures

Impacts	Mitigation Measure
Environmental	
Habitat Alteration and Biodiversity Impacts	• Avoiding Protected Areas, • Aligning new infrastructure with existing RoWs or defined corridors, • Limiting the size of construction RoWs where possible, and • Complying with existing land use and PA management plans
Air Emissions	• Complying with the Air Quality Regulations (2014) and emission standards as provided in KS 1515, • Using cleaner energy sources and promoting their use, • Limiting land conversion to only necessary areas, and • Managing wastes according to regulations in addition to employing the 3Rs to ensure they are managed sustainably.
Landscape Modification	• Locating infrastructure with existing land use plans, • Complying with ecosystem management plans of protected areas, • Limiting the size of construction RoWs, and • Avoiding protected areas and settlements
Soil	• Limiting excavations to only necessary areas, • Implementing soil conservation strategies in areas with high Soil Erosion Potential, • Complying with waste management regulations, • Complying with regulations and guidelines on soil conservation such as those provided by land use plan, ecosystem management plans and those gazetted by the Agriculture and Food Authority, and • Implementing run-off and water management measures
Hydrology and Hydrogeology	• Avoiding wetlands, water towers, groundwater conservation areas and flood plains, • Implementing water ingress management measures as appropriate, and • Controlling run-off from infrastructure and implementing sustainable drainage systems (SUDS) which mimic or allow natural percolation of water.

Impacts	Mitigation Measure
Pollution	• Developing complementary waste management facilities including a sanitary landfill and a hazardous waste disposal facility, • Integrating Life Cycle Assessments into the project level environmental risk management, • Managing wastes (collection, transport and disposal) in accordance to the provisions of the Waste Management Regulations (2006) and providing adequate equipment and facilities to do so, and • Integrating the 3Rs (Reduce, Reuse, Recycle) of waste management in NEC MP and at the project level.
Natural Resource Demand	• Integrating Life Cycle Assessment into the project level environmental risk management, • Complying with regulations governing resource extraction such as Forests Act (2005), EMCA (2014), Sand Harvesting Guidelines (2009), Water Resource Management Rules (2006) and Water Act (2014) amongst others, • Adopting sustainability standards at the project level such as those pertaining to green building and energy efficiency (LEED), • Ensuring building materials are sourced from sustainable sources, and • Implementing demand management and resource efficiency measures for water, electricity and materials.
Accidents	• Complying with industry guidelines and regulations in the design of infrastructure, • Implementing and supporting programs to ensure vehicles and crafts are maintained to regulatory approved standards, • Implementing and supporting programs that ensure drivers and pilots are adequately trained to operate their respective vehicles and crafts, • Implementing and supporting programs aimed at raising public awareness in the pertinent industries, and • Developing project level emergency/disaster preparedness and response plans.
Spills	• Developing project level emergency/disaster preparedness and response plans as well as spill contingency plans and providing resources to respond to spills, • Complying with the National Oil Spill Response Plan by integrating its provisions to any project level contingency plans,

Impacts	Mitigation Measure
	• Implementing and supporting monitoring programs at the project level, • Providing training to project staff on spill prevention and management, and • Adhering to industry guidelines on the design and maintenance of any fluid storage, loading and conveyance equipment and infrastructure.
Natural Hazard	• Avoiding construction in flood plains in line with industry guidelines, • Integrating considerations for seismicity in the engineering design of infrastructure in seismically active areas, • Complying with industry guidelines for the design and maintenance of dams such as those published by the International Commission for Large Dams (ICOLD), • Avoidance of fault zones, • Incorporating landslide prevention measures for any construction in landslide prone areas, • Implementing and supporting disaster/emergency preparedness and response plans and programs at the project level, • Implementing and supporting programs aimed at raising personnel and public awareness on potential hazards, and • Integrating the provisions of the National Disaster Response Plan into project level disaster/emergency preparedness and response plans, and coordinating with the pertinent authorities.
Socio-Economic	
Loss of Cultural Heritage	• The presence of cultural heritage assets would need to be confirmed in detailed studies associated with each potential project; this could influence the design and location of infrastructure, commercial enterprises and industrial facilities. • Incorporation of heritage sites into tourism master plans as a way of preserving such sites • Projects associated with the construction and operation of infrastructure should be subject to Environmental and Social Impact Assessment (ESIA) commensurate with the scale of the project and impacts which includes consideration of cultural heritage and the development of appropriate mitigation and management plans. • In terms of locally important cultural heritage sites, any loss or alteration to such sites should be consulted on, and agreed, with the local communities and the custodians of the

Impacts	Mitigation Measure
	site. If necessary, appropriate rituals should be undertaken to move the cultural asset, or to otherwise expiate disturbance or loss of the site. • A framework "chance finds procedure" should be developed to support the Master Plan which involves and references all relevant ministries, other agencies and major cultural heritage stakeholders in the country. The framework procedure should be deployed within the construction and management planning for all developments implemented under the auspices of the Plan.
Livelihood	• Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation
Rural Urban Migration	• Infrastructure projects should be subject to Environmental and Social Impact Assessment (ESIA) undertaken in line with international standards such as those of the World Bank or the International Finance Corporation (IFC). The scope of the ESIA should always include consideration of rural – urban migration. • Urban development plans / CIDP should also cater for rural-urban migration.
Public Health	• Infrastructure projects should be subject to Environmental and Social Impact Assessment (ESIA) undertaken in line with international standards such as those of the World Bank or the International Finance Corporation (IFC). The scope of the ESIA should always include consideration of health related impacts. For large Projects this may require that appropriately qualified international experts are appointed to address impacts on health. • The development and implementation of HIV/AIDS/malaria policies and information documents for all workers directly related NEC projects. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS as well as malaria. • All projects should have a Worker Code of Conduct for all project personnel that include guidelines on worker-worker interactions, worker-community interactions and development of personal relationships with members of the local communities. As part of the Worker Code of Conduct, all project personnel should be prohibited from engaging in illegal activities including the use of commercial sex workers and transactional sex. Anyone caught engaging in illegal activities will be subject to disciplinary proceedings. If

Impacts	Mitigation Measure
	workers are found to be in contravention of the Code of Conduct, which they will be required to sign at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. • Working in conjunction with relevant partners (eg health authorities, NGOs, development agencies), information, education and communication campaigns around diseases and health practices should be developed as part of the Master Plan implementation
Insecurity	• The successful implementation of the NEC Master Plan Strategies will require the active participation of the Ministry of Interior and Coordination of National Government.
Land Acquisition and resettlement	• Formulation and implementation of a land title management project to establish a land title database with cadastral map information, and • Arrangement of technical assistance for a land acquisition and resettlement program • Any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation. • Institutional strengthening and capacity building for agencies across the NEC who are responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation • The budgeting process for any of the NEC initiatives must also include a budget for resettlement and compensation, as these costs can be quite significant.
Land use and settlement pattern	• Institutions responsible for land use plans should ensure that they contain measures relating to infrastructure provision that are robust and fit for purpose, with a focus on the poorest and most vulnerable communities • Avoidance of conservation areas, national parks, wetlands, protected areas
Urbanisation	• Any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation. • Institutional strengthening and capacity building for agencies across the NEC who are

Impacts	Mitigation Measure
	responsible for promoting and coordinating commercial developments to ensure that social risks are adequately understood and addressed through mitigation • Regional and/or County Integrated Development Plans (CIDP) to plan for such urbanisation
Land tenure	• Formulation and implementation of a land title management project to establish a land title database with cadastral map information.

12.3 RECOMMENDATIONS

12.3.1 Recommended PPP Changes

Intra-governmental coordination for the implementation of the NEC (i.e. between different levels of government) will be hampered in the absence of the appropriate coordination mechanisms.

To that end, the various countries traversed by the NEC will have to cooperate with the National Government and, the National Government in turn would have to cooperate with other national governments in the region such as Uganda, Rwanda, Southern Sudan and DRC.

Future County Integrated Development Plans (CIDP) would have to be harmonized with that of NEC Master Plan goals and objectives, while the Master Plan goals and objectives would have to be sensitive to national policies and plans of Counties expected to use the NEC for their exports and imports.

Consequently two additional mechanisms to the national inter-sectorial coordination agency would have to be put in place: one at county and the other at regional levels to coordinate implementation of Master Plan.

12.3.2 Recommended Alternatives(s)

As discussed in *Chapter 7*, the *Multi-Core with Regional Industrial Development Type* alternative aims at balanced growth and efficient logistics in the NEC region by promoting urban functions of 18 Secondary Cites, including 6 Secondary cum Regional Production Centres (see *Figure 12.1*).

This alternative promotes:

- decentralizing urban functions to Secondary Cities,
- the urbanization of Secondary Cities and the concentration of population on them from surrounding regions,
- regional production centres, as demand for commercial and services in urban area (which results from surrounding regional area) will promote the demand of Secondary Cities.

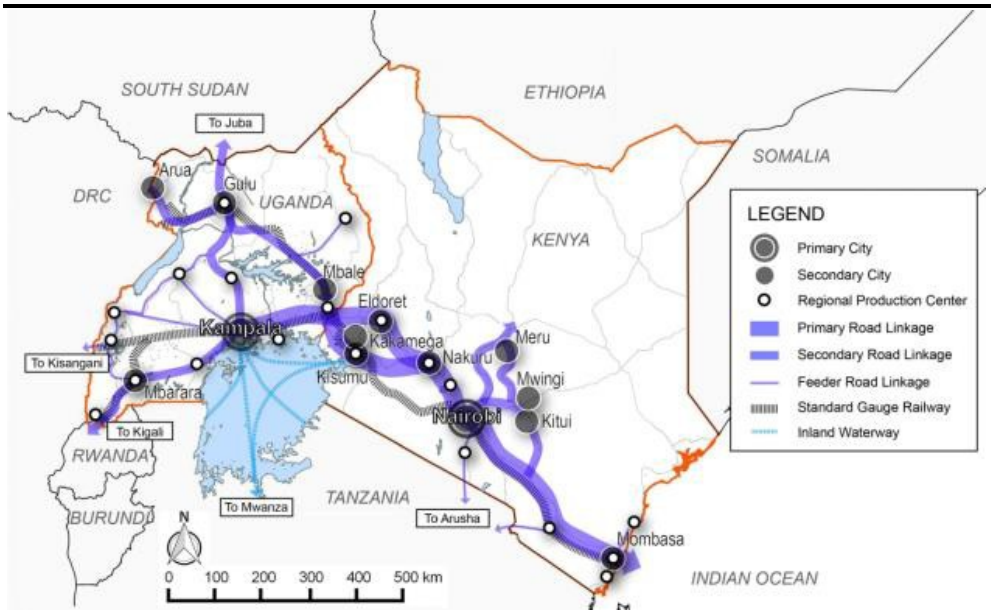
These Secondary Cities will serve as regional urban centres supplying urban services and logistics hub connecting Regional Production

Centres and Primary Cities as consumption areas. In this alternative, the involvement of local Government is also essential.

It is important to note however, this structure plan requires more public engagement and management capacity for urban management and development control to avoid unnecessary development.

This is the preferred alternative because it is consistent with Vision 2030, the MoTI Strategic Plan and the goals of the Master Plan, which are to improve logistics for the NEC as well as provide an integrated regional development strategy consistent with sub-regional development plans and national development plans.

Figure 12.1 Alternative C: Multi-Core with Regional Industrial Development Type



Source: JST, 2016

12.3.3 *Subsequent Environmental and Social Impact Assessment for NEC Projects*

JST has proposed 119 projects for the development of the NEC (see Annex C) in both Kenya and Uganda. The potential impacts of these projects have been discussed in Chapters 9 and 10 of this Report, and are within the following sectors:

- road
- railway
- border posts
- port, airport, and inland way
- logistic hub

- oil and mining
- agriculture and fishery
- manufacturing
- power
- water

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

- identify all potentially project-specific significant adverse environmental and social impacts of the project and recommend measures for mitigation;

- gather baseline data to inform the assessment of impacts and to monitor changes to the environment as a result of each of the projects as well as evaluate the success of the mitigation measures implemented; and

- recommend measures to be used to avoid or reduce the anticipated negative impacts and enhance the positive impacts.

For each project the ESIA should be carried out in line with Kenyan regulations as well as international best practice as defined by the World Bank or International Finance Corporation (IFC).

The ESIA reports should also consider environmental impacts and also include the following socio-economic impacts, where possible:

- cultural heritage,
- loss of livelihoods,
- health, and
- rural – urban migration

It is also recommended that any physical and/or economic resettlement of communities should be subject to the development of Resettlement Action Plans/ Livelihood Restoration Plans which should be prepared in line with Kenyan regulations and international best practice as defined by the World Bank or International Finance Corporation

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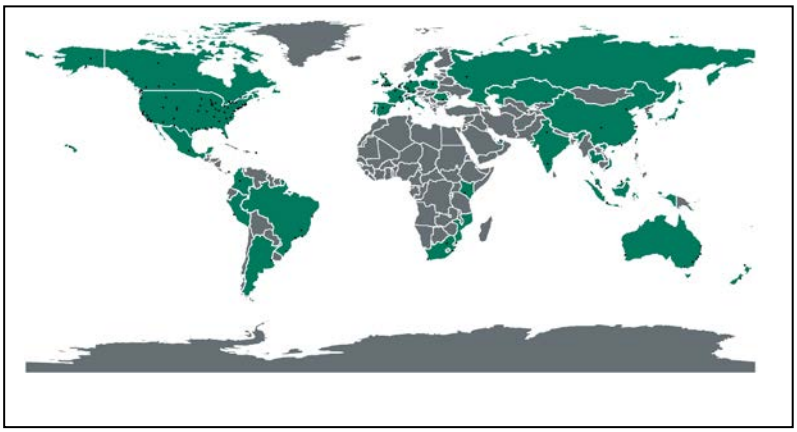

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