ENVIRONMENTAL IMPACT ASSESSMENT PROJECT REPORT

FOR

THE PROPOSED OIL AND GAS SEISMIC SURVEY PROJECT IN BLOCK 10BA: TURKANA CENTRAL, TURKANA NORTH, LOYANGALANI AND NORTH HORR DISTRICTS BY TULLOW KENYA B.V.

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JUNE 2011

PROJECT REPORT

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Submitted by ..... MARTIN MBUGO

Position ..... GENERAL MANAGER

Signed .....

Date 20.06.2011

We the undersigned, confirm that the contents of this report are a true representation of the Environmental Impact Assessment Project Report of the proposed oil and gas seismic survey project in Block 10BA Turkana Central, Turkana North, Loyangalani and North Horr Districts by Tullow Kenya B. V.

Prof. Norbert Opiyo-Akech
(Team Leader and Director)

Sign.....

Date..... 20/6/2011

Dr. Daniel Olago
(Lead Expert and Director)

Sign.....

Date..... 20/6/2011

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

EXECUTIVE SUMMARY

Tullow Kenya B.V. (TKBV) holds an Exclusive Prospecting Right (EPR) over Block 10BA, which covers parts of Turkana Central and Turkana North districts (western side of lake Turkana), and Loiyangalani and North Horr (eastern side of Lake Turkana), as well as the northern and central basins of the lake. The main objective is to study in detail the assigned area of 16204.55 km^2, in accordance with the contractual obligations under the Production Sharing Agreement (PSC) signed with the Kenya Government on 17th September 2008 in order to delineate potential hydrocarbon prospects. This Environmental Impact Assessment Project Report has been prepared for TKBV, in accordance with the objectives established by the Environmental Management and Coordination Act (EMCA) of 1999, and subsequent related regulations.

Tullow Oil, a FTSE100 company, is one of the largest independent oil and gas exploration and production companies. Seismic surveys are a primary tool utilized during the exploration of hydrocarbons in both onshore (land) and offshore (marine or lake) areas. A seismic survey is conducted by creating an energy wave commonly referred to as a 'seismic wave' on the surface of the ground or in water along a predetermined line, using an energy source. This wave travels into and through the earth strata, where it is reflected and refracted by various subsurface formations, and returns to the surface where receivers called geophones are used to detect the waves and convey them to a recorder for analysis. Seismic waves can be induced by the following methods: small explosive charges, primarily dynamite, set off in shallow holes known as 'shot holes'; large 'Vibroseis' trucks equipped with heavy plates that vibrate on the ground; or use of compressed point-source air pulses (commonly referred to as 'airguns') in water settings. By analyzing the time it takes for the seismic waves to reflect off subsurface formations and return to the surface, formations can be mapped and potential oil or gas deposits identified. Block 10BA encompasses both land (onshore) and lake (offshore – Lake Turkana) settings.

Undertaking the seismic survey is justified by a number of factors. Following the discovery of hydrocarbons in the South Sudan rifts and, more recently, by Tullow Oil and Heritage Oil in Uganda within the western branch of the East African Rift, several oil companies have intensified exploration efforts in the related Mesozoic and Early Tertiary rift basins of Kenya with a view to meeting the global, regional and local demand for energy. This project, if successful would play a major role in enabling the country to reduce the cost of energy and over-reliance on hydroelectric power and crude oil imports, as well as benefit from oil and gas exportation to other countries, thus increasing the per capita income and the GDP from foreign exchange. Other possible spin-offs would include: opening up of the northern frontier districts in Kenya to development activities and trade in sectors such as mining, tourism, fishing, agriculture, and animal husbandry which are currently extremely under-exploited; job creation; and increased economic activity in the area.

The detailed field-based environmental impact assessment study, which was preceded by extensive desk top studies, was undertaken from 4th to 13th March and 13th to 20th April. The biophysical studies included, amongst others, an assessment of the surface geology and geomorphology, soils, hydrogeology and water resources, climate, hydrology, terrestrial flora and fauna and their habitats. The socio-economic study covered issues such as population and economic activities, education, social amenities

(healthcare and schools), cultures and traditions, infrastructure and communications. The legislative and regulatory framework, has also been extensively explored in this report. The public consultations were extensive, and included formal and informal meetings with key interested and affected persons and groups (e.g. officials of governmental and non-governmental agencies, community leaders, Community Based Organisations, Women and Youth groups), public barazas, and open-air "market" meetings, as well as completion of questionnaires by a sample of local households. The information gathered provides detail for the current environmental and socio-economic baseline situation and is a critical component for development of the Environmental Management Plan.

The potential environmental and social impacts, and for which clear, achievable, and effective mitigation measures have been suggested in this report, include:

- Noise and vibrations from vibroseis machines, dynamite charges, and compressed air pulses in water;
- Disturbance to terrestrial,aquatic habitats, flora and fauna along survey line transects;
- Dust generation and exhaust emissions by vehicles and equipment;
- Waste generation at camp sites and other work areas;
- Disturbance to livelihood activities during data acquisition along survey lines; and
- Interference with sensitive cultural, natural heritage and archaeological sites.

Both the field survey and documentation reveal the following already existing pressures on the environment and social fabric: land degradation that has resulted in heavy silt loading in the rivers and lake, soil compaction by grazing animals; active wind and water erosion; more frequently recurring droughts that are related to global climate changes; dust generated by moderate to strong winds and enhanced by low vegetation cover; pollution of rivers, water pans and shallow groundwater in luggas from humans and livestock; high demand for potable groundwater; and, land degradation due to overgrazing and charcoal burning. The communities lack adequate provision of basic services such as education, health care and security. While the communities are fairly stable, their security situation is compromised by sporadic but often deadly cattle rustling. Conflicts also occur from time to time in relation to access to natural resources such as water and grazing lands.

Due to the nature, scale and short time duration of the proposed seismic survey, the impacts would by and large be temporary and/or transient, rather than long-term and/or permanent. A number of seismic surveys have already been conducted in the region and other areas of Kenya, and no adverse or long-lasting impacts have been reported from these activities. The measures proposed to mitigate these environmental and social impacts detailed in the Environmental Management Plan within this report are considered adequate and effective in safeguarding the environmental and social fabric of the area, and should be strictly adhered to.

The community members and leaders who attended the various public meetings and participated in the questionnaire survey welcomed the proposed project, but appealed for adherence to environmental safeguards and labour legislation. TKBV (as outlined in its EHS [Environmental, Health and Safety] and CSR [Corporate Social Responsibility] Policies) is committed to environmental protection at the highest level, continual

engagement of local stakeholders throughout the duration of the project, and to being sensitive to local culture and customs, and would want to be seen as a valued part of the communities in the project area.

CHAPTER 1:

INTRODUCTION

1.1 INTRODUCTION

This environmental impact assessment (EIA) project report presents baseline biophysical and socio-economic information, project mitigation measures, and an environmental management and monitoring plan for a proposed land and marine seismic data acquisition programme for identification of potential oil and gas deposits in the National Oil Corporation of Kenya (NOCK, 1987) exploration Block 10BA, which includes the central and northern basins of Lake Turkana and part of its watershed area (Figure 1.1). This is done in accordance with the requirements of Kenya's Environmental Management and Coordination Act of 1999 and subsidiary legislation, and in fulfilment of the more general requirement that projects maintain a clean, sustained and healthy environment. The project proponent is Tullow Kenya B.V. (TKBV). This EIA project report has been prepared by Earthview Geoconsultants for TKBV, and has aimed at establishing and mitigating the potential impacts of the proposed seismic survey operations in Block 10BA (Figure 1.1), which covers parts of Turkana Central and Turkana North Districts on the western side of Lake Turkana, and Loyangalani and North Horr Districts on the eastern side of the Lake.

1.2 DEVELOPER IDENTIFICATION

This EIA is carried out for TKBV (Pin P051340553U), a subsidiary company of Tullow Oil PLC, with respect to the proposed seismic survey in Block 10BA.

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Ground Floor Acacia House Westlands Office Park Waiyaki Way Nairobi	Mr. Martin Mbogo General Manager Tullow Kenya B.V. P.O. Box 63298-00619 Nairobi Kenya

Africa Oil Corporation is the development partner. TKBV will engage an internationally experienced seismic acquisition geophysical company that will use suitable state-of-the-art technology to execute the seismic program in Block 10BA.

1.3 ACTIVITIES OF TULLOW OIL PLC: AN OVERVIEW

Tullow Oil PLC is one of the largest independent oil and gas exploration companies, and is a FTSE100 company. The Group has over 80 licences in more than 20 countries, with operations in Africa, Europe, South Asia and South America.

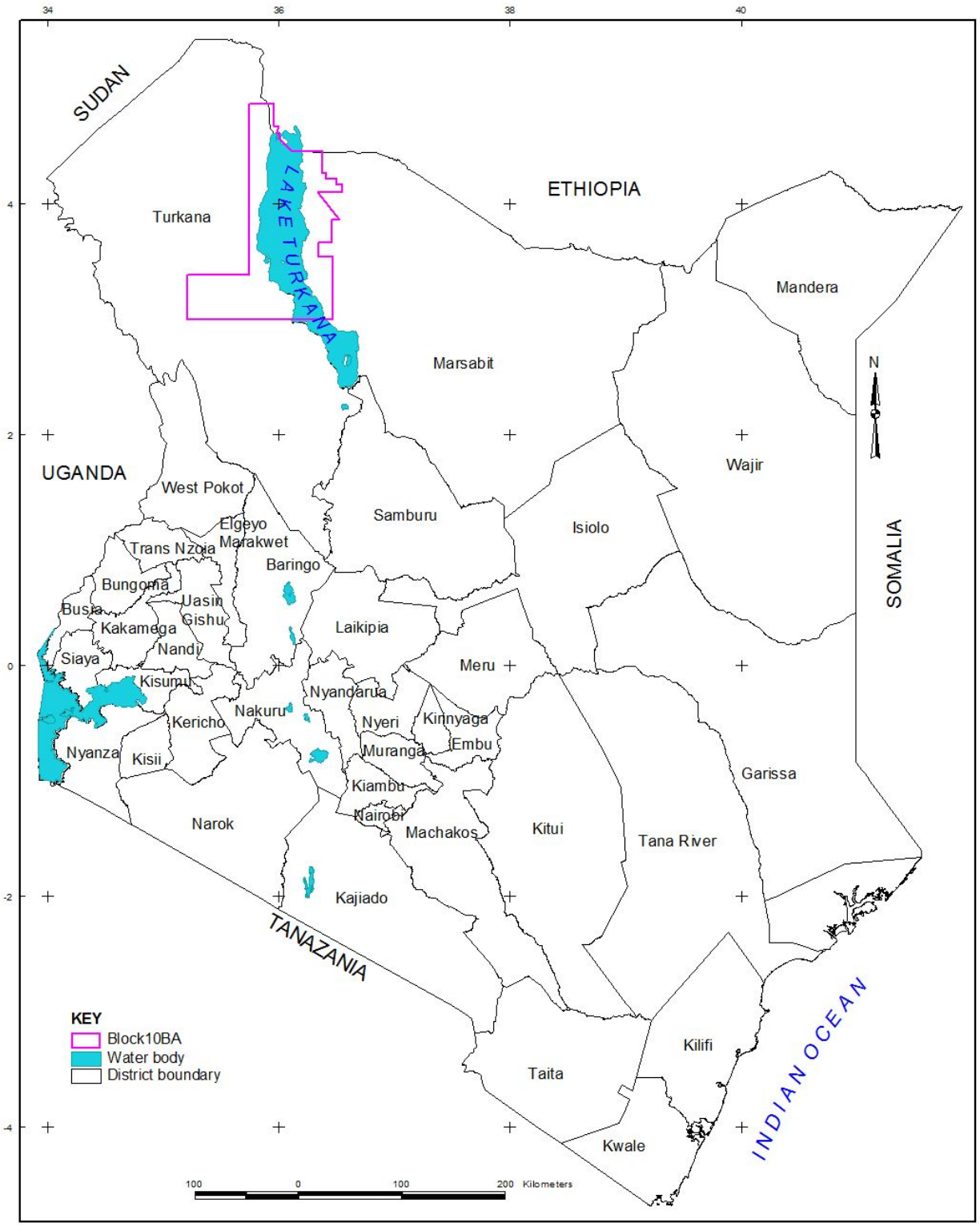


Figure 1.1: Location map of the project area.

1.4 BRIEF REGIONAL DESCRIPTION

The National Oil Corporation of Kenya (NOCK) has identified potential petroleum exploration regions in Kenya and demarcated them into blocks. The project area, classified as Block 10BA by NOCK, covers parts of Turkana Central and Turkana North districts (western side of lake Turkana), and Loyangalani and North Horr (eastern side of Lake Turkana), as well as the northern and central basins of the lake. Lake Turkana lies within a broad depression known as the Turkana depression, between the Kenya and Ethiopia domes in that part of the East African Rift known as the Kenya Rift. The Kenya Rift, which is topographically well-defined throughout most of Kenya, splays out into a broader, less distinct zone of rifting within the vicinity of the lake area. The Turkana Depression has generally been regarded as a diffuse zone of faulting, linking the rift segments to the north and to the south (Dunkelman *et al.*, 1988).

The area is semi-arid: the mean annual temperature is 30°C, mean annual rainfall is below 255mm/yr, and the evaporation rate (Class A pan) is about 3.6m per year. There are two rainfall seasons: from March to June, with a peak in April, and from October to December, with a peak in November or December. For most of the year an easterly wind prevails and is particularly strong near the lakeshore, rising after sunset and blowing steadily until the following noon, when it is usually followed by several hours of dead calm. Grassy plains with yellow spear grass and *Commiphera* and *Acacia* sp. characterise the vegetation of the region. Acacia thorn scrubs grow around the lake, while relatively larger acacia trees grow along the river and lugga courses.

The fairly high alkali content of the lake's waters greatly limits the range of species of vegetation. Galleries of forest occur along the affluent watercourses, being characterised by *Acacia elatior, Balanites aegyptiaca* and *Hyphaene coriacea* (Hughes and Hughes, 1992). *Salvadora persica* forms a bushland on Central and South Islands (Hughes and Hughes, 1992). The fairly high alkali content of the lake's waters greatly limits the range of species of macrophytic and littoral vegetation. The principal emergent macrophytes are the grasses *Paspalidium germinatum* and *Sporobolus spicatus* which cover the seasonally exposed shallows, and provide important nurseries for fish (Hughes and Hughes, 1992). There are extensive *Potamogeton* beds in the shallow bays (Hughes and Hughes, 1992). The dominant phytoplantkon are the blue-green alga *Microcystis ceruginosa* and the green alga *Botryococcus braunii*, while in Ferguson's Gulf *Anabaenopsis arnoldii* (blue-green alga) is dominant (Kallqvist et al., 1988). The development of phytoplankton is limited by the availability of nitrate and light (WLD); light limitation is caused by turbid water and vertical mixing. The zooplankton is dominated by protozoans in terms of numbers, but by crustaceans in terms of biomass (Hughes and Hughes, 1992). Lake Turkana has a nilotic riverine fauna (Lowe-McConnell, 1995). Some 48 species of fish have been identified in the lake, of which 30 are widespread Sudanian types, 8 have restricted distributions and 10 are endemic (Hughes and Hughes, 1992). 36 occur in the lake and 10 are confined to the inflowing Omo River (Lowe-McConnell, 1995).

The area is thinly populated, with Turkana tribesmen to the west and Gava tribesmen to the east of the Lake respectively. They are mostly nomadic pastoralists, but a few are fishermen. They obtain their water from Lake Turkana and the surrounding seasonal rivers. The Turkana region is classified as one of the poorest regions in Kenya, and investment levels and employment opportunities are very low. Food consumption levels are well below the UNICEF minimum of 2000 calories per day. There is a tarmacked but degraded access road from the major towns in the south to Lodwar, the largest of the district headquarters in the region. The Turkana area itself has very few roads, where they do exist they are of poor quality.

Telecommunication facilities are limited, cell phone coverage being centred around the larger villages and towns Lodwar has a well-maintained airstrip with a regular commercial flight schedule that connects the town with Nairobi, Kenya's capital city.

1.5 PROJECT BACKGROUND, OVERVIEW, JUSTIFICATION AND OBJECTIVES

1.5.1 Project Background

Tullow Oil PLC is an international oil and gas exploration company with interests in exploration licences in many parts of the African continent including Kenya, Uganda and Ghana.

A Production Sharing Contract (PSC) with the Government of Kenya was signed on 17th September 2008, and an Exclusive Prospecting Right (EPR) over Block 10BA was obtained. TKBV's main aim and objective over the years will be to explore in detail the assigned block area of 16204.55 km^2, in accordance with its contractual obligations under the PSC, in order to: (a) delineate potential hydrocarbon prospects, (b) carry out exploratory drilling within the identified potential prospect areas, and (c) carry out well appraisal and production of oil and/or gas if the prospects turn out to be economically viable. TKBV is committed to ensuring that the activities that will be carried out to achieve the stated objectives will be done in a manner that is not detrimental to the natural environment or the local communities in the area.

1.5.2 Overview of the Project

The project is an exploratory activity for determination of potential oil and gas resources in the assigned area (Block 10BA), and is commonly referred to, in the Oil and Gas Industry parlance, as a "seismic survey". A seismic survey is conducted by creating an acoustic energy wave (commonly referred to as a 'seismic wave') using an energy source placed on or close to the surface of the ground or in water along a predetermined line (seismic survey line, or transect). This wave travels into and through the earth strata, where it is reflected and refracted by various subsurface formations, and returns to the surface where receivers called geophones (or hydrophones, in water) are used to detect the waves and convey them to a recorder for analysis. By analyzing the time it takes for the seismic waves to reflect off subsurface formations and return to the surface, formations can be mapped and potential oil or gas deposits identified. The seismic waves can be induced using three types of energy sources: (i) dynamite charges that are set off in shallow (5 to 20m deep) holes (known as 'shot holes'); (ii) 'Vibroseis' trucks that are equipped with heavy plates that vibrate on the ground, and (iii) compressed air systems that release rapid bursts of air (commonly known as airguns) in water bodies.

1534 km of 2D seismic data (onshore and lake; see Appendix 1) will be acquired over a projected time period of up to 6 months, beginning around August/September 2011. The workforce that will be required to carry out the survey will be between 100 and 150 in number. Line clearance along the pre-determined and pre-surveyed transects on land will be done by use of mulchers and light hand-cutting tools, and where access roads are required, by bulldozers. Support vehicles such as for personnel movement, carrying of data recording equipment, etc., will be available. For the lake survey, the boat specifications, operations and safety requirements shall conform to the International Association of Oil and Gas Producers (OGP) guidelines for watercraft and water in geophysical exploration.

The workforce will reside in a base camp that will be constructed by a professional civil and building contractor with experience in setting up such camps. Issues such as camp security, provision of basic services (e.g. accommodation, water, sanitation, lighting, and health care), waste management, materials storage areas, etc., shall be incorporated in the camp design. The camp will be sited at least 20 km away from existing settlements, and its location shall be determined in consultation with the local community leaders. The health and safety of the crew and the general public at large will be ensured by the company complying both with the relevant national legislation, and its own in-house environmental health and safety (EHS) policies which embrace the international best practices for such activities. An emergency response plan will be put in place in case of any accidents. A close working relationship will be fostered with the local communities, and as far as is practicable, unskilled and semi-skilled workers shall be recruited locally.

1.5.3 Project Justification

Following the discovery of hydrocarbons in the Muglad and Melut basins of the South Sudan rifts and, more recently, by Tullow Oil and Heritage Oil in Uganda within the western branch of the East African Rift, several oil companies have intensified exploration efforts in the related Mesozoic and Early Tertiary rift basins of Kenya with a view to meeting the global, regional and local demand for energy.

Energy is an important factor in socio-economic development (GVEP Kenya, 2006). The international community is today confronted with the daunting task of reducing poverty and achieving sustained economic growth and development for the benefit of all. The provision of adequate, quality, and affordable energy services can play a decisive role in poverty reduction (GVEP Kenya, 2006). To improve on the security of energy supply in Kenya, industries have had to invest in stand-by generators, which run on expensively imported diesel, thus pushing the cost of production even higher. The industry sector has thus been faced with costly energy supply, which has contributed to high industrial production costs. Thus, the availability of fossil fuels locally would significantly reduce the energy cost as well as production cost of industries.

This project, if successful would play a major role in enabling the country to reduce the cost of energy and over-reliance on hydroelectric power and crude oil imports, as well as benefit from oil and gas exportation to other countries, thus increasing the per capita income and the GDP from foreign exchange. Other possible spin-offs would include: opening up of the northern frontier districts in Kenya to development activities and trade in sectors such as mining, tourism, fishing, agriculture, and animal husbandry which are currently extremely under-exploited; job creation; and increased economic activity in the area. The project is in line with the objectives of the national Energy Policy (improving access to affordable energy services, enhancing security of supply, promoting development of indigenous energy resources; promoting energy efficiency and conservation; and promoting prudent environmental, health and safety practices); the Economic Recovery for Wealth and Employment Creation Strategy (expanding and improving infrastructures, developing arid and semi-arid lands, and safeguarding environment and natural resources); and Kenya Vision 2030 (enhanced equity and wealth creation for the poor in semi-arid and arid districts, must generate more energy at a lower cost and increase efficiency in energy consumption).

1.6 PURPOSE OF THE EIA

In Kenya, the primary authority that regulates the environment with respect to oil and gas exploration activities is the National Environment Management Authority (NEMA). Other key

national players and regulators in the oil and gas industry are: the Ministry of Environment and Mineral Resources, the Ministry of Energy, and the National Oil Corporation of Kenya. The country is also signatory to a number of international treaties and conventions related to environmental protection and conservation.

1.6.1 The Mandate of NEMA

NEMA is the institution that has been established under the Environment Management and Coordination Act (EMCA) of 1999 in order to deal with matters pertaining to the environment, with the object and purpose of exercising general supervision and co-ordination over all matters relating to the environment and to the principal instrument of government in the implementation of all policies relating to the environment. Some of its mandates that are relevant to EIAs are to:

- Co-ordinate the various environmental management activities being undertaken by the lead agencies and promote the integration of environmental considerations into development policies, plans, programmes and projects with a view to ensuring the proper management and rational utilisation of environmental resources on a sustainable yield basis for the improvement of the quality of human life in Kenya;
- Carry out surveys which will assist in the proper management and conservation of the environment;
- Undertake and co-ordinate research, investigation and surveys in the field of environment and collect, collate and disseminate information about the findings of such research investigation or survey;
- Identify projects and programmes or types of projects and programmes, plans and policies for which environmental audit or environmental monitoring must be conducted under the Act;
- Monitor and assess activities, including activities being carried out by relevant lead agencies, in order to ensure that the environment is not degraded by such activities, environmental management objectives are adhered to and adequate early warning on impending environmental emergencies is given;
- Undertake, in co-operation with relevant lead agencies programmes intended to enhance environmental education and public awareness about the need for sound environmental management as well as for enlisting public support and encouraging the effort made by other entities in that regard;
- Publish and disseminate manuals, codes or guidelines relating to environmental management and preventing or abatement of environmental degradation;
- Render advice and technical support, where possible, to entities engaged in natural resources management and environmental protection so as to enable them carry out their responsibility satisfactorily.

1.6.2 Requirements and Scope of Work for the EIA

A project report is defined, in the preliminary section of the EMCA (1999) and the interpretation section of the Environmental (Impact and Audit) Regulations (2003), as a summarized statement of the likely environmental effects of a proposed development referred to in section 58 of the Environmental Management and Co-ordination Act, 1999. Section 58 requires that a proponent intending to carry out any undertaking listed in the Second Schedule to the Act must submit a project report to the National Environmental Management Authority (‘the Authority’) in the prescribed form accompanied by the prescribed fee. The seismic survey project falls under Schedule 2, 6(j) “exploration for the production of petroleum in any form” of EMCA 1999.

Regulation 7 of the Environmental (Impact and Audit) Regulations, 2003 lays down the specific issues that the project report must address, which in summary are: the nature, location, activities, and design of the project; the materials that are to be used; the potential environmental, economic and socio-cultural impacts and mitigation measures; plans for the prevention and management of accidents and for ensuring the health and safety of workers and neighbouring communities; and the project budget. These issues are to further address, as outlined in the Second Schedule of the Environmental (Impact and Audit) Regulations (2003): ecological considerations; sustainable use; ecosystem maintenance; social considerations; landscape and land uses; and water. Within this framework, the collection of relevant baseline data, and consultations with stakeholders and the public are important, and ought also to be included in the report.

1.6.3 The EIA Review and Approval Process

Where the Authority finds that the project report conforms to the requirements of Regulation 7 (1), it must within seven days of receiving the report, submit a copy to each of the relevant lead agencies, the relevant District Environment Committee, and where it involves more than one district, to the relevant Provincial Environment Committee. Each of these lead agencies and Committees must then submit their written comments to the Authority within twenty-one days from the date on which they received the project report from the Authority or within any other period that the Authority may prescribe (Regulation 9). Once the Authority comes to a decision, it must communicate that decision, together with the reasons for it, to the proponent within forty-five days from the date on which the project report was submitted to it (Regulation 10(1)). Where the Authority is satisfied that the project will have no significant impact on the environment, or that the project report discloses sufficient mitigation measures, it may issue a licence (Regulation 10(2)). If, however, it finds that the project will have a significant impact on the environment, and the project report discloses no sufficient mitigation measures, the Authority will require that the proponent undertake an environmental impact assessment study in accordance with the Regulations.

1.7 THE EIA TEAM

Earthview Geoconsultants (K) Ltd. was appointed by TKBV on 16th March 2011 to undertake the EIA for the seismic survey in Block 10BA. Earthview is a well-established consultancy firm based in Nairobi with good capacity in environmental and social impact assessments and audits, geological and hydrogeological studies, geographic information systems, natural resource surveys, and project planning, implementation and management. Earthview is officially registered with the National Environment Management Authority as an Environmental Consultancy Firm. The firm comprises of individuals with many years experience and knowledge in these and other areas. The firm is conversant with national legislation and regulations that relate to the sectors in which it carries out its activities, including NEMA requirements for environmental and social impact assessments and audits, as well as applicable international best practices and standards.

Name	Role	Qualifications	Experience (years)
Prof. Norbert Opiyo-Aketch	Overall coordination/Geological issues	PhD	30
Dr. Daniel Olago	Coordination/Biophysical and Socio-economic issues	D.Phil.	20
Mr. Joseph Nganga	Soil and Waste Management	BSc	20

Mr. Adams Gakuo	Aquatic Ecology	MSc	4
Mr. Francis Aketch	Terrestrial and Wildlife Ecology	MSc	4
Mr. John Obunga	Geology, Hydrogeology, Water Resources	BSc	5
Mr. James Ndunda	Socio-economist	BSc	5
Ms. Evelyne Sindani	Health and Socio-cultural issues	BSc	3
Mr. Peter Kibe	GIS Expert	MSc	20
Mr. Nicholas Aketch	Logistics/Administration	BSc	8
Ms. Emily Atieno	Policy/Legislation/Regulations	LLB	25

1.8 OBJECTIVES OF THE EIA PROJECT REPORT

In carrying out the project, and considering the national legislative and regulatory requirements for EIAs, TKBV shall seek to:

a) Identify, evaluate and propose suggested mitigation measures for potential environmental impacts of the proposed project on the various biophysical and socio-economic structures of the area.
b) Assess and analyse the environmental costs and benefits associated with the proposed project.
c) Outline environmental management plans and monitoring mechanisms during the project execution phase.
d) Ensure that concerns and aspirations of the local community are addressed in all stages of the project cycle.
e) Ensure that the project activities do not in any way interfere with the environmental sustainability of the area. This is ensured by giving due consideration to:
    - Lake Turkana and the ecosystems in and around the lake.
    - Local communities and land tenure systems.
    - Sensitive historical, archaeological and cultural sites.
f) Put in place mitigation and monitoring measures that will ensure that any potential negative impacts arising from activities of the project are eliminated or reduced at the earliest opportunity to obviate any harmful effect to the environment.
g) Boost the economy by providing jobs and trading opportunities to the local community in the region.

1.9 TERMS OF REFERENCE (TOR)

The following are the Terms of Reference (TOR) for the EIA:

- To hold meetings with the project proponent to establish the procedures, define requirements, responsibilities and a time frame for the proposed project.
- To carry out a systematic environmental and social impact assessment of the proposed seismic survey project within the project area, following the National Environment Management Authority legislative and regulatory requirements and best international practice for an activity of this nature.
- To provide a description of the proposed activities throughout the entire implementation process of the proposed project with special focus on potential impacts to the surrounding environment and the socio-economic fabric of the local communities.
- To produce an Environmental Impact Assessment Project Report that contains the details of potential negative impacts, together with recommendations for their mitigation and/or

prevention, as well as positive impacts and recommendations for enhancing and/or encouraging them.
- To develop an Environmental Management and Monitoring Plan and cost estimates for the proposed project.

1.10 STRUCTURE OF THE REPORT

The structure of the report is based on that proposed in the NEMA EIA Guidelines (2002), and is indicated in Table 1.1 below.

Table 1.1: Structure of the EIA Project Report

Chapter	Title	Contents
1	Introduction	Introduction to the project area; identification and activities of the project proponent in other regions; project background; objectives and justification; purpose of the EIA and objectives of the report; the EIA team; TORs for the report.
2	Project Description	The technology and processes to be used in the implementation of the project; workforce requirements; the materials to be used in the construction and implementation of the project; the products, by-products and waste generated by the project.
3	Methodology	Methods used in carrying out the assessment; identification of gaps in knowledge and uncertainties that were encountered in compiling the information.
4	Legal and Regulatory Framework	A concise description of the national environmental, legislative and regulatory framework, international best practices, and Tullow Oil plc policies.
5	Baseline Environmental Parameters of the Project Area	Description of the potentially affected environment within the framework of the proposed EIA; assessment of existing (pre-project impacts) and potential (project and residual impacts) what?
6	Analysis of Project Alternatives	Alternative technologies and processes available, and reasons for preferring the chosen technology and processes.
7	Environmental Impact Assessment	Environmental effects of the project including the social, economic and cultural effects and the direct, indirect, cumulative irreversible, short-term and long-term effects anticipated.
8	Environmental Management Plan	Environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the cost, time frame and responsibility to implement the measures; provision of an action plan for the prevention and management of foreseeable accidents and hazardous activities in the course of carrying out the project activities; measures to prevent health hazards and to ensure security in the working environment for the employees and for the management of emergencies.
9	Conclusions and Recommendations	Summary of the conclusions and key recommendations from the EIA.
References	References	List of references and websites referred to in the text.
Appendices	1. Provisional 2011 seismic program	Provisional seismic survey lines: may be revised in context of data needs and EIA recommendations.

	2. Minutes of meetings	Minutes of meetings held with communities, community leaders and other stakeholders in the project area.
	3. Copies of laboratory results	Laboratory results for samples collected in the field (water quality, soil chemistry, phytoplankton, zooplankton, lake sediments).
	4. Certificates	Certificates of the consultants and the company doing the EIA project report.
	5. Pin Number and VAT certificates	Pin number and VAT certificates of the proponent.

CHAPTER 2:

PROJECT DESCRIPTION

2.1 INTRODUCTION

TKBV is proposing to undertake seismic surveys in order to delineate potential hydrocarbon prospects in Block 10BA (which covers an area of 16204.55 km^2) in the northern Kenya Rift (see Figure 1.1). The major portion of the project area is located on L. Turkana with the remaining sections being onshore. The onshore areas of the block have poor physical infrastructure, and other than in the Lodwar area, lack tamacked roads. There is a low density network of generally poorly maintained murram or earth roads, many of which are impassable during rains because they are criss-crossed by luggas or traverse through river/lugga floodplains. The communications infrastructure is poor, although telecommunications coverage and reliability has increased in recent years due to nation-wide expansion programmes that have been launched by the major mobile service companies in Kenya.

2.2 PROJECT LOCATION

The project area lies in parts of Turkana North, Turkana Central, Loiyangalani and North Horr districts (Figure 1.1). It is bounded by latitudes *ca.*3 ºN and 5ºN and longitudes *ca.*35ºE and 36.5ºE and covers an area of 16204.55 km^2. The area is located in two counties - Turkana County and Marsabit County.

2.3 OVERVIEW OF SEISMIC SURVEYS AND DESIGN

Seismic surveys are a primary tool utilized during the exploration of hydrocarbons in both onshore (land) and offshore (marine or lake) areas. A seismic survey is conducted by creating an energy wave commonly referred to as a 'seismic wave' on the surface of the ground or in water along a predetermined line, using an energy source. This wave travels into and through the earth strata, where it is reflected and refracted by various subsurface formations, and returns to the surface where receivers called geophones are used to detect the waves and convey them to a recorder for analysis. Seismic waves can be induced by the following methods: small explosive charges, primarily dynamite, set off in shallow holes known as 'shot holes'; by large 'Vibroseis' trucks equipped with heavy plates that vibrate on the ground or by use of compressed point-source air pulses (commonly referred to as 'airguns'). By analyzing the time it takes for the seismic waves to reflect off subsurface formations and return to the surface, formations can be mapped and potential oil or gas deposits identified. Block 10BA encompasses both land (onshore) and lake (offshore – Lake Turkana) settings. The seismic surveys in these two different settings entail the use of two different imaging configurations which are outlined below.

2.3.1 Onshore Seismic Surveys

Onshore 2D seismic surveys are conducted along ground transects where sequential "receiver cables" of 6 to 12 kilometres in length are laid out on the ground. A group of evenly spaced geophones that are sensitive to small sound waves and vibration are placed on the ground and

connected to the cable. A truck-mounted recording system connected at one end of the receiver cable records the sound waves picked up by the geophones. At carefully calculated points along the receiver line, an impulse is sent into the earth. This “shot” may be caused by a specially-built vibrator truck shaking the surface (Vibroseis) or by a small detonation at the bottom of a five to twenty metre deep, narrow-diameter hole drilled into the ground. On completion of recording, a section at one end of the cable is unplugged and moved, together with its geophones/hydrophones, to the front of the cable where the process is repeated. In this way, the recording moves along the pre-determined seismic line.

2.3.2 Offshore Seismic Surveys

Offshore seismic exploration is similar to onshore exploration, but rather than trucks and geophones, a boat is used to convey the equipment needed to generate the seismic waves and gather the seismic data, and hydrophones are used to pick up seismic waves underwater. The hydrophones are towed behind a boat or cables are laid on the bottom of the sea or lakebed in various configurations, and are respectively referred to as “streamer arrays”or Ocean Bottom Cables (OBC). The seismic boat uses compressed point-source air pulses (“airgun”) that releases bursts of compressed air under water to create sound waves that travel down through the water column and into the earth’s crust and generate the necessary seismic reflection signal.

2.3.3 Seismic Survey Data

(a) 2D Surveys

Computer analyses of the recorded seismic waves provide a profile of the underlying rock strata and offer the basis for identifying potential hydrocarbon traps. The analysis creates a two-dimensional picture (Figure 2.1) that shows the subsurface geology of the earth’s strata along the line of the cable.

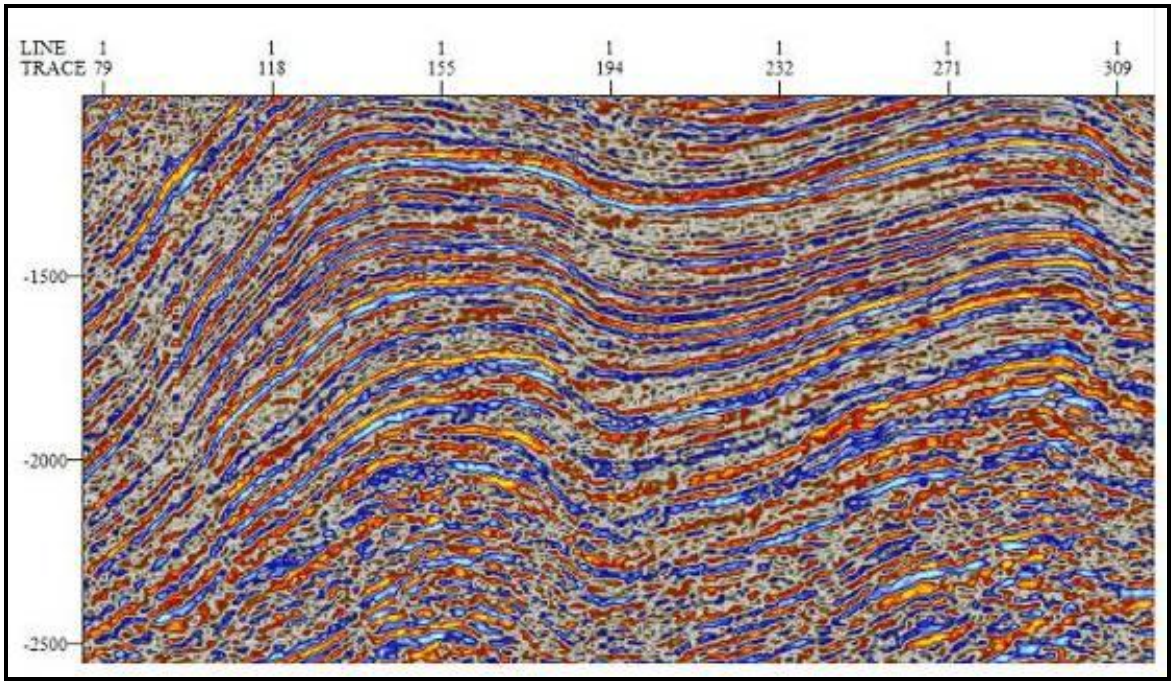


Figure 2.1: 2D Seismic section (after McFarland, 2009).

(b) 3D Surveys

3D surveys are acquired by laying out energy source points and receiver points in a grid over the area to be surveyed. The receiver points, which record the reflected vibrations from the source points, are laid down in parallel lines (receiver lines), and the source points are laid out in parallel lines that are orthogonal to the receiver lines. The spacing of the source and receiver points is determined by the design and objectives of the survey. Several “shots” from calculated positions along and between the receiver lines are taken, before the cables are moved up and the process repeated. 3D surveys are normally undertaken once oil is discovered and a more detailed three dimensional picture of the sub-surface is required.

2.4 THE PROPOSED SEISMIC SURVEY

2.4.1 Seismic Survey Objectives

The objectives of the seismic surveys to be conducted are to infill existing seismic data from earlier exploration initiatives and to delineate the mapped prospects. It is expected that the new seismic will be considerably better quality than the existing seismic, and lower environmental impact due to improved acquisition methods and equipment. Infilling the older data will add confidence and detail to the interpretation and location of the prospects and define the prospects in sufficient detail to, at a later and different stage, test one or more by drilling.

2.4.2 Seismic Survey Scale and Extent

As per the PSC requirements, 1533 km of 2D seismic data will be acquired. Mobilisation is anticipated to commence in July 2011 and be completed before the end of September 2011. Acquisition of seismic data will commence late September 2011 and anticipated to be completed by March 2012. It should be noted that while there are pre-determined seismic line transects based on analysis of existing data as well as available information, the actual locations of the seismic transects may be varied prior to and/or during the seismic data acquisition exercise.

The seismic survey operation will be constrained along the seismic survey lines on land and in the lake, and to the base and fly camps, as well as to the access roads to these areas.

Prior to conducting the seismic data acquisition programme in the lake, TKBV are undertaking a high resolution bathymetric survey to improve on the understanding of the lake bottom topography which had earlier been mapped on a coarse-resolution scale by scientific research groups in the 1980s.

2.4.3 Seismic Survey Logistics

The seismic surveys are expected to take about 6 to 8 months to complete, including the mobilisation and demobilisation period, and the survey will involve approximately one hundred and fifty personnel (see Chapter 8 for more details on the activity time frame). A base camp will support the crew, and “fly camps” will accommodate smaller-sized groups of personnel in outlying areas, and will be set up as and when required (see section 2.2.4 below). A fully equipped and staffed ambulance will be on standby in case of accidents or emergencies, and will be supported by a fully equipped and staffed clinic that will be located in the base camp.

There will also be an on-call helicopter for crew movement and emergency evacuations. There are three airstrips in the area that can handle small fixed-wing aircraft. The best is at Lodwar, with a tarmacked landing strip. There are now two companies that offer regular commercial flights to and from Nairobi City. The other two strips are on the eastern shore of the lake, at Illeret and Alia Bay, and can receive 12-seater Caravans. They are served only by charter flight companies. The Seismic Contractor will provide a detailed Emergency Response Plan (ERP) prior to works commencing.

Unskilled and semi-skilled workers will be hired locally from towns and villages representative of the area and after consultation with the local authorities and communities. The aim will be to ensure a fair distribution of employment opportunities.

(a) Land Operations

Approximately 40 vehicles (light trucks and pickups) will be required for movement of personnel and equipment, and to support camp operations. A number of vibroseis trucks will be used for acoustic energy generation, and there will also be recording trucks to receive the data relayed from the geophones. Bulldozers and mulchers will be used for improving or opening up new access roads (the latter only if absolutely necessary), and for cutting the transect lines, respectively. For areas requiring the use of dynamite as a source instead of vibroseis, small 'shot hole' drill rigs will be used.

(b) Lake Operations

A number of boats specifically tailored to carry out the seismic data acquisition on the lake will be supplied by the contractor, as there are no boats on the lake currently that are capable of being modified to carry out the work. The boat will have the capacity to mount the airgun system and associated equipment, and to deploy seismic cables with hydrophones.

A pier will have to be constructed at selected landing areas, e.g. at Kalokol on the western shore, and Alia Bay or Illeret on the eastern shore of the lake since there are no adequate facilities to facilitate loading and offloading of personnel, equipment and machinery that will be required for the offshore operation. A storage base would also have to be built and manned with a 24 hour security detail.

2.4.4 Data Acquisition Methods and Equipment

The seismic survey will be conducted using vibroseis and/or dynamite charges on land, and airguns (where a pulse of compressed air is released from a specialized nozzle into the water) in the lake. The airguns will be mounted on a vessel (boat) in the deeper parts of the lake and on a floating platform for work in the shallow littoral zones.

The seismic acquisition methodology has been designed to minimise disruption to local flora and fauna as well as the local communities. Low Impact Seismic technologies (see Chapter 7) will include, on land: the use of vibroseis and/or deep-drilled dynamite charges as acoustic energy sources; line-cutting with mulchers to minimise line width and accelerate re-growth of vegetation; and use of bulldozers and graders to open up new or improve existing access roads. In the lake, compressed point-source air pulses (airguns) will be used as the acoustic energy source to minimise impact on aquatic organisms and habitats; and a floating streamer array with hydrophones, towed by the boat will record the reflected signals.

The seismic data acquisition plan is as follows:

- Seismic survey teams will be divided into two: land and lake survey teams.
- Survey teams will first map out the seismic transects on the ground and lake surface using coordinates of planned seismic lines. On land, they will take care to avoid existing infrastructure and minimize any damage to cultivated land, natural water points and pastureland.
- Transects line placements and program size will be adjusted accordingly to bypass habitations or areas of particular sensitivity. A detailed evaluation of each line will be carried out as work progresses and line placements will be adjusted to achieve maximum effect at minimum disruption.
- In the 2D land seismic survey, vibroseis and/or dynamite charging will be the source of acoustic energy. One "receiver cable" will be laid out at a time on the ground. This cable will have an anticipated length of between 9 to 12 kilometres. After every 25 metres or so a group of small geophones will be placed on the ground and connected to the cable.
- In the lake, at water depths exceeding 40 to 50 metres, the seismic survey will be conducted from a boat, with airguns being the source of acoustic energy, and hydrophones arranged in either streamer array or Ocean Bottom Cable, deployed by the boat, shall record the reflected signals.

The proposed onshore seismic survey will involve the use of four-wheel drive (4x4) vehicles and recording trucks, small 'shot hole' drill rigs, a grader, and a bulldozer to provide vehicular access roads (cut-lines), while offshore operations will be carried out from boats.

Uphole Survey: In addition, there will be seismic 'Upholes' drilled and surveyed at the intersections of the land seismic lines. These upholes will involve using a water-well drilling rig to drill to about 100m below ground level, allowing seismic velocity data to be collected for the shallow weathered layers of bedrock. It is likely that about 25 upholes will need to be drilled and surveyed. These boreholes are typically backfilled and plugged on completion of the survey.

LVL Survey: Shallow seismic refraction (Low Velocity Layer, LVL) surveys will be carried out along the land seismic lines at approximately 5km intervals. These low impact surveys are required to collect data on the shallow weathered layers, allowing the calculation of 'statics' required for accurate seismic processing.

2.4.5 Campsite Facilities

The crew will reside in temporary accommodation (base and fly camps). The campsites are yet to be identified and will be established in consultation with the local communities, elders and area leaders. However, the seismic base camp will be positioned most conveniently and centrally for efficient operations, with good access and security, and will not move during the course of each survey. This camp may house between 100 and 150 people, and it will be erected by a qualified and licenced civil and building contractor. The camp area would be between 10,000 and 20,000m^2.

The base camp will typically comprise of: staff accommodation facilities (steel container dwelling units, office units, and tents); one or more mess and work tents (with concrete bases); steel container kitchen, bathroom, lavatories, laundry store, refrigeration and generator units; prefabricated buildings housing toilets and bathrooms linked to septic tank; a few stand-alone pit latrines; and a water processing unit. The fly camp accommodation will typically have

wooden prefabricated office units and mess area, and tents. Facilities will include: kitchen, bathroom, lavatories, store, a refrigeration unit, and a water processing unit. Other facilities will include fully equipped and staffed medical unit and radio control and communications room (with radio, internet and satellite phone facilities) that will be manned on a 24-hour basis. Safety equipment such as fire extinguishers will be placed strategically within the camp site.

The base camp will be secured by perimeter fencing, and a number of security watchtowers will be erected at strategic points along the perimeter fencing. Security fortresses will be erected within the camp, and will have sand-sack perimeter walls and adequate space to accommodate all staff in case of a bandit or militia attack. Such provision will also be made for the fly camp(s).

A workshop area will be set apart and constructed using container units (or corrugated sheet metal for the fly camp). This would serve as a storage base and fleet maintenance workshop. It will have a concrete floor suitably lined in order to contain oil/fuel spillage. The fly camp workshop may be constructed of corrugated sheet metal.

A parking bay for vehicles will be demarcated, and it will have a fuelling station, which will be underlain with a spill-containing liner. A fuel storage area will be set at one end of the parking bay area, and will be bunded. The bunds should have the capacity to contain all the fuel stored inside the fuel bladder in case of leakage. The fuel storage area will have a tarpaulin covering to protect it from the weather, but should be well aerated. The fuel storage floor shall be concrete-based, and canvas-lined to capture minor spillages, with a structure measuring at least 12m x 8m x 0.05m. The bladder will be charged with diesel ferried by tankers, and will be conveyed to the pump via an outlet hose. Clearly marked spill kits will be placed adjacent to the refuelling area, and all staff involved in vehicle maintenance and refuelling will be trained in their use. Clear ‘no smoking’ signage shall be posted in this area. A similar facility, if necessary, shall be erected at the fly camp.

The generator housing unit (whether at the base camp or fly camp) will also house the power control unit and the power distribution network and shall have junction points where the power can be isolated or cut-off for repair or emergency purposes. This unit should be secured, and only authorised personnel allowed to enter in. Adequate warning signs and fire extinguisher equipment will be visibly and appropriately posted. The generator and its fuel storage area will be bunded to prevent accidental loss of hydrocarbons.

Water for general use will typically be stored in a bladder with an adequate capacity to serve the camp. It shall be placed in a bunded area (with the bunded containment being able to capture the entire capacity of water stored in case of leakage). This water will be pumped into a raised storage tank from which it will be distributed. A water processing plant will be set up to ensure potable water supplies. Charging of the water (for general use and drinking) will be done using water bowsers that will likely source the water from a borehole that will be drilled by TKBV. The intention is to donate the water well to the local community on completion of the survey.

2.4.6 Occupational Health and Safety

Safety and environmental protection responsibility are among the most important aspects of modern seismic surveying in oil and gas exploration and production activities. The health and safety of all personnel and the impact of operations on third parties and on the environment are of paramount importance. It is the responsibility of crew managers to ensure that safety standards are maintained and safe working practices are adhered to by all members of the

crew. No work can be done efficiently if it is not performed safely. Some of the safety issues include, but are not limited to, the following factors:

- Noise generation;
- Solid and liquid waste management, including wastewater and effluent discharges;
- Oil and chemical spills;
- Transportation;
- Fire protection;
- Material handling; and
- Risk of personal injury at work, especially during excavation and construction.

Occupational health and safety issues are best addressed when company internal management systems that address worker and public safety are compliant with Oil and Gas Industry guidelines on international best practices, e.g. International Association of Oil and Gas Producers (OGP), International Association of Geophysical Contractors (IAGC), World Bank – International Finance Corporation (WB-IFB).

It is a requirement that the Tullow Oil Environmental, Health and Safety Management System (EHS-MS), together with the EHS and CSR (Corporate Social Responsibility) policies be integrated into the project lifecycle. The crew must also ensure that they adhere, at all times, to all international health and safety standards applicable in the Oil and Gas industry, in addition to TKBVs internal management systems.

2.4.7 Waste Management

The types of waste that will be generated at the camp sites and/or work sites during the survey operation can be grouped into two categories, non-hazardous and hazardous, as per the NEMA Waste Management Regulations of 2006. The non-hazardous wastes would include: domestic wastes and effluents, plastics, metal cans, and paper. The hazardous wastes would include: medical and pharmaceutical wastes, waste oils, and used batteries.

The domestic waste disposal facilities will be located outside the perimeter fence of the camp compound. Typically, they would consist of solid waste pits and unlined grey water pits that would receive effluent from the bathrooms and kitchens. There would also be black water pits serving as settling and overflow discharge pits, set in a cascading sequence. The conveyance of waste water and black water effluents from the bathrooms, kitchens and toilets will be via PVC-drain pipes. Wastes generated on the boat, such as sewage and putrescible wastes, will be treated according to MARPOL regulations, but shall not be discharged into the lake. These, and non-combustible solids will be returned to shore for disposal at an approved facility. Combustible materials (*e.g.*, oily rags, paint cans) should be handled separately in hazardous materials containers and disposed of onshore at an approved facility (see below). Solid inert combustible wastes may be incinerated on-board if such a facility is provided on the vessel; otherwise, they must also be disposed of onshore at approved facilities.

All waste material from field operations (land and lake) should be brought back to the base camp for proper disposal. Disposal options include: incineration, compaction and removal from site to approved facilities, and burial (especially for biodegradable material), or a combination of these activities. Where practical, wastes should be managed on site by burial in pits. During construction of the campsite, qualified personnel should survey the land to determine the best site for construction of waste pits and/or landfills. At particularly sensitive locations, or with

hazardous materials, these disposal methods are not permitted, requiring the wastes to be transported to off-site locations for disposal at a commercial disposal facility or municipal landfill. In such cases, the closest such facility would be in Lodwar town. Metallic and other materials such as timber may be donated to the local communities for their own use, or otherwise sold to dealers in the town centres.

Hazardous (medical and pharmaceutical, waste oils) and non-hazardous wastes will be segregated, and disposed of in the waste disposal facility as provided for by the relevant Local Authority (Turkana County Council in the western part of the project area, and Marsabit County Council in the eastern part of the project area) (Table 2.1). Biomedical waste will not be stored above 0ºC for more than seven days without the written approval of the relevant lead agency, provided that untreated pathological waste shall be disposed of within 48 hours.

Table 2.1 Biomedical and pharmaceutical waste handling (NEMA Waste Management Regulations (2006).

	Type of Wastes	Details	Colour of Container and Markings	Type of Container
1.	Infectious Waste	Waste suspected to contain pathogens e.g. laboratory cultures, waste from isolation wards, tissues (swabs), materials, or equipment that has been in contact with tubings, catheters, IGS toxins, live or attenuated vaccines, soiled plaster costs and other materials contaminated with blood infected patients, excreta.	Yellow	Strong leak-proof plastic bag with biohazard symbol
2.	Pathological waste	Human and animal tissues or fluids. e.g body parts, blood and other body fluids, fetuses, animal carcasses.	Yellow	Strong leak-proof plastic bag with biohazard symbol
3.	Sharps	Sharp waste. e.g needles, infusion sets, scalpels, knives, blades, broken glass that may cause puncture and cuts. This includes both used and unused sharps.	Yellow – (marked sharps)	Puncture proof
4.	Pharmaceutical waste	Waste containing pharmaceutical e.g pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes).	Brown	Plastic bag or container
5.	Genotoxic Waste	Waste containing substances with genotoxic properties. e.g waste containing cytostatic drug (often used in cancer therapy), genotoxic chemicals.	No details provided	No details provided
6.	Chemical waste	Waste containing chemical substances e.g laboratory reagents; film developer, disinfectants,(disinfectants) that are expired or no longer needed solvents	Black	Plastic bag or container
7.	Waste with high content of heavy metals	Batteries, broken thermometers, blood-pressures gauges, etc	No details provided	No details provided
8.	Pressurized containers	Gas cylinders, gas cartridges, aerosol cans.	No details provided	No details provided

9.	Radioactive waste	Waste containing radioactive substances e.g unused liquids from radiotherapy or laboratory research, contaminated glassware, packages, or absorbent paper, urine and excreta from patients treated or tested with unsealed radionuclides, sealed sources.		Lead box, labeled with radioactive symbol
10.	General solid waste	Waste generated from offices, kitchens, packaging material from stores.	No details provided	No details provided
11.	Microorganisms	Any biological entity, cellular or non-cellular capable of replication or of transferring genetic material.	No details provided	No details provided
	Non-infectious/non-hazardous (non-clinical)		Black	Plastic bag or container

2.4.8 Sourcing of Equipment and Supplies

All the technical equipment and machinery that are required for the seismic survey will be imported as they are not available locally. Other support vehicles such as pick-ups and trucks may be purchased or hired locally. It is a Tullow corporate requirement that all vehicles working for or on behalf of Tullow are compliant with OGP Land Transportation Safety Recommended Practice.

TKBV will source general goods, consumables and food items, in the first instance, locally within the project area to support the service industries there. Where these are not available locally, they will be sourced from other parts of the country. TKBV will have its own water supply (borehole) for the camps. In order to be able to drill a water well, the services of a registered[1] professional hydrogeologist or hydrogeology firm will be required.

2.4.9 Emergency Response Plans

A number of different types of accidents or incidents can occur in this kind of operation, with risks e.g. personal injury; fire; collisions between vehicles (or vessels in the lake water), collisions between vehicles and humans or animals; oil pollution on land from storage bladders/tanks or pipe leaks or rupture, during its transportation by trucks, and indiscriminate disposal of used lubricating oil; and oil loading/unloading or collision or grounding of vessels in marine waters. Mitigation of these risks is outlined in Chapter 8 of this report (Environmental Management Plan). However, it is noted that comprehensive response plans to specific hazards and associated risks will need to be developed, which are in line with both the national regulations and regulations that govern the oil and gas industry activities in Kenya, and Tullow Oil's policies that are in tandem with current best practices in the oil and gas industry (see sections 1.12.1 and 1.12.2). TKBV will need to customise and domesticate these plans to fit into the Kenyan context.

[1] A hydrogeologist or hydrogeology firm is registered by the Ministry of Water and Irrigation under the classification "Consultant Hydrogeologists". A list of the registered consultants can, on request, be obtained from the Ministry.

2.5 CAMPSITE(S) DECOMMISSIONING

A decommissioning plan would involve the following sequence of activities:

- Workers lay-off and compensation
- Equipment demobilization (such as containers, vehicles, accommodation facilities)
- Dismantling of camp facilities
- Cleaning the camps and disposal of solid, liquid and hazardous waste
- Restoration of waste pits, cesspools and the whole camp site
- Audit and sign off.

The decommissioning will cover the base camp and any fly camps or any other facility that shall be erected. The decommissioning will lay emphasis on:

- Examining the conformity to the EMP's developed during the EIA for the seismic survey project;
- Preparation of a decommissioning strategy and EMP before decommissioning begins;
- Awareness creation;
- Ecological, socio-cultural and economic survey of camp sites and impacts;
- Conforming to national legislation and regulatory requirements and international best practices.

The decommission will be carried out as soon as is practicable after the end of the seismic survey, hence the specifics of it, which will depend largely on what was actually constructed on the ground, will need to be formulated well in advance.

CHAPTER 3:

ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

3.1 APPROACH TAKEN FOR THE EIA

The approach that was taken for the EIA assessment included, with respect to the proposed seismic survey, the following:

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

3.2 WORK EVALUATION FOR THE EIA

The work evaluation for the EIA was based on the NEMA requirements (section 1.6.2) and customised for the project to be undertaken (outlined in Chapter 2), as per the objectives and terms of reference outlined sections 1.9 and 1.10.

3.3 TOPICS ADDRESSED AND ISSUES CONSIDERED

Topic or Context	Issues Considered	Rationale	Spatial Scope	Limitations of Methodology and Consequences for the Study Outcomes
Project Design, Technologies, Scale and Extent	• Project components • Equipment and machinery used • Personnel required • Facilities required • Management of fluid and solid wastes • Occupational and public health and safety • Supplies • Decommissioning	• Project components equipment/machinery used, and facilities will have a number of environmental impacts related to construction, operations and decommissioning • Identification and prioritisation of factors requiring mitigation • Personnel and public safety during operations needs to be ensured	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites, pier site(s), storage, repair and waste disposal and facilities	• None
Legislative and Regulatory	• Legislation and regulations	• Need to ensure that all applicable laws are followed	• National legislation and	• None

Framework	applicable to project design, execution, affected parties, and environment protection	during project execution • Need to be conversant with the authorizations required for the regulatory approval of the project • Some legislation, regulations and guidelines have embedded mitigations relevant to the proposed seismic survey	regulations • International best practices in Oil and Gas industry • Company EHS, CSR and Code of Conduct	
Geographical Aspects and Boundaries	• Description of the setting of the project area • Identification of key features	• Determination of the context within which the work is to be done • Assessment of the scale and extent of the work	• Entire project area	• None
Administrative set-up	• Key administrative units and their roles in the project area	• Establishment of jurisdictions • Identification of key administrative contacts • Role in emergency situations (e.g. security threats) and response	• Entire project area	• None
Communication and Transport	• Road infrastructure • Air transport network • Lake transport network • Land, radio and mobile communications network	• These will determine the ease with which the project will be carried out • Identification of areas difficult to access • Inform on types of equipment/machinery that will be required for the project • Assist in development of contingency/emergency plans	• Entire project area	• None
Governmental, Non-Governmental and Community Based Organisations	• Activities and projects carried out in the area	• Identification of potential local partners particularly with respect to CSR	• Entire project area	• None
Physiography and Geology	• Physiography and geology • Assessment of terrain ruggedness • Assessment of susceptibility to landslides, earthquakes, subsidence and floods • Active surface processes	• Establishment of baseline conditions • Identification of potentially difficult areas to work in – terrain and accessibility by vehicles • Identification of areas requiring extra safety precautions • Identification of hazard-prone areas • Assessment of project impacts, primarily cut-lines and access roads, and mitigations	• The entire project area	• Some areas were not accessible due to lack of roads or security concerns hence data is incomplete but samples representative of the whole area were assessed.
Soils	• Soil degradation status • Areas subject to wind and water erosion	• Establishment of baseline conditions • Ease of accessibility by vehicles	• Entire project area	• Some areas were not accessible due to lack of roads or security

	• Soil texture and drainage characteristics • Soil chemical quality • Assessment of rehabilitation potential	• Identification of hazard prone areas (e.g. ponding/flooding) • Assessment of impacts of opening up access roads and cut-lines and campsite construction • Assessment of impacts of domestic effluent discharges on soils • Identification and prioritisation of factors requiring mitigation		concerns hence data is incomplete
Climate	• Temperature • Winds • Precipitation • Climate change	• Establishment of baseline conditions • Information useful for project elements such as cooling of temperature-sensitive equipment and installations • Wind strength and direction is important for safety particularly in lake operations • Wet seasons can significantly impede progress in seismic data acquisition • Sudden, torrential rains can pose a danger to personnel through flash flooding in lugga crossing zones	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• No data available for trend analysis.
Air Quality	• Ambient air quality • Generation of dust, smoke, odorous fumes, and other toxic gaseous emissions • Release of gases which contribute climate change or ozone damage • Identification of project components that can lower air quality	• Establishment of baseline conditions • Assessment of project impacts on air quality • Identification and prioritisation of factors requiring mitigation	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• Lack of air quality data on particulate loading, SO_x and NO_x or any other gaseous compounds in the area. Area is, however, rural and undeveloped so air quality can be assumed to be good and varies mainly due to variations in wind speeds (natural particulate loading).
Surface and Ground Water Resources	• Ground and surface water sources • Ground and surface water use • Planned water use • Changes in quantity • Identification of project components that can affect water use	• Establishment of baseline conditions • Potentially high demand for water by project group in a water scarce region • Planned water uses that affect water quantity may be blamed on the project proponent • Identification and	• Selected camp sites and pier sites and facilities • Lake area	• Inaccessibility of some areas due to lack of roads and security concerns

		prioritisation of factors requiring mitigation		
Water Quality	• Current ground and surface water quantity • Current point and non-point sources of water pollution • Identification of project components that can potentially alter water quality	• Establishment of baseline conditions • Assessment of project impacts (e.g. effluent disposal and accidental spills) on water quality • Domestic and boat effluent discharges • Identification and prioritisation of factors requiring mitigation	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• Representative water samples were taken.
Terrestrial Environment (Habitats, Flora and Fauna)	• Vegetation cover and classes • Habitat conditions • Floral and faunal communities which are uncommon, threatened or endangered • Environmentally sensitive localities • Wildlife corridors • Pastoral areas • Assessment of ecosystem state	• Establishment of baseline conditions • Physical disturbance of terrestrial environment during operations, e.g. line cutting • Determination of pre-project endanged communities • Assessment of areas requiring special precautions • Avoidance of human-human and human-wildlife conflicts • Identification and prioritisation of factors requiring mitigation	• Entire project area	• Old data, but the ecosystem structures are resilient to the effects of land degradation and deforestation, Land cover, for example, has become more patchy, but the species diversity within the various ecotones remain the same.
Aquatic Environment (Habitats, Flora and Fauna)	• Habitats • Lake resource inventory • Floral and faunal communities which are uncommon, threatened or endangered • Fish, reptile or invertebrate breeding and nesting areas • Fishing grounds • Bird nesting and breeding areas • Assessment of ecosystem state	• Establishment of baseline conditions • Physical disturbance of aquatic environment and ecosystems e.g. by vessels and associated equipment • Potential impacts of accidents such as oil and chemical spills, collisions	• Lake area and perennial rivers.	• Lake bathymetry is not well known – this needs to be established before the lake operations begin • Aquatic ecosystem structures in deep water are not deemed to have changed significantly over the past three decades due to changes in lake level. Significant changes have occurred in shallow littoral and deltaic areas
Land and Lake Resources and National Parks	• Land use and designation • Existing activities in the area • Currently known and exploited mineral resources • Artisanal, commercial and	• The land and lake resources are critical resources supporting livelihoods in the area. • Parks are national and global heritage areas • Consideration of competing resources	• Entire project area	• Limited accessibility to the parks

	sport fishing activities, tourism • Resource inventory			
Archaeological, Historical and Cultural Sites	• identification of archaeological, historical, cultural sites	• Establishment of currently known sites • Avoidance of such sites during line cutting and seismic data acquisition	• Project land area in the east and west within the lake basin	• Only a few sites were visited and georeferenced, relative to existing number (hundreds) of archaeological sites. GPS coordinates of sites will have to be obtained from NMK and TBI to assist in determining cut-line locations.
Visual Aesthetics	• Aesthetic or high scenic value	• Establishment of baseline conditions • Assessment of project impacts such as vegetation clearance along cut lines and at campsites	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• None
Noise and Vibrations	• Ambient noise and vibration levels in the area • Potential sources of noise and vibrations produced by project operations • Noise impacts on terrestrial and aquatic fauna	• Establishment of baseline conditions • Acoustic source impacts on terrestrial and aquatic fauna and mitigation • Noise and vibrations impacts on the project workforce and the neighbouring public • Impacts on nearby structures and facilities	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• Lack of studies on noise and vibration impacts on inland water fauna
Solid and Liquid Wastes	• Disposal of all waste streams • Damage to marine environment through accidental spills of oil, fuel, cargo, waste or sewage	• Establishment of baseline conditions • Campsites will require to install waste management systems • Boat crew will have to manage waste on board	• Campsites • Working areas • Lake	• None
Social Characteristics	• Level of services available • Social support information • Identification of key community needs	• Quality of life baseline. • Ability to absorb change	• Entire project area	• Language barrier in some places • Unwillingness to adopt new social practises
Economic Setting	• Area targeted for growth • Labour and employment	• Quality of life baseline • Development level baseline • Willingness to adopt new economic activities	• Entire project area	• Unwillingness to adopt new economic opportunities by the locals
Health Setting	• Status of health facilities • Access to health	• Determination of the available health facilities in the area	• Project area and the surrounding	• Inaccessibility of some areas

	services • Occupational health and safety hazards • Hazards due to the use, storage, disposal or transportation of flammable, explosive, toxic, carcinogenic or mutagenic substances • Emission of electromagnetic or other radiation which may adversely affect electronic equipment or human health • Traffic hazards	• Availability of officials in the available health facilities • Emergency preparedness	environment	
Security and Public Safety	• Public risks • Crime • Conflicts over resources • Fires	• Need to enhance security in some parts of the project area • Emergency preparedness	• Project area and the surrounding environment	• Some areas are considered as high risk areas in terms of security
Public Consultations	• Awareness creation regarding the project • Environmental pressures in the area • Expert and indigenous knowledge of the area	• Involvement of all stakeholders • Information gathering on environmental issues and concerns in the project area • Acceptability of the project	• Entire project area	• Language barrier
Corporate Social Responsibility	• Community prioritisation of areas/projects for possible CSR assistance	• Stated during the public consultations	• Project area	• High and sometimes unrealistic expectations
Mitigation Measures	• Mitigation hierarchy	• Avoiding or reducing at source • Abating on site • Abating off-site • Repair or remedy • Compensate for loss or damage	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• None
Environmental Management Plan	• Effective mitigations specified for the topics addressed • Costs • Responsibility • Management • Relevant legislation and regulations • Decommissioning	• Least possible interference with the environment • Compliance with principles, policies and legislation relating to conservation of environment • Decommissioning of campsites	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• None

Environmental Monitoring Plan	• Parameters to be monitored • Personnel required • Training needs	• Ease of monitoring • Effectiveness of monitoring method • Cost of monitoring • Frequency	• Pre-determined seismic survey lines on land and lake • Access roads • Selected camp sites and pier sites and facilities	• None

3.4 COLLECTION OF BASELINE DATA

3.4.1 Overview of Methods

The general framework of the baseline data collection was as follows:

- Scoping (determination of geographical and other boundaries; preliminary assessment).
- Review of existing regulatory framework and Institutional arrangement.
- Detailed environmental assessment and community sensitization.
- Impact identification and development of suggested mitigation measures.
- Development of an Environmental Management Plan (EMP) including costs estimates and responsibility assignment.

Prior to the field study, a desktop study was conducted to review the available reports, and to design plans and maps in order to compile relevant biophysical and socio-economic information of the project area. The field study (detailed environmental impact assessment, community sensitization and social impact assessment, and development of mitigation measures and environmental management plan) was undertaken in two phases: from 4th to 13th March and from 13th to 20th April. GPS coordinates were taken and recorded for all the sampling points in the field as shown in Figure 3.1. Biophysical studies covered environmental aspects such as physiography, climate, hydrology, drainage, soils, geology/hydrogeology, vegetation, wildlife, and aquatic environment. The socio-economic environmental study covered information on issues such as population, literacy, social amenities (healthcare and schools), land use, land tenure, the social dimensions of well being and income levels, water supply, sanitation levels and security, along with other pertinent issues. The field study also enabled cross-checking of the data compiled during the desktop study.

3.4.2 Physiography and Geology

A literature review and field verification of the physiography, regional geology and geological setting of the project area was undertaken and the potential of related hazards such as subsidence, landslides, earthquakes, soil erosion, etc. were assessed in relation to the proposed seismic survey to be done in the area. A seismic survey base map representing the area was also obtained from TKBV and a map with fossil sites was obtained from the Turkana Basin Institute (TBI).

3.4.3 Soils

Primary soil data was obtained using the exploratory soil and agro-climatic zone map and report of Kenya (Sombroek *et al* 1982). Reference was also made to the NOCK oil blocks map for boundary delineation. The scale used in this report was 1:50,000. Field data was collected

through visual observation of soil units and road/riverbed cut descriptions where applicable. The surface description assisted in classification of the soil units. Parameters assessed included soil texture, colour, structure, drainage, soil depth, surface stones and rock outcrops. Surface physical characteristics were described to determine wind and soil-water erosion hazards, flooding, ponding and water-logging potential and accessibility of the units by equipment and vehicles. A GPS was used to geo-reference the sampling points. Soil samples were collected for fertility and texture laboratory determination. Desktop work included soil map compilation and correlation to assign soil boundaries and harmonize the soil legend.

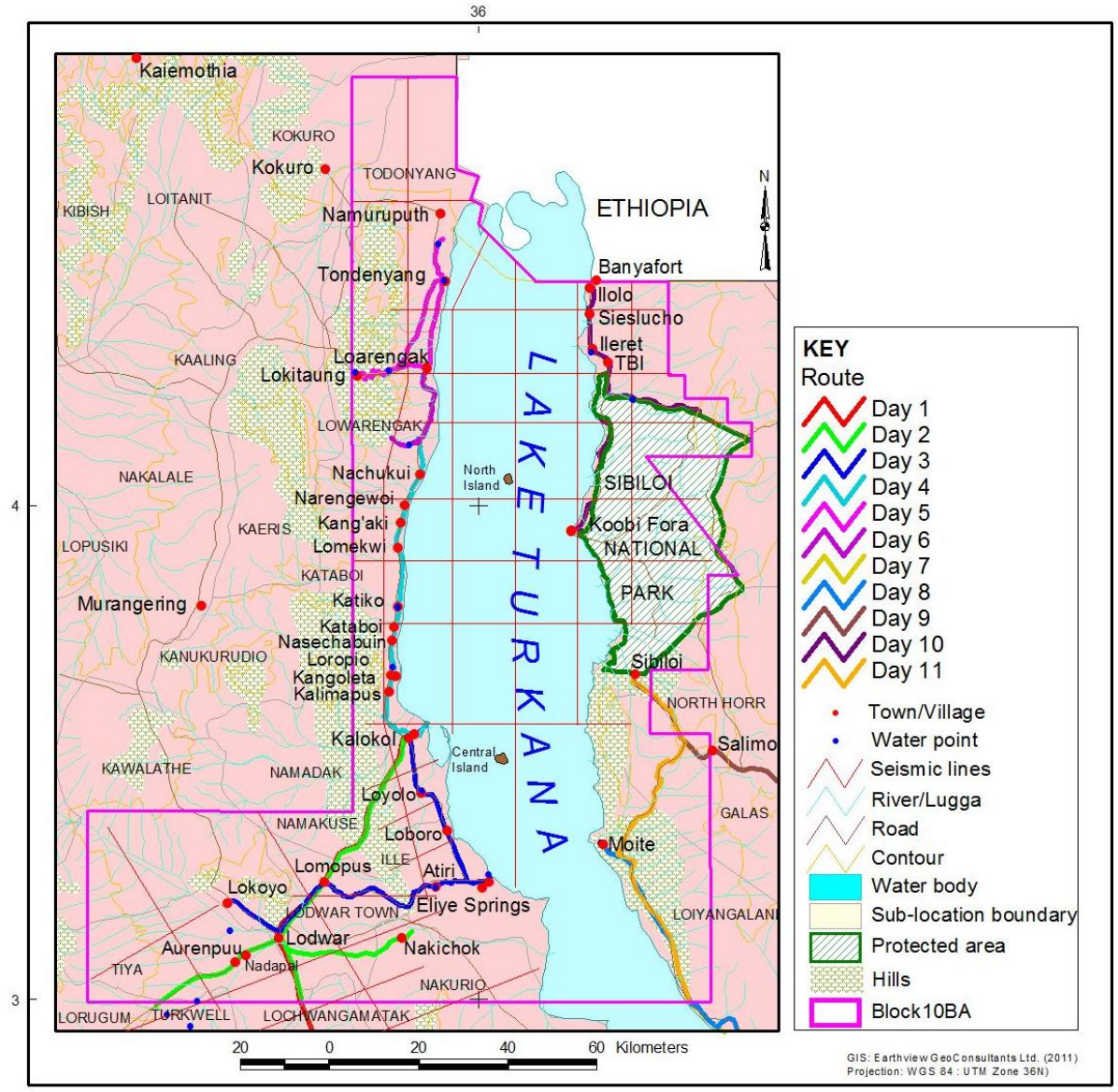


Figure 3.1: Route map of the project area.

3.4.4 Climate

Wind and precipitation data was obtained from desktop studies of existing literature from Kenya Meteorological Department. In addition, wind data was supplemented by visual observations in the field.

3.4.5 Air Quality

Determination of the ambient air quality in this rural and sparsely populated setting was assessed qualitatively.

3.4.6 Surface and Ground Water Resources

In order to assess the water potential and quality, a literature review was conducted covering the existing water sources for physico-chemical analysis. In addition, water samples were collected from boreholes, shallow wells, water pans, springs, streams and rivers for physico-chemical analysis. Some water samples were also collected from the lake. The locations of all sampling points were determined and recorded using a GPS receiver.

3.4.7 Terrestrial Environment

Collection of baseline information for the terrestrial environment including floral and faunal components in the project area was based on field observations and supported by literature review. Considerations included inventories of habitat types and species (including local names, where provided); vegetation cover, classes, and dominance levels; presence of rare and endangered species; presence of ecological reserves, and any critical ecosystem components. In addition, assessment was done to determine whether the area has experienced any known loss of habitat or biodiversity decline, and whether the proposed seismic survey activity would have any adverse effect on the existing ecosystems, flora, and fauna. Field guide books were handy in helping to confirm identified species.

Habitats and animal encounters of interest were recorded, and photographs of species of mammals, birds, reptiles, amphibians, and arthropods present at the time of observation were taken.

3.4.8 Aquatic Environment

Assessment of the lake environment included field-based identification of floral and faunal components in the project area and sampling, supported by a literature review. The lake habitats were assessed, covering issues such as: inventories of lake habitat types and species; presence of rare, endemic and endangered floral and faunal species; presence of ecological reserves. A boat was used to carry out the study, and GPS coordinates of points/places of interest were noted.

Sampling and analysis methods for the various parameters were as follows:

- Phytoplankton samples were taken using a 20 litre container and sieved through a 20µm sieve. Counts were done using an inverted compound microscope.
- Zooplankton samples were taken using zooplankton nets of diameter 0.29m with a mesh size of 335µm which was towed for 10 minutes at a constant speed by the boat. Samples collected were analysed using a dissecting microscope.
- Phosphates and nitrates in the water column were assessed using the colorimetric method and a spectrophotometer.
- Depth readings were taken using a hand held Echo Sounder (PLASTIMO ECHO TEST II).
- Temperature readings were taken using a normal mercury thermometer (-5 to 50ºC).

- Salinity readings were taken using a hand-held portable refractometer (0 – 100 ppt; W/ATC300011).
- pH readings were taken using a portable pH meter (Orion 3 Star).
- Samples for Total Suspended Solids (TSS) were collected and filtered through a glass fibre filter using a hand pump.

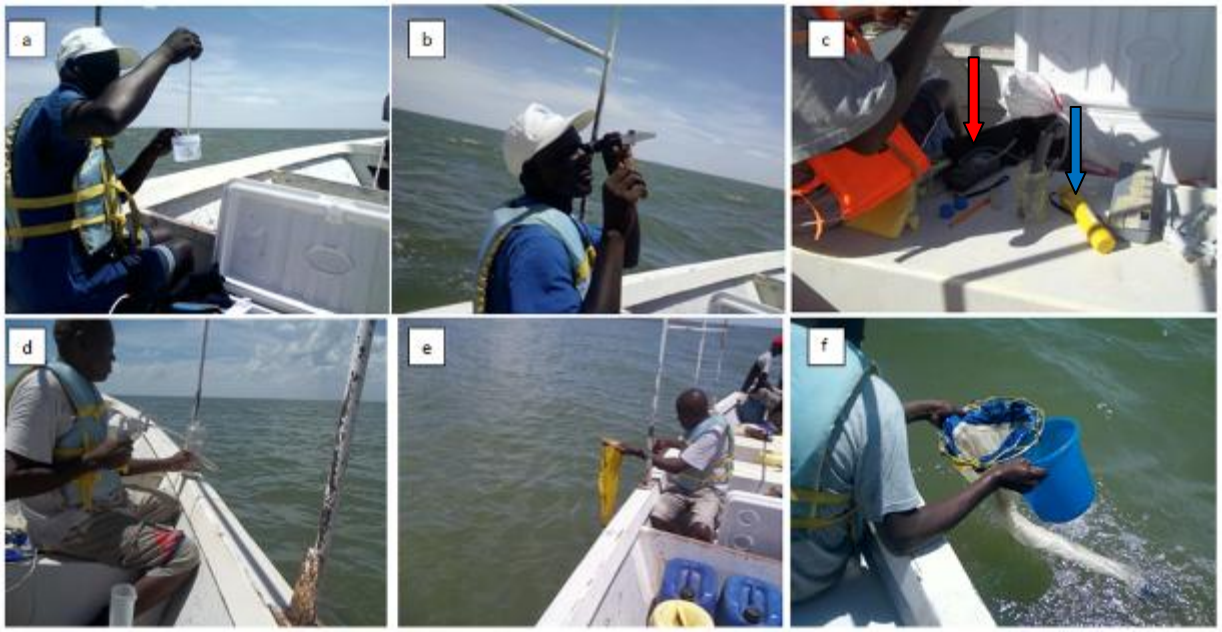


Plate 3.1: a) In-situ temperature measurement, b) salinity measurement, c) pH measurement (red arrow) and echo sounder for depth measurement (blue arrow), d) TSS sampling, e) phytoplankton sampling and f) zooplankton sampling

3.4.9 Land and Lake Resources and National Parks

The assessment was achieved through literature review and direct observation. The issues considered included available natural resources, heritage sites, as well as land use patterns in the area. Also considered was the potential impact of the proposed seismic exploration in the area on the resources and heritage sites.

3.4.10 Visual Aesthetics

An assessment of visual aesthetics was based on observations in the field. The following issues were considered:-

- Scenery;
- Geomorphology and landscapes;
- Pristine natural environments;
- Potential impacts of seismic surveys and associated operations on the visual aesthetics of the area.

3.4.11 Noise and Vibrations

The potential disturbance caused by noise levels during the seismic operation within the project area were taken into consideration during the fieldwork period. The mitigation of noise and

vibrations arising from the use of vibroseis and dynamite (on land) and airguns (in water) to generate the acoustic (seismic) waves, and associated support vehicles, vessels and equipment, were addressed.

3.4.12 Solid and Liquid Wastes

Possible impacts from solid and liquid wastes generated as a result of the proposed seismic operation were assessed taking into account the increased use of motor vehicles and marine vessels, and mitigation measures suggested. An assessment of methods to be employed in solid waste and effluent management in the proposed project was made and implementation suggestions recorded.

3.4.13 Public Consultations and Socio-Economics

Public consultations were carried out with the following aims:

- To inform the local people and their leaders about the proposed seismic data acquisition project and its objectives.
- To gather the concerns and views of the local people and fishermen on the proposed project.
- To establish if the local people foresee any positive and/or negative impacts associated with the proposed seismic survey project, and suggest possible ways of mitigating negative impacts and enhancing positive impacts arising from it.
- To identify and document the diverse socio-cultural and economic setups in the project area that could be potentially impacted by the project activities.

Table 3.1: Meetings held in Block 10BA

	DAYS & DATES	TIME (Start/End)	AREAS COVERED	DISTRICTS	GPS COORDINATES
1	MONDAY 7/03/2011	10:05A.M 12:05 P.M	Kalokol Location Kaolokol Division	TURKANA CENTRAL	266/ N03.53931 E035.86171 379M
2	TUESDAY 8/03/2011	9:05 A.M 10:25A.M	Lodwar Location Lodwar Division	TURKANA CENTRAL	-
3	TUESDAY 8/03/2011	3:05 P.M 5:03 P.M	Kang'atotha Location Kalokol Division	TURKANA CENTRAL	267/ N03.13376 E035.96272 498M
4	WEDNESDAY 9/03/2011	3:40P.M 5:00P.M	Kalokol Location Kalokol Division	TURKANA CENTRAL	-
5	FRIDAY 11/03/2011	10:14 A.M 11:30A.M	Kataboi Location Kataboi Division	TURKANA NORTH	268/ N03.75672 E035.83034 396M
6	FRIDAY 11/03/2011	1:02P.M 2:05P.M	Nachukui Sub location Ng'isiger Location Lokitaung Division	TURKANA NORTH	268/ N04.06762 E035.88334 405M
7	SATURDAY 12/03/2011	9:00 A.M 10:30 A.M	Lowareng'ak Sub location Ng'isiger Location Lokitaung Division	TURKANA NORTH	269/ N04.27898 E035.89540 390M
8	SATURDAY 12/03/2011	1:51 P.M 3:20 P.M	Lokitaung Location Lokitaung Division	TURKANA NORTH	270/N04.27220 E035.75329 736M
9	SUNDAY 13/03/2011	10:10A.M 10:39 A.M	Todonyang Location Lapur Division	TURKANA NORTH	271/N04.45869 E035.92911 367M
10	MONDAY 14/03/2011	11:50 A.M 1:30 P.M	Lodwar Location Lodwar Division	TURKANA CENTRAL	-
11	THURSDAY 14/04/2011	10:33 A.M 12:55 P.M	Loiyangalani location Loiyangalani Division	LOIYANGALANI	N2.75720 E36.71862

12	THURSDAY 14/04/2011	3:00 P.M 4:15 P.M	Komote village ElmoloBay Sublocation Loiyangalani Location Loiyangalani Division	LOIYANGALANI	N2.82654 E36.69770
13	FRIDAY 15/04/2011	1:22 P.M 2:43 P.M	Moite Sub location Loiyangalani Location Loiyangalani Division	LOIYANGALANI	N3.31458 E36.25065
14	SUNDAY 17/04/2011	2:35 P.M 3:36 P.M	Illeret Location North Horr Division	NORTH HORR	N4.31117 E36.22831

Other social and economic aspects relating to the project area, including livelihoods and cultures, education and health, among others, were assessed.

The methodologies employed include review of available literature, public meetings and consultation with local residents and their leaders; and administration of formal questionnaires and interviews with interested parties and at household level.

3.4.14 Health and Public Safety

This assessment was done through literature review of the available health data in the area. It also consisted of a site-walk survey using a checklist of environmental health issues such as general level of sanitation, waste disposal practices, water supply and availability of health facilities.

The main issues assessed include:

- Sources of water;
- Types of sewage disposal/facilities;
- Types and quality of housing;
- Refuse disposal;
- The general cleanliness of the environment;
- Availability of health facilities;
- Interaction between environment and health; and
- Potential health impacts related to the project.

3.4.15 Key informant interviews

Administrative, social, economic, cultural and health issues were captured through interviews with key informants, including district administration officers, opinion leaders, councillors, community elders, chiefs, teachers, health workers and spiritual leaders. Some of the information elicited during these interviews included:

- Cultural practices;
- Religion and belief systems;
- Social amenities and infrastructure;
- Health facilities available within the communities in the project area;
- Common diseases in the community;
- Community health concerns relating to the project;
- Health expectations from the project;
- View on employment of locals for the project; and Security issues.

3.5 IMPACT ASSESSMENT CRITERIA AND RATING SCALES

CRITERIA	RATING SCALES
Intensity (expected size or magnitude of impact)	**Negligible** **Low** - where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected **Medium** - where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected **High** - where natural, cultural or social functions and processes are altered to the extent that it will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected
Extent (predicted scale of impact)	**Site-specific** **Local** (immediate surrounding areas) **Regional** **National**
Duration (predicted lifetime of impact)	**Short-term** - 0 to 5 years **Medium term** -6 to 15 years **Long term** - 16 to 30 years - where the impact will cease after the operational life of the activity either because of natural processes or by human intervention **Permanent** - where mitigation either by natural process or human intervention will not occur in such a way or in such a time span that the impact can be considered transient
Probability (likelihood of impact occurring)	**Improbable** – where the possibility of the impact materialising is very low **Probable** – where there is a good possibility (<50% chance) that the impact will occur **Highly probable** – where it is most likely (50-90% chance) that the impact will occur **Definite** – where the impact will occur regardless of any prevention measures (>90% chance of occurring)
Status of impact	**Positive** - a “benefit” **Negative** - a “cost” **Neutral**
Degree of confidence (specialist’s level of confidence in predictions +/or information on which it is based)	**Low** **Medium** **High**

Assigning significance ratings

The application of all the above criteria to determine the significance of potential impacts uses a balanced combination of duration, extent and intensity, modified by probability, cumulative effects and confidence.

Significance is described as follows:

Low: Where the impact will have a negligible influence on the environment and no modifications or mitigations are necessary for the given programme description. This would be allocated to impacts of any severity/magnitude, if at a local scale and of temporary duration.

Medium: Where the impact could have an influence on the environment, which will require modification of the programme design and/or alternative mitigation. This would be allocated to impacts of moderate severity/magnitude, locally to regionally, and in the short-term.

High: Where the impact could have a significant influence on the environment and, in the event of a negative impact the activity/ies causing it, should not be permitted (i.e. there could be a 'no-go' implication for the programme, regardless of any possible mitigation). This would be allocated to impacts of high magnitude, locally for longer than a month, and/or of high magnitude regionally and beyond.

The relationship between the significance ratings and decision-making can be broadly defined as follows:

Low: Will not have an influence on the decision to proceed with the proposed programme, provided that recommended measures to mitigate impacts are implemented;

Medium: Should not influence the decision to proceed with the proposed programme, provided that recommended measures to mitigate impacts are implemented; and

High: Would strongly influence the decision to proceed with the proposed programme.

CHAPTER 4:

POLICY, LEGAL, AND REGULATORY FRAMEWORK

4.1 THE CONSTITUTION OF KENYA, 2010

The Constitution provides that every person has the right to a clean and healthy environment (Article 42). The State is obligated to conserve the environment and natural resources and to protect genetic resources and biological diversity. In that regard it must eliminate any processes or activities that would be likely to endanger the environment. Everyone is expected to cooperate with the State agencies to protect and conserve the environment and ensure that the use and development of the natural resources are ecologically sustainable (Article 69). These environmental rights are enforceable in a court of law (Article 70). Land must be used in a sustainable manner, and in accordance with the principles of sound conservation and protection of ecologically sensitive areas. The State may regulate the use of any land or right over any land in the interest of land use planning (Article 66).

The Constitution of Kenya gives recognition to public, community and private land. Land use regulation goes beyond exploitation merely for economic purposes, and lays emphasis on conservation. It is required that wildlife conservation promotes sustainable development which includes both environmental conservation and economic development. Parliament has five years from the date of promulgation to enact legislation to give full effect to the provisions relating to the environment. Community land vests in communities identified on the basis of ethnicity, culture, or other similar common interest. Apart from land registered or transferred, it consists of land that is lawfully held, managed or used by specific communities as grazing areas or shrines, and ancestral lands (Articles 60 – 72). The State is generally mandated to regulate the use of any land in the public interest. Public land is described as including: all minerals and mineral oils; specified government forests; government game reserves; water catchment areas; national parks; government animal sanctuaries; specially protected areas; and all rivers, lakes and other water bodies as defined by law. However, land on which mineral and mineral oils exist is held by the national government in trust for the Kenyan people (Article 62). Lake Turkana is listed by UNESCO as a World Heritage Site (natural). Its National Parks, consisting of Sibiloi, Central and Southern Islands, are protected sites and are under the management of the Kenya Wildlife Service. The archaeological sites in the area are managed by the National Museums of Kenya.

4.2 THE POLICY FRAMEWORK

4.2.1 Environment and Development Policy

The Environment and Development Policy is outlined in the draft Sessional Paper No.6 of 1999. It covers the following environment and development issues: biological diversity; land and land based resources; water resources; fisheries and marine resources; energy resources; atmospheric resources; waste management; management of toxic and dangerous chemicals; radiation management; environmental health and occupational safety; human settlements; disaster management; implementation strategies; priorities for action; human resources development; environmental planning; environmental laws; environmental impact assessment;

environment and land use practices; environment, industry and economic development; environment, research and technology coordination and participation; regional and international cooperation; and environmental management authority.

It outlines the following principles, goals and objectives:

Principles

a) Environmental protection is an integral part of sustainable development.
b) The environment and its natural resources can meet the needs of present as well as those of future generations if used sustainably.
c) All the people have the right to benefit equally from the use of natural resources as well as an equal entitlement to a clean and healthy environment.
d) Poverty reduction is an indispensable requirement for sustainable development.
e) Sustainable development and a higher quality of life can be achieved by reducing or eliminating unsustainable practices of production and consumption; and by promoting appropriate demographic policies.
f) Endogenous capacity building is essential for development, adaptation, diffusion, and transfer of technologies for sustainable development.
g) Indigenous/traditional knowledge and skills are vital in environmental management and sustainable development.
h) Effective public participation is enhanced by access to information concerning the environment and the opportunity to participate in decision-making processes.
i) Public participation including women and youth is essential in proper environmental management.
j) For sustainable management, the polluter pays principle should apply.
k) Access to judicial and administrative proceedings, including redress and remedy, is essential to environmental conservation and management.
l) Private sector participation in environmental management is essential for sustainable development.
m) Effective measures should be taken to prevent any threats of damage to the environment, notwithstanding lack of full scientific certainty.
n) Peace, security, development, and environmental protection are interdependent and indivisible.
o) International co-operation and collaboration is essential in the management of environmental resources shared by two or more states.

Overall Goal

The overall goal is to integrate environmental concerns into the national planning and management processes and provide guidelines for environmentally sustainable development.

Specific Goals

a) To incorporate environmental management and economic development as integral aspects of the process of sustainable development.
b) To promote maintenance of a quality environment that permits a life of dignity and well being for all.
c) To encourage sustainable use of resources and ecosystems for the benefit of the present generations, while ensuring their potential to meet the needs of future generations.

d) To promote maintenance of ecosystems and ecological processes essential for the functioning of the biosphere.
e) To promote the preservation of genetic resources, biological diversity, their cultural values and their natural heritage.
f) To incorporate indigenous knowledge, skills, and interests for effective participation of local communities in environmental management and sustainable development.

Objectives

a) To conserve and manage the natural resources of Kenya including air, water, land, flora, and fauna;
b) To promote environmental conservation with regard to soil fertility, soil conservation, biodiversity, and to foster afforestation activities;
c) To protect water catchment areas;
d) To enhance public awareness and appreciation of the essential linkages between development and environment;
e) To initiate and encourage well coordinated programmes of environmental education and training at all levels of society;
f) To involve NGOs, private sector, and local communities in the management of natural resources and their living environment;
g) To support a coordinated approach to policy formulation on environmental matters;
h) To ensure development policies, programmes, and projects take environmental considerations into account;
i) To ensure that an acceptable environmental impact assessment report is undertaken for all public and private projects and programmes;
j) To develop and enforce environmental standards;
k) To enhance, review regularly, harmonize, implement, and enforce laws for the management, sustainable utilization, and conservation of the natural resources;
l) To provide economic and financial incentives for sustainable utilisation, conservation, and management of natural resources;
m) To apply market forces, taxation, and other economic instruments including incentives and sanctions to protect the environment and influence attitudes and behaviour towards the environment;
n) To ensure adherence to the polluter pays principle; and
o) To develop adequate national laws regarding liability and compensation for the victims of pollution and other environmental damage.

4.2.2 National Policy on Water Resources Management and Development (Sessional Paper No.1 of 1999)

The management of water resources in Kenya is guided by four specific policy objectives, namely:

a) Preserve, conserve and protect available water resources and allocate it in a sustainable, rational and economic way.
b) 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.
c) Establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector.
d) Develop a sound and sustainable financing system for effective water resources management, water supply and sanitation development.

4.2.3 Energy Policy (Sessional Paper No.4 of 2004)

The broad objective of the national 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 specific objectives are to:

a) provide sustainable quality energy services for development;
b) utilise energy as a tool to accelerate economic empowerment for urban and rural development;
c) improve access to affordable energy services;
d) provide an enabling environment for the provision of energy services;
e) enhance security of supply;
f) promote development of indigenous energy resources; and
g) promote energy efficiency and conservation as well as prudent environmental, health and safety practices.

4.2.4 Mining Policy

The National Mineral Resources and Mining Policy is currently at an advanced stage of being adopted. In tandem with this process, the Government has developed new mining legislation to replace the *Mining Act, Cap.306* of 1940, which is both antiquated and ineffective. Under the new mining legislation, rights and interests in minerals of all kinds, including commonly found minerals, will be regulated. The new mining legislation is being harmonised with existing environmental legislation. In particular, mining companies will be required to comply with the requirements of the Environmental Management and Co-ordination Act and other applicable environmental legislation and, the new legislation will provide that mining licences may not be granted unless the applicant has obtained an Environmental Impact Assessment ('EIA') Licence.

4.2.5 Health Policy

The Kenya Health Policy Framework (1994) sets out the policy agenda for the health sector up to the year 2010, so this is likely to be reviewed in the near future. The policy includes strengthening of the central public policy role of the Ministry of Health (MoH), adoption of an explicit strategy to reduce the burden of disease, and definition of an essential cost-effective healthcare package. To operationalise this Health Policy Framework Paper, the National Health Sector Strategic Plan (NHSSP, 1999-2004) was developed in 1994. The strategic plan emphasized the decentralisation of health care delivery through redistribution of health services to rural areas. The plan is currently being revised to reflect the Poverty Reduction Strategy Paper (2001-2004) agenda. The new plan focuses on the essential key priority packages based on the burden of disease and the required support systems to deliver these services to the Kenyans. Major players in the health sector include the government represented by the Ministry of Health and the Local Government, private sector and non-governmental organization (NGOs). The organization of Kenya's health care delivery system revolves around three levels, namely the MoH headquarters, the provinces and the districts. The headquarter sets policies, coordinates the activities of NGOs and manages, monitors and evaluates policy formulation and implementation. The provincial tier acts as an intermediary between the central ministry and the districts. It oversees the implementation of health policy at the district level, maintains quality standards and coordinates and controls all district health activities. In addition, it monitors and supervises district health management boards (DHMBS), which supervise the operations of health activities at the district level.

4.2.6 Economic Recovery for Wealth and Employment Creation Strategy

The overall goal of the Strategy is to ensure clear improvements in the social and economic well-being of all Kenyans, thereby giving Kenyans a better deal in their lives and in their struggle to build a modern and prosperous nation (GVEP Kenya, 2006). The key areas covered in the Strategy are:

(i) expanding and improving infrastructures;
(ii) reforms in Trade and Industry;
(iii) reforms in forestry;
(iv) affordable shelter and housing;
(v) developing arid and semi-arid lands; and
(vi) safeguarding environment and natural resources.

The Strategy, which has commanded a great deal of attention in recent years, essentially subsumes the Poverty Reduction Strategy Paper (PRSP).

4.2.7 Kenya Vision 2030

Kenya Vision 2030 was launched on October 30, 2006, and is the country's new development plan for the period 2008 to 2030. It seeks to transform Kenya into an industrialized "middle-income country providing a high quality of life to its citizens by the year 2030".

Vision 2030 is based on three 'pillars': the economic, the social and the political. The adoption of the Vision follows the successful implementation of the Economic Recovery Strategy for Wealth and Employment Creation (ERS) launched in 2002. The Vision is to be implemented in successive five-year medium-term plans, with the first such plan covering the period 2008-2012.

The economic, social and political pillars of Kenya Vision 2030 are anchored on macroeconomic stability, continuity in government reforms, enhanced equity and wealth-creation opportunities for the poor, infrastructure, energy, science, technology and innovation, land reform, human resources development, security, as well as public sector reforms.

The foundations for the Vision are:

a) **Macroeconomic Stability for Long-term Development**: The Vision places the highest premium on Kenya's current stable macroeconomic environment which works in favour of the poor, and expects it to continue in the future as a matter of policy. The projects proposed under Vision 2030 will be subjected to the parameters set under the macroeconomic stability framework.

b) **Continuity in Governance Reforms**: These will be accelerated in order to create a more conducive environment for doing business, and also to enable Kenyans to fully enjoy their individual rights under the Constitution. Towards this end, the government will intensify the anti-corruption programme through more efficient investigation and prosecution; eliminating bribery in the public service and increasing public education and judicial and legal reform. The government will also fully support the people of Kenya, parliament, civil society and the press, recognising that they are the ultimate defence against abuse of office.

c) **Infrastructure**: The Vision aspires for a country firmly interconnected through a network of roads, railways, ports, airports, water and sanitation facilities and telecommunications. This is a high priority issue.

d) **Enhanced Equity and Wealth-Creation Opportunities for the Poor**: The Vision includes equity as a recurrent principle in economic, social and political programmes. Special attention has been given to arid and semi-arid districts, communities with high incidence of poverty, the unemployed youth, women, and all vulnerable groups.

e) **Science, Technology and Innovation (STI):** The government will intensify the application of STI to increase productivity and efficiency levels across all three pillars. It recognises the critical role played by research and development in accelerating development in the emerging nations. The government will create and implement an STI policy framework to support Vision 2030.

f) **Land Reform**: Land is a vital resource for the socio-economic and political developments set out in the Vision. It is recognized that respect for property rights to land, whether owned by individuals, communities or companies is key to rapid economic growth. A national land use policy will need to be created urgently to enable this growth.

g) **Human Resources Development**: Kenya will create a globally competitive and adaptive human resource base to meet the needs of a rapidly industrializing economy through training and education, raising labour productivity to international levels, creating a human resource database to facilitate better planning, and establish more training institutions.

h) **Security**: The government will increase security in order to lower the cost of doing business and provide Kenyans with a more secure environment to live and work in. The strategies will include improving community policing, reducing the police-to-population ratio, and adopting information and communication technology in crime detection and prevention. These measures will be supported by judicial reforms.

i) **Energy**: Since development projects recommended under Vision 2030 will increase demand on Kenya's energy supply, she must generate more energy at a lower cost and increase efficiency in energy consumption. The government is committed to continued institutional reforms in the energy sector, including a strong, regulatory framework, and will encourage more power generation by the private sector. New sources of energy will be found through the exploitation of geothermal power, coal, and renewable energy sources.

j) **The Public Sector**: An efficient, motivated and well-trained public service is expected to be one of the major foundations of the Vision. Kenya intends to build a public service that is more citizen-focused and results-oriented. The government will intensify efforts to bring about an attitudinal change in public service that values transparency and accountability to the citizens of Kenya.

4.3 KENYA LEGISLATION AND REGULATIONS

4.3.1 The Petroleum (Exploration and Production) Act, Cap. 308

The purpose of this legislation is to regulate the Government's negotiation of petroleum agreements relating to oil exploration, among other things. The Act, its regulations, and the terms and conditions of the petroleum contract, together govern oil operations. The Minister may make regulations for the conservation of petroleum resources, the safety measures to be taken on site, environmental protection and the prevention of pollution, waste and accidents. The contractor[2] is expected to take necessary measures to conserve petroleum and other resources, as well as protect the environment and human life. Should the rights of the owner or occupier be infringed in the course of the petroleum operations, the contractor must pay a fair and reasonable compensation (sections 4, 6, 9, 10). In our view, precedent cases of compensation under similar conditions, where they exist, should be considered as guidelines to the level of compensation.

4.3.2 The Petroleum (Exploration and Production) Regulations

The existence of a petroleum agreement or the issue of a permit under the parent Act does not authorize the contractor or the grantee to occupy or exercise any rights in a) any burial land in the locality of any church, mosque or other places of worship; b) any area within fifty metres of any building in use, or any reservoir or dam; c) any public road; d) any area within a municipality or township; d) any land within one thousand metres of the boundaries of any aerodrome; and any land declared to be a national park or national reserve under the Wildlife (Conservation and Management) Act. However, directional drilling into the subsurface from land adjacent to the mentioned areas is permitted with the consent of the competent authority (Regulation 6).

It relates to interference with sensitive cultural, natural heritage sites, and the use of vibroseis machines, dynamite charges and exhaust emissions from vehicles, machines and equipment such as generators, etc. It also relates to disturbance of flora and fauna.

4.3.3 The Explosives Act, Cap. 115

There are restrictions on transport, storage and possession of both authorized and unauthorized explosives. A permit is required to purchase and use blasting materials as well as to convey explosives within Kenya (sections 6, 7, 11, 13). It also applies to noise and vibrations from dynamite charges.

4.3.4 The Explosives (Blasting Explosives) Rules

The use of explosives in the vicinity of any public road is not permitted. Also prohibited is the use or transport of explosives in the working of a mine, quarry, excavation or other project, unless an "explosives manager[3]" has been appointed and the inspector notified in writing. The explosives manager is responsible for the safety and security of all explosives used, transported or stored, until they are handed to the blaster for use. He is also responsible for the safety of every person who may be employed on the project, whether under his direct

[2] "Contractor" here means the individual(s) or company undertaking the work or project.
[3] "Explosives Manager" here means any person assigned to be responsible for the explosives.

supervision or not (Rules 78 – 80) in the context of the use of explosives. Also, such responsibility does not extend to a situation where the person was operating under the direct supervision or control of someone else who holds a valid permit to use explosive materials when the prevailing rules were contravened, or an accident occurred.

4.3.5 The Merchant Shipping Act, 2009

The Minister of Transport has the power to make regulations in respect of vessels operating in inland waters including near the coast, and more specifically in relation to: safety of navigation and vessels, permissible cargo and method of storing it; the safety equipment to be carried aboard the vessels; sanitary requirements; duties of masters carrying explosives and dangerous cargo; and any other matter that he/she may deem fit to enhance the safety and security of vessels plying the inland waters as well as preserve the aquatic environment (section 36).

This relates to the safety and health of the project vessel crew and others plying the waters. It also covers the disturbance of aquatic life and habitats such as would be caused by vessel strikes, and the use of airguns. In addition, it applies to interference with fishing and other marine activities.

4.3.6 The Fisheries (General) Regulations

These regulations are made under the Fisheries Act, Cap. 378. The Kenya fishery waters (being the inland waters and the waters of the maritime zones as described in the Maritime Zones Act, Cap. 371) are designated pollution-prevention zones in order to protect the aquatic environment ecology. Unless it is to protect the safety of craft or crew in an emergency situation, no one is permitted to place or discharge into any of Kenya's fishery waters any article, including abandoned fishing gear or any other pollutant which may (a) cause harm to any fisheries resource or marine mammal, (b) interfere with fishing or obstruct fishing gear or vessels, or (c) become a hazard to navigation. Where any person intends to move a boat or fishing gear from a body of water to another within Kenya's inland waters, or anything already placed in that body of water, he must notify a fisheries officer in charge of the waters from which the vessel or equipment is intended to be moved. The officer must then inspect the vessel or equipment to ensure that they bear no forbidden weeds, fish or other organisms that may spread to other fishery water bodies (Regulations 59 - 62).

Breeding areas are protected and no one may disturb any spawn or spawning fish in such areas (Regulation 50). Fishing for some species of fish may be restricted for a specified closed season under the Fisheries (Prohibitions) Regulations, 2003, ostensibly to permit unhnindered spawning. Notice of such restriction will be published in the Kenya Gazette. Trawling is a prohibited fishing method on Lake Turkana, and one may not land fish whose standard length is less than 25cm (Regulation 43 (1) (c) and (5) (a)). There are no other specific fisheries restrictions on the lake at the present time.

4.3.7 The Energy Act, No. 12 of 2006

All petroleum business must be conducted in compliance with the Kenya Standard or other approved standard on environment, health and safety and in conformity with the relevant laws in that regard. Measures must be instituted for transporting petroleum by inland waters, pipeline or any other mode to ensure that the mode of transportation is safe. Anyone engaged in any licensed undertaking must notify the Energy Commission of any accident or incident causing

loss of life, personal injury, explosion, oil spill, fire or any other accident or incident causing significant harm or damage to property or to the environment (sections 98, 117).

This Act is applicable to the health and safety of the project crew and the environment.

4.3.8 The Public Health Act, Cap. 242

This legislation focuses on securing and maintaining health. The Director of Medical Services may enter any premises or vessels to execute or superintend rules for prevention of disease. The provisions of the Act apply to every vessel anchoring off or arriving in a port or being elsewhere in territorial waters (section 57). Any noxious or waste water discharged from any premises into any watercourse, irrigation channel or bed not designated to receive it is deemed a nuisance (section 118). It is the duty of every local authority to take measures to prevent any pollution dangerous to the health of any supply of water which the public uses for domestic purposes. They must purify the water supply should it become polluted, and take appropriate action against any person polluting any such water supply or any stream so as to cause a nuisance or danger to health (section 129). They are also obligated to take measures to maintain clean and sanitary conditions and to prevent or remedy any nuisance that may cause injury to health (section 116). The Minister may make rules (a) as to the standard or standards of purity of any liquid which may be discharged as effluent after treatment or (b) for the discharge of liquid or other material prone to cause offensive smells, pollute streams, or are likely in any way to be a nuisance or dangerous to health (section 126).

This statute is applicable to the waste generated at the camp and worksite(s) and its safe discharge.

4.3.9 The Occupational Safety and Health Act, No. 15 of 2007

This legislation applies to all workplaces. Every occupier must ensure the health, safety and welfare at work of all the people working in his workplace as well as protect other people from risks to safety and health occasioned by the activities of his workers. The occupier's duty to ensure the safety, health and welfare of all persons at work in his premises includes providing a working environment and work procedures that are safe. The likely emission of poisonous, harmful, or offensive substances into the atmosphere should be prevented, and where such incidents occur, they must be rendered harmless and inoffensive. Machinery, protective gear, and tools used in all workplaces have to comply with the prescribed safety and health standards. Dust, fumes or impurity must not be allowed to enter the atmosphere without appropriate treatment to prevent air pollution or harm of any kind to life and property. Highly inflammable substances must be kept in a safe place outside any occupied building. Where dangerous fumes are liable to be present, there must be a means of exit and suitable breathing apparatus made available. Means for extinguishing fire must be available and easily accessible, and evacuation procedures tested regularly (sections 6, 21, 47, 55, 64, 78, 79, 81, 82).

This covers activities that may be hazardous to the health and safety of the project workers and other persons both onshore and offshore, due to accidents caused by, for instance, vehicle collisions, collisions with animals, and vessel to vessel collisions. It includes injury involving equipment, as well as emissions from vehicles, equipment and vessels. It also relates to vibroseis machines and dynamite charges.

4.3.10 The Water Act, Cap. 372

The Minister is mandated to prescribe a system for classifying water resources in order to determine resource quality objectives of each water resource. It is an offence to wilfully obstruct, interfere with, or divert water from any watercourse or water resource, or to negligently allow such acts, or to throw any dirt, effluent, trade waste or other offensive or unwholesome matter or thing into or near any water resource in such a way as to cause or be likely to cause pollution of the water resource (sections 12, 44 and 94).

This Act is relevant to the project waste generation – solids, effluents and oils at camp and work areas – and its safe discharge.

4.3.11 The Water Resources Management Rules, 2007

No one may discharge any toxic or obstructing matter, radioactive waste or other pollutants into any water resource unless the discharge has been treated to permissible levels. Discharge of effluent into a water resource requires a valid discharge permit issued by NEMA. The wilful and deliberate spilling into any water source or onto land where the spillage may contaminate any surface or groundwater is not permitted. Any threat of contamination must swiftly be dealt with (Regulations 81, 82, 88). NEMA may identify a catchment area or part of a catchment area or water resource to be recognized as a protected area or designated as a groundwater conservation area if it is satisfied that it is necessary to protect the water resource and its multiple uses (Regulation 123).

This Act is applicable to the safe discharge of waste emanating from the camp/s and worksites.

4.3.12 The Local Government Act, Cap. 265 (Revised 2010)

This Act gives local authorities the power to control or ban businesses, factories and workshops which may emit smoke, fumes, chemicals, gases, dust, smell, noise or vibration, and in so doing become a danger or annoyance to the neighbourhood. The local authority may therefore lay down conditions under which such enterprises may carry on business (section 163). A local authority may refuse to grant or renew a licence, or cancel it on various grounds, some of which are (a) that it would cause nuisance or annoyance to the residents; and (b) that the method adopted or proposed to prevent noxious or offensive vapours, gases or smells arising from the trade are not efficient (section 165). However, the Local Government (Amendment) Bill, 2009, is intended to repeal and replace this statute and will provide for various classes of local authorities. It is worth noting that the Bill provides that a municipality will be granted city status and a city metropolitan status only if they demonstrate an effective programme of environmental conservation and the ability to render environmental conservation services within their areas respectively. The Bill went through its second reading in Parliament in June 2010.

This relates to the project's compliance with the laws and regulations regarding the protection of the environment from forms of pollution that may occur as a result of the use of vibroseis machines, dynamite charges, and waste discharge and disposal, as well as exhaust emissions from vehicles, machines and equipment.

4.3.13 The Physical Planning Act, Cap. 286

The statute establishes Physical Planning Liaison Committees to determine development applications relating to industrial location, dumping sites or sewerage treatment which may

have adverse impact on the environment. If a local authority is of the opinion that a proposed development, dump site, sewerage treatment plant, quarry or other development activity will impact on the environment adversely, it will require the applicant to submit an environmental impact assessment report for consideration.

This Act covers any project development activities that may result in adverse effects on the environment, particularly the generation of waste and the method of its discharge.

4.3.14 The Wildlife (Conservation and Management) Act, Cap. 376

Where the Minister is satisfied that in order to secure the safety of the flora and fauna or to preserve the habitat and ecology within a national park, reserve or sanctuary, it is necessary to restrict or forbid any activity in the adjacent area, he may declare it a protected area and prohibit those activities. The Wildlife Director or any authorized officer of the Service may close to the public or any class of people, a portion of a national park or any road or part of a road within the park for a period for the protection of animal or plant life, or for the safety of the public, or for the protection of a road, or for climatic reasons, or for any other reason (Regulation 4). The Minister may declare that any provision of the Act shall apply to non-game animals, or to any trophy or meat of any such animal, and on publication of the notice the animal concerned will be deemed to be a game animal or game bird (section 15).

This Act relates to the project in the form of any disturbance of aquatic life, flora and fauna, interference with cultural and natural heritage sites and visual aesthetics.

4.3.15 The National Museums and Heritage Act, Cap. 216

The Minister may prohibit or restrict access or any development which in his/her opinion is liable to damage a monument or object of archaeological or palaeontological interest there. A protected area means a site which has been and remains so declared by the Minister under section 25 (1). These include (a) an open space, (b) a specified site on which a buried monument or object of archaeological or palaeontological interest exists, including the adjacent area, or (c) a geo-park. The protected area may be placed under the control of the National Museums of Kenya. Where private land is included in a protected area, the owner of the land is entitled to compensation. All antiquities lying in or under the ground, or on the surface of any land protected under the law as a monument, or being objects of archaeological, palaeontological and cultural interest are the property of the Government (sections 25, 34, 35, 46).

This statute relates to the disturbance of, and interference with, sensitive cultural, natural heritage and archaeological sites by the proposed project.

4.3.16 The Penal Code, Cap. 63

The following acts constitute offences under section 191 to 193 of the Penal code:

- Voluntarily fouling the water of any public spring or reservoir, thereby making it less fit for its normal purpose.
- Corrupting the atmosphere in any place, so as to make it noxious to the health of people in the vicinity.
- For trade or other purposes, making loud noises or offensive smells in circumstances causing annoyance to others.

The relevance of this Code, to the proposed project, relates to compliance with the law as regards air and water pollution from site activities.

4.4 NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY – ACT AND REGULATIONS

4.4.1 The Environmental Management and Co-ordination Act, 1999

The Environmental Management and Co-ordination Act, 1999, provides for the establishment of an appropriate legal and institutional framework for the purpose of managing the environment and matters connected with it. The National Environment Management Authority (NEMA) is established under section 7 of the Act. Its mandate is to monitor the operations of industries, projects or activities to determine their immediate and long-term effects on the environment.TKBV, being a project whose activities fall within the ambit of the Act, is therefore subject to its provisions. The Act (Part VIII) lays down provisions pertaining to environmental quality standards. It establishes a Standards and Enforcement Review Committee whose broad functions are to (a) advise NEMA on how to establish criteria and procedures to measure water and air quality and (b) issue standards and guidelines for the safe and proper disposal of waste (sections 70, 71, 78, 86). Where Kenya is a party to an international convention, treaty or agreement on the management of the environment, NEMA must initiate legislative proposals to give effect to them (section 124).The law does not permit anyone to deposit any substance in a lake, river or wetland or in, on or under its bed, if that substance is likely to cause adverse environmental effects. NEMA may prescribe measures to ensure that the biological resources in place are preserved, issue guidelines to promote the conservation of the various terrestrial and aquatic systems, and protect species, ecosystems and habitats threatened with extinction. Any area of land, lake or river may be declared a protected natural environment in order to promote and preserve specific ecological processes, natural environment systems or species of indigenous wildlife. It is an offence to discharge pollutants into the aquatic environment. No one is permitted to discharge any hazardous substance, chemical, oil or mixture containing any oil into any waters or any other parts of the environment. Noise must not be emitted in excess of the laid-down standards (sections 42, 43, 51, 54, 71, 72, 93, 102, 108).

This statute regulates all the activities of projects that may have adverse environmental impacts.

4.4.2 The EIA Guidelines and Administrative Procedures

The Environment Impact Assessment and Administrative Procedures arose from the policy framework and the legislative and regulatory (the Environmental Management and Co-ordination Act, 1999, and its regulations) procedures in order to assist in the integration of environmental concerns in economic development so as to foster sustainable development. The document sets out guidelines for carrying out Environmental Impact Assessment, Environmental Audit and Monitoring, Strategic Environmental Assessment and dealing with issues of transboundary, regional and international conventions, treaties and agreements. It sets out the procedure in EIA studies and Environmental Audits as well as the contents and format of the reports required to be submitted to NEMA for consideration. The EIA study review process and decision-making are also explained. The guidelines are mainly intended to assist project proponents, EIA practitioners, lead agencies and members of the public to understand the process and the basis on which decisions are made.

4.4.3 The Environmental Management and Co-ordination (Water Quality) Regulations, 2006

Everyone is required to refrain from any act which directly or indirectly causes water pollution, and no one may throw or cause to flow into or near a water resource any liquid, solid or gaseous substance, or deposit any such material in or near it so as to cause pollution. No one is permitted to carry out any activity near lakes, streams, springs and wells that is likely to have an adverse impact on the quality of the water without first obtaining an environmental impact assessment licence. It is an offence to discharge or apply any toxic or obstructing matter, radioactive wastes or other pollutants or permit the dumping or discharge of any such matter into water meant for fisheries and wildlife (Regulations 4-8, 12 and 24).

This applies to solid or liquid waste generated from the campsite or from the project site(s) and other work areas, and the manner of disposal of such waste in, or close to, the named water sources.

4.4.4 The Environmental (Impact Assessment and Audit) Regulations, 2003

Any project that is likely to have a negative impact on the environment must be submitted to an environmental impact assessment process. The terms of reference must include matters considered germane in the environmental impact assessment process as set out in the Second Schedule to the Regulations. In addition, the study must take into account environmental, social, cultural, economic, and legal considerations. The report must state: a) the proposed location of the project and a description of the environment likely to be affected; b) the products, by-products and waste generated by the project; c) the project's environmental effects, including the socio-cultural consequences and the anticipated direct, indirect, cumulative, irreversible, short-term and long-term impacts; d) an environmental management plan proposing the measures for eliminating or mitigating adverse impacts on the environment; e) an action plan to prevent and manage foreseeable accidents and dangerous activities in the course of carrying out the project; and f) the measures to prevent health hazards and to ensure security in the workplace for the employees (Regulations 4, 7, 11, 16 and 18).

Applicability to the proposed project relates to the requirements of the environmental impact assessment process.

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

Regulation 4 provides that no person shall engage in any activity that may have an adverse impact on any ecosystem or lead to the unsustainable use of natural resources. The conservation of biological diversity applies to any area of land, lake or river which the Minister has declared to be a protected natural environment system for purposes of promoting and preserving biological diversity in accordance with section 54 (on protection of environmentally significant areas) of the parent Act (Regulation 8).

This relates to disturbance of flora and fauna, vegetation disturbance and removal, and the disturbance of soil, surface and groundwater, and the marine environment.

4.4.6 The Environmental Management and Co-ordination (Wetland, Riverbank, Lakeshore and Seashore Management) Regulations, 2009

These Regulations aim to ensure the sustainable use of wetlands for ecological and aesthetic purposes and in addition seek to prevent and control pollution and siltation as well as other activities that may degrade the environment. All wetland resources must be used in a sustainable manner compatible with the continued presence of wetlands and their hydrological, ecological, social and economic functions and services. Some permitted uses of wetland include cultivation, fishing (subject to the Fisheries Act), small-scale fish farming, grazing, and hunting (subject to the Wildlife (Conservation and Management) Act). Areas that have national significance may be declared to be protected wetland due to their biological diversity, ecological importance, natural heritage, aesthetic value or landscape. Local authorities are mandated to make bye-laws to manage solid waste and waste waters on lakeshores and riverbanks in accordance with the Public Health Act, Cap. 342 (Regulations 4, 5, 8, 11, 16, 17, 22, 24).

This applies to interference with fishing and other marine activities, and the possible disturbance of aquatic life, flora and fauna. In addition it relates to interference with grazing and other economic activities close to the project area, as well as visual aesthetics, and interference with the natural heritage.

4.4.7 The Environmental Management and Co-ordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

The Regulations prohibit the making of loud, unreasonable, unnecessary or unusual noise or excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of other people and the environment. There are laid-down permissible noise levels which may not be exceeded unless the noise is reasonably necessary to preserve life, health, safety or property. Any person intending to engage in any commercial or industrial activity likely to emit noise or excessive vibrations must carry out that activity within the prescribed level of emission (Regulations 3-5, 11, 20).

These regulations apply to the proposed project in that they relate to noise and vibrations from the use of vibroseis machines, dynamite charges, vehicles, machines and equipment such as generators, etc.

4.4.8 The Environmental Management Co-ordination (Fossil Fuel Emission Control) Regulations, 2006

Every person in Kenya is entitled to a clean and healthy environment and is obligated to safeguard and enhance that environment. Internal combustion engines are subject to inspection and must pass tests to show that they comply with the standards and requirements for the control of air pollution or contamination. It is an offence to operate an internal combustion engine which emits smoke or other pollutant in excess of the emission standards. NEMA may approve any substance to be used as a fuel catalyst if it improves fuel economy, enhances combustion and reduces harmful emissions that adversely affect human, animal and plant health, and degrade the environment. The cost of clearing pollution through fuel emission is borne by the polluter (Regulations 4, 7, 12).

These regulations are relevant to vehicular exhaust emissions that could be potentially harmful to the project crew as well as to other persons in the vicinity. It includes all other equipment that emits fumes.

4.4.9 The Environmental Management and Co-ordination (Waste Management) Regulations, 2006

Anyone generating waste must minimize it by adopting cleaner production methods. This may be done by improving the production process through conserving raw materials and energy, eliminating the use of toxic raw materials and reducing toxic emissions and wastes. Waste can also be minimized by incorporating environmental planning in the design and disposal of the product. Every industrial undertaking must mitigate pollution by installing at its premises anti-pollution equipment for treating the waste it generates. Discharge or disposal of any waste in any form into the environment is not permitted without prior treatment. An Environmental Impact Assessment licence must be obtained by anyone intending to engage in any activity likely to generate hazardous waste. Anyone generating toxic or hazardous waste must have it treated according to the laid-down guidelines (Regulations 14, 15, 17).

This applies to waste generation at camp and the work site(s), and its disposal in a way that does not endanger human health and the environment.

4.5 INTERNATIONAL PRACTICES, STANDARDS AND CONVENTIONS

4.5.1 International Best Practices

Alexandra Wawryk[4] puts forward five major environmental practices that are considered 'best practice' in the oil exploration and production industry by reason of the fact that they have been endorsed by national and international oil companies in their industry guidelines. The five practices, if properly used, reduce the negative impacts of oil exploration and production, particularly in the developing nations where enforcement of environmental laws may be somewhat inadequate. Their application will protect the physical environment as well as the health, culture, economic and social fabric of the local and indigenous communities.

1. *Environmental and Social Impact Assessment (EIA/SIA)*

The Environmental Impact Assessment procedure allows for the study of the significant environmental impacts that may ensue from the activities of the proposed development project. The process involves a number of specific common factors: screening, scoping, identifying alternatives that may have less injurious impacts, the baseline study, impact prediction, possible mitigation measures, the Environmental Impact Statement or Report, public consultation and participation, the decision by the relevant body, and finally the post-project analysis. In many cases, the Social Impact Assessment is undertaken as part of the environmental impact assessment process.

[4] Wawryk, Alexandra, "International Environmental Standards in the Oil Industry: Improving the Operations of Transnational Oil Companies in Emerging Economies", 1 OGEL 1, 2003

2. *Environmental Management Systems (EMS)*

Environmental Management Systems consist of rules of procedure intended to assist the management to detect, prevent and reduce environmental impacts that may arise as a result of the company's activities, and in so doing increase its operating efficiency.

3. *Environmental Performance Evaluation (EPE)*

Environmental Performance Evaluation is a management tool to measure a company's continuing environmental performance (specifically the actions of management employees) against the standards set by the management. It must be informed by meaningful indicators to measure the environmental impact of the company's activities.

4. *Environmental Monitoring and Auditing*

Environmental Monitoring involves regular examination of equipment, management systems and activities and their effect on the environment to ensure that both environmental and social regulations are complied with. The company must also fulfill any other conditions required of the project on the basis of the Environmental Impact Assessment. Environmental Auditing is a systematic, periodic and objective process in assessing an organization's performance in its activities in relation to the laid-down standards and regulations.

5. *Environmental and Social Reporting*

Environmental and Social Reporting requires that a company discloses to the public information regarding its environmental and social performance. This guarantees the company's accountability for the social and environmental impacts of its activities and improves its performance in those areas.

It would appear that these widely accepted codes of best practice were and are intended to apply to all oil exploration ventures, regardless of whether they relate to land, marine or inland waterways. Some countries do have their own codes of practice or guidelines for oil exploration specific to their geographical regions and physical features. South Australia, for instance, has a Code of Practice developed by the Environment Protection Authority for vessel and facility management in respect of marine and inland waters. The United Kingdom has an Inland Waters Small Passenger Boat Code for vessels not proceeding to sea, as well as varied codes for commercial and other uses.

4.5.2 International Conventions

One of the key principles in international agreements is reflected in Principles 21 and 2 of the Stockholm and Rio Declarations respectively, namely that States have sovereignty over their natural resources and the obligation not to cause damage to the environment of other states beyond their borders. Both these principles, including the co-operation principle, form the basis for international cause of action.

It is evident from this rule that States' sovereign rights over their natural resources are limited and subject to significant environmental restrictions. The core principle of the Law of Treaties is that every treaty in force is binding on the Parties and they must therefore fulfill their parts in good faith. However, recognizing that this may not always occur, Parties may refer a dispute to the International Court of Justice (ICJ) which is the United Nations' primary judicial organ, for

interpretation or application of the provisions of the Convention in issue. A legal claim may therefore be brought for environmental damage. However, its application will hinge on the circumstances of each particular case. Violations of treaties may attract sanctions, but in some cases, these have proved to be ineffective.

In the matter concerning Ethiopia's Gibe III Dam, both Kenya and Ethiopia have ratified several Conventions relevant to the project, such as the African Convention for the Conservation of Nature and Natural Resources, the Ramsar Convention and the Convention Concerning the Protection of the World Cultural and Natural Heritage. However, reports (see "Ethiopia's Gibe III Dam: Sowing Hunger and Conflict", *International Rivers, January 2011*)[5] to the effect that a power purchase agreement was signed between Kenya and Ethiopia in 2006 raises questions as to the Kenya government's plans in this regard. Whatever the situation, she has recourse to the ICJ should the Ethiopian government fail to address the project's flawed preparations and the dam's transboundary impacts on Kenya's water rights and her northern people's livelihood. Kenya's failure to protect her citizens' environmental and other rights under the Constitution may expose her to proceedings by any person or class of people to enforce those rights.

There are no foreseeable legal implications at this stage, on the activities of Block 10BA as a result of the circumstances surrounding the Gibe III Dam project in Ethiopia.

The Kenya Constitution provides that the general rules of international law shall form part of the laws of Kenya, as shall any treaty or convention that she ratifies (Article 2). Kenya has ratified or subscribed to the following international conventions that relate to the environment within her borders:

	Convention	Entry into force	Date of ratification
1.	African Convention for the Conservation of Nature and Natural Resources, Algiers, 1968 Parties must conserve their natural resources – soil, water, flora and fauna – ensuring that they are used and scientifically developed in a manner that will benefit their people.	16 June, 1969	12 May, 1969 (accession)
2.	African Convention on the Conservation of Natural Resources (Revised Version) Maputo, 2003 Parties must ensure that developmental and environmental needs are met in a sustainable, fair and equitable manner.	11 July, 2003	17 December, 2003 (signature)
3.	Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971 It provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	21 December, 1975	5 October, 1990
4.	Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972 It establishes a system of collective protection of cultural and natural heritage of outstanding universal value.	17 December, 1975	1 July, 1983
5.	Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973 It aims at ensuring that international trade in specimens of wild animals and plants does not threaten their survival.	1 July, 1975	13 March, 1979
6.	Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979 It aims to protect those species of wild animals that migrate across or outside of national boundaries. Parties must protect them, conserve and restore their habitat, mitigate obstacles to migration and control other factors that might endanger them.	1 November, 1983	
7.	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Basel, 1989 It aims at protecting human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous wastes.	5 May , 1992	2000 (accession)
8.	Amendments to the Basel Convention on the Control of Transboundary Movements of	5 May, 1992	9 September,

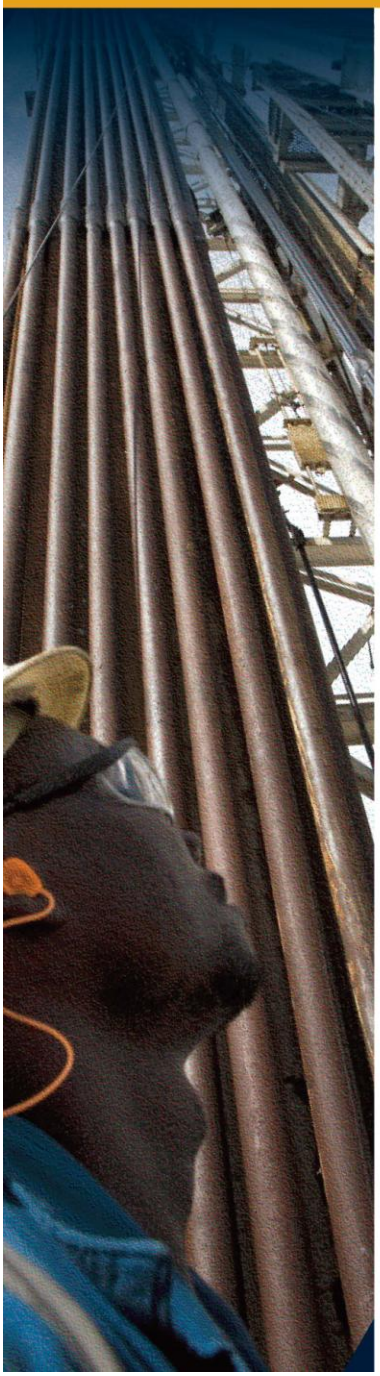
[5] *http://www.international rivers.org/africa/gibe-3-dam-ethiopia*

	Hazardous Wastes and their Disposal, Geneva, 1995 The amendment prohibits exports of hazardous wastes destined for final disposal or recycling purposes from Annex VII countries to non-Annex VII countries (Annex VII not yet in force).		2009 (acceptance)
9.	United Nations Framework Convention on Climatic Change, New York, 1992 It sets an overall framework for intergovernmental efforts to tackle the challenge posed by climatic change, recognizing that the climate system can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.	21 March, 1994	30 August, 1994
10.	Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 1997 It sets binding targets for 37 industrialized countries and the European Community as well as for countries undergoing the process of transition to a market economy in order to reduce greenhouse gas emissions.	16 February, 2005	2005 (accession)
11.	Convention on Biological Diversity, Rio de Janeiro, 1992 It aims at granting the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the use of genetic resources.	29 December, 1993	27 June, 1994
12.	Stockholm Convention on Persistent Organic Pollutants, Stockholm, 2001 It protects human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife. It requires Parties to take measures to eliminate or reduce the release of persistent organic pollutants into the environment.	17 May, 2001	24 September, 2004
13.	Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, Bamako, 1991 It binds Parties to take appropriate legal, administrative and other measures within the area under their jurisdiction to prohibit the import of all hazardous wastes, for any reason, into Africa from non-Contracting Parties.	22 April, 1998	17 December, 2003 (signature)

4.6 TULLOW OIL PLC POLICIES

(next two pages)

Environmental, health and safety policy



At Tullow Oil, we are committed to high standards of Environment, Health and Safety (EHS) performance across our business.

Our goal is to preserve biodiversity and promote sustainable development by protecting people, minimising harm to the environment and reducing disruption to our neighbouring communities.

We seek to achieve continual improvement in our EHS performance.

Tullow Oil has established an EHS management system to ensure that:

- We plan and organise EHS efficiently and effectively.
- Safe places, safe systems of work and suitable procedures are provided and maintained.
- We minimise discharges, emissions and waste that adversely affect the environment.
- Staff and contractors are given appropriate EHS training to perform their tasks competently, safely and with due regard for the environment.
- Risks from our activities are assessed and either eliminated or reduced to acceptable levels.
- We comply with all applicable EHS laws and regulations, and apply responsible standards where the legislation is inadequate or non-existent.
- We are comprehensively prepared to respond effectively in the event of an emergency.
- We promote a culture of reporting and investigating accidents, incidents and near misses, and the sharing of lessons learned.
- We have an audit programme which verifies compliance with this policy and monitors our EHS performance.
- We are all empowered to stop any activity if there is an unacceptable risk of accident or environmental incident.

This EHS policy is reviewed periodically to ensure its ongoing suitability and effectiveness.

Whilst we provide a strong and visible leadership commitment to EHS, everyone in Tullow Oil has individual authority, responsibility and accountability for the safety of themselves and others, and an obligation to actively participate in promoting an effective EHS culture. We will regularly set and review our EHS objectives and targets with the aim of driving continual improvement in EHS knowledge and performance.

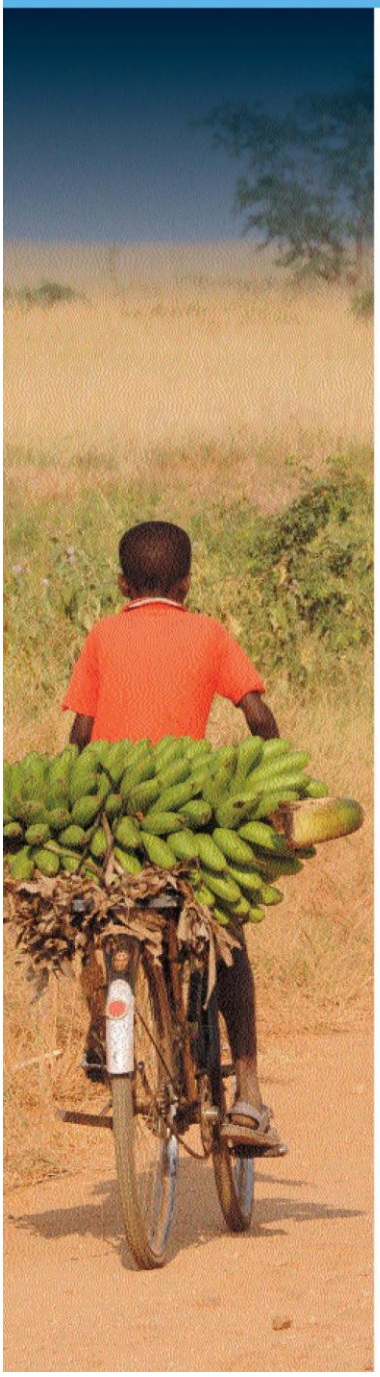
Aidan J Heavey

Aidan J Heavey,
Chief Executive Officer, Tullow Oil plc
May 2009

TULLOW OIL plc

TO-EHS-POL-001-Rev7

Corporate social responsibility policy



Tullow Oil's policy is to conduct all our business operations to best industry standards and to behave in a socially responsible manner.

Our goal is to behave ethically and with integrity in the communities where we work, and to respect cultural, national and religious diversity.

Directors, company personnel and contractors are responsible for ensuring compliance with this policy, and specifically to:

- Respect the rights of all employees, treating them fairly and without discrimination
- Commit to providing opportunities for staff development
- Provide equal employment opportunities
- Recognise individual and team contributions
- Ensure compliance with Tullow's EHS policy by all personnel involved in our activities
- Provide clear direction on key CSR initiatives, policies, performance data and targets
- Actively engage with communities in areas where we operate
- Support selected social and community development projects
- Maintain high ethical standards and support transparency in our activities
- Encourage our partners and stakeholders to observe similar standards wherever possible

Tullow is committed to continual improvement in all its standards and practices.

Aidan J Heavey

Aidan J Heavey,
Chief Executive Officer, Tullow Oil plc
May 2009

TO-EHS-POL-001-Rev7

TULLOW OIL plc

CHAPTER 5:

BASELINE ENVIRONMENTAL AND SOCIAL PARAMETERS

5.1 INTRODUCTION

5.1.1 Project Location and Layout of the Chapter

This chapter provides a description of the current environment and the socio-economic situation in the project area upon which the potential impacts of the proposed seismic survey may be assessed and any environmental changes monitored. It provides details of the desktop studies, field survey, and results from laboratory analyses of samples collected in the field, which are based on the methods applied as outlined in Chapter 3. The project area lies in parts of Turkana North, Turkana Central, Loyangalani and North Horr districts (Figure 5.1). It is bounded by latitudes *ca.*3 ºN and 5ºN and longitudes *ca.*35ºE and 36.5ºE and covers an area of 16204.55 km^2.

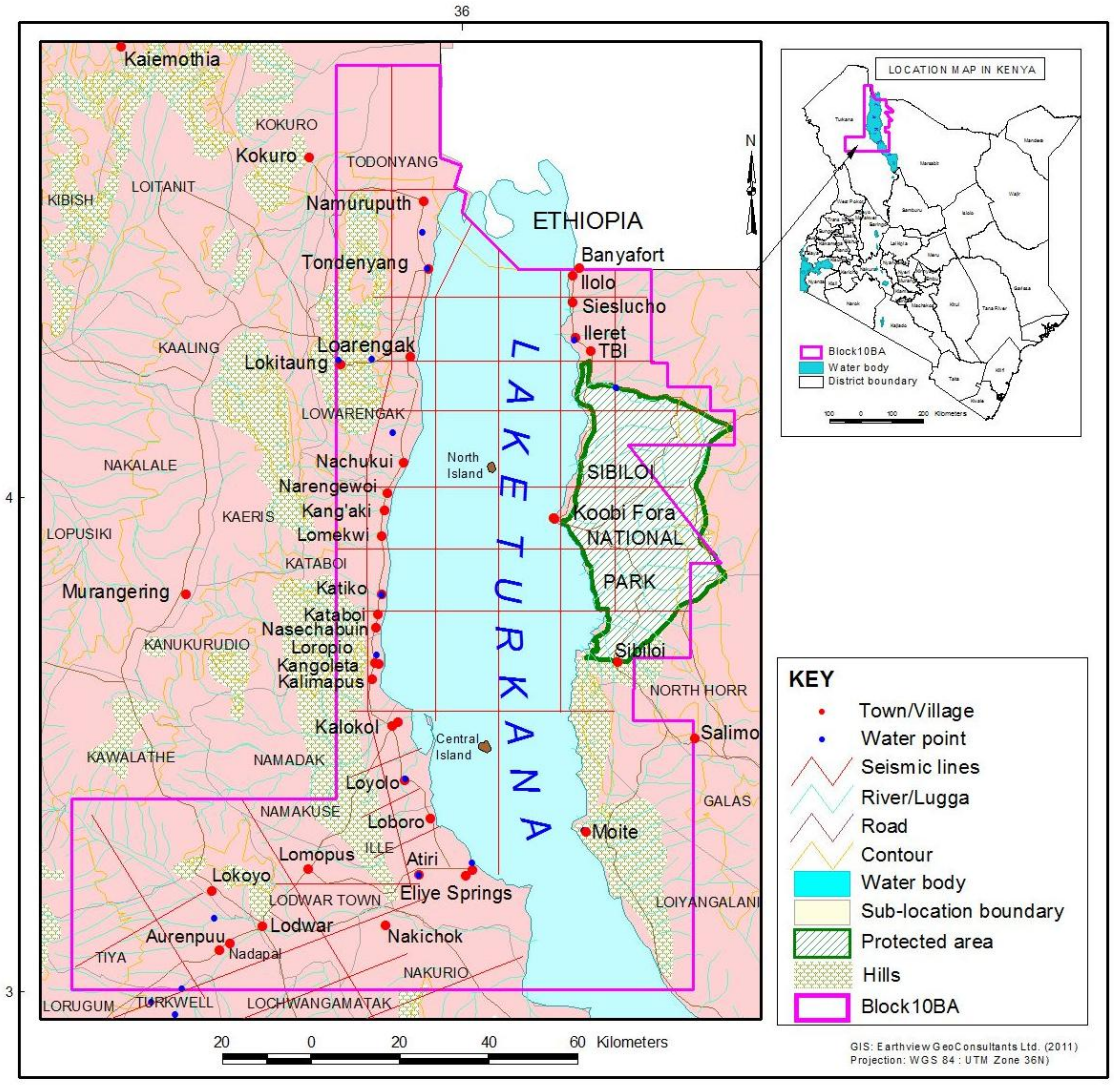


Figure 5.1: Location of the project area.

The baseline study draws from both primary and secondary data sources. Primary data sources involved the visit to the project area and undertaking a baseline survey, while secondary sources of data include various research and published literature including social and economic data from Government reports. It should be noted that some of the information in this chapter may be limited due to lack of previous research. More generally, the Lake Turkana basin area has been little researched due to its remoteness and lack of infrastructure across most sectors and disciplines save for geology and archaeology/palaeoanthropology.

Due to the fact that the seismic survey will take place in two different environmental settings, viz. onshore (land) and offshore (Lake Turkana), that entail different approaches, as well as different technologies, equipment and techniques, this chapter has been structured as follows: the first part deals with the baseline environmental information for onshore seismic survey; the second part deals with the baseline environmental information for the offshore (lake) seismic survey; while the third part addresses the environment-related socio-economic baseline, which is essentially a cross-cutting theme (Table 5.1).

Table 5.1: Chapter layout.
(*) These include information on the entire project area including the lake area and so are not repeated in the section on the offshore baseline environmental survey. However, mitigations related to the Climate and Air Quality sections of the offshore baseline environmental survey are discussed in Chapter 7 on mitigations and in the EMP.

Major Sections in this Chapter	Issues Addressed
Introduction	• Project Location and Layout of the Chapter(*) • Geographical Aspects and Boundaries(*) • Administrative setup (*) • Communications and transport (*) • Government, Non-Governmental and Community Based Organisations(*)
Onshore environmental baseline survey	• Physiography and Geology • Soils • Climate(*) • Air Quality(*) • Surface and Ground Water Resources • Water Quality • Terrestrial Environment • Land Resources and National Parks • Archaeological, Historical and Cultural Sites(*) • Visual Aesthetics(*) • Noise and Vibrations(*) • Solid and Liquid Wastes(*)
Offshore environmental baseline survey	• Lake Bathymetry and Hydrography • Lake Sediments • Climate and Climate Sensitivity • Lake Resources and National Parks • Lake Water Quality • Aquatic Environment
Environment-related Social and Economic baseline	• Demography • Education • Housing

	• Energy sources • Land tenure systems • Labour force • Livestock and crop production • Trade, commerce and Industry • Health settings • Security and public safety • Community views and concerns • Corporate Social Responsibility

5.1.2 Geographical Aspects and Boundaries

Lake Turkana lies in a broad, arid depression between the Ethiopian Rift to the northeast and the Kenyan Rift to the south. It is the largest lake in the eastern arm of the rift valley, with a drainage basin of at least 146,000km^2, a length of about 250 km, an average width of 30km (48 km at its widest), a mean depth of 35 m, and a maximum depth of 120m (Figure 5.2). Its surface area is approximately 6750 km^2. The lake floor slopes gradually from the shoreline towards the offshore basins throughout most of the lake (Dumont, 2009).

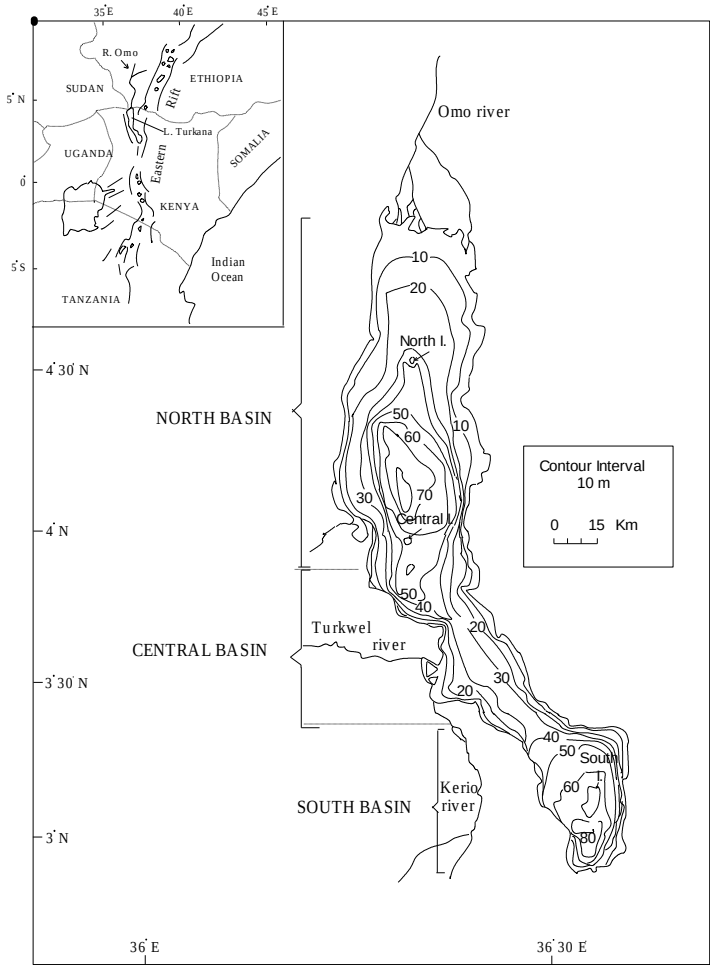


Figure 5.2: Bathymetry of Lake Turkana, East Africa (from UNEP, 2004, after Dunkelman, 1986).

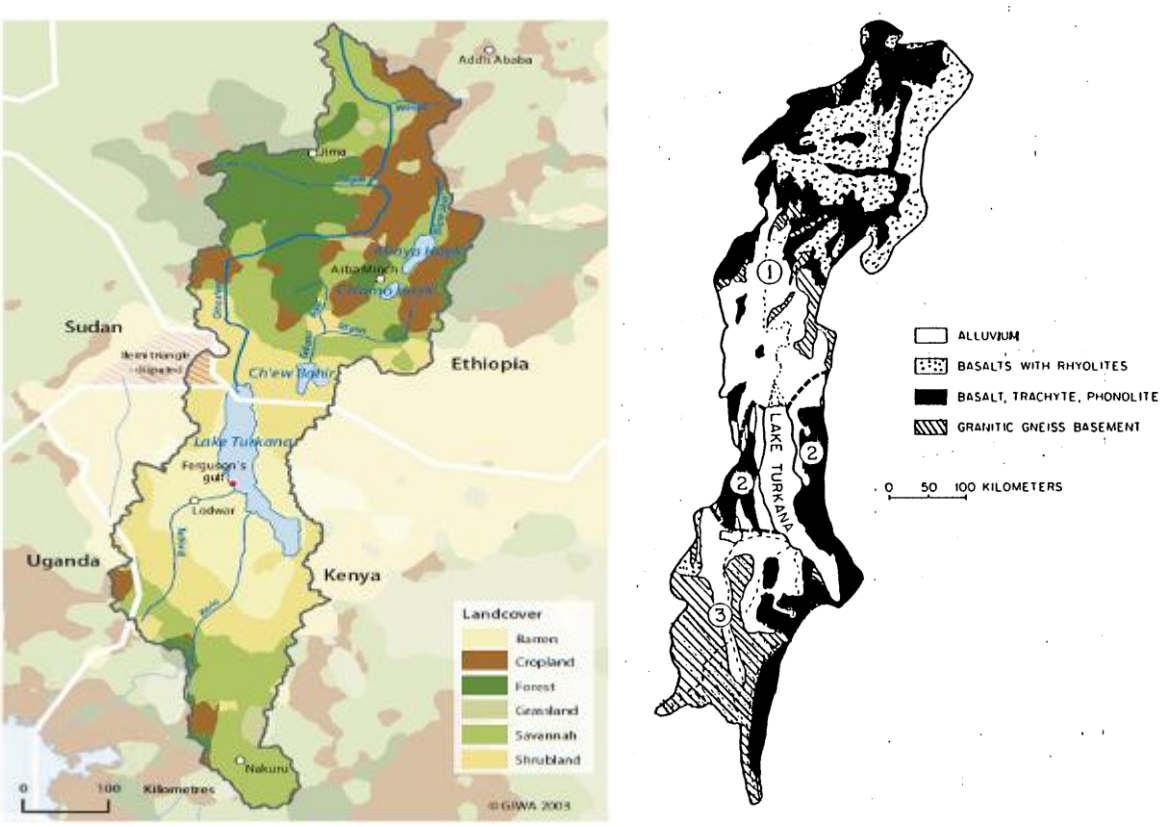


Figure 5.3: Left panel - Lake Turkana watershed (from UNEP, 2004); Right panel – Source rock geology of the Turkana basin. 1. Omo River 2. Area drained by small ephemeral streams 3. Turkwel-Kerio river drainage (from Yuretich, 1979).

Lake Turkana's main tributary is River Omo, which enters the lake from the north and contributes more than 90% of the total water influx (Cerling, 1986), delivering volcanic-rich sediments to the lake from the Ethiopian plateau where mid-year monsoonal rainfall exceeds 1500mm (Halfman and Johnson, 1988) (Figure 5.3). There are other two rivers that drain into the central part of the lake from the west namely the Kerio and Turkwel rivers (Figure 5.3). Other rivers are temporary, flooding only during sporadic rains. The Omo River catchment area accounts for 58% of the total catchment area of the Lake Turkana basin (Ferguson and Harbott, 1982) (Figure 5.3).

Lake Turkana is a closed basin where the water level is determined by the balance between the influx from rivers and groundwater and the evaporation from the lake surface (ILEC, 2002). The lake has no outlet, and water is lost from it mainly by evaporation. The high evaporation rates (estimated at 2,335 mm yr^{-1}), the absence of an outlet, and the reduced inflows to the lake subjects the lake water to a marked seasonal fluctuation of 3-4 m.

5.1.3 Administrative Set-up

The project area straddles parts of two counties: the entire area west of the lake is in Turkana County, while the entire area east of the lake is in Marsabit County (Figure 5.4). Counties are the new second tier administrative level after the National level and the structures are still being set up in accordance with Kenya's new constitution that was promulgated in August 2010. Counties shall be headed by Governors. There are four administrative districts that were established under the old constitution but that are still active until the new constitutional

structures are in place. They are Turkana Central, Turkana North, Loyangalani and North Horr, and are headed by District Commissioners. The district headquarters are in Lodwar, Lokitaung, Loyangalani and North Horr towns, respectively. These districts fall, under the old constitution, in the Rift Valley Province, whose administrative head is the Provincial Commissioner, based in Nakuru town several hundreds of kilometres south of the project area. The block area also covers parts of four parliamentary constituencies, namely, Turkana North, Turkana Central, Laisamis and North Horr (Figure 5.4).

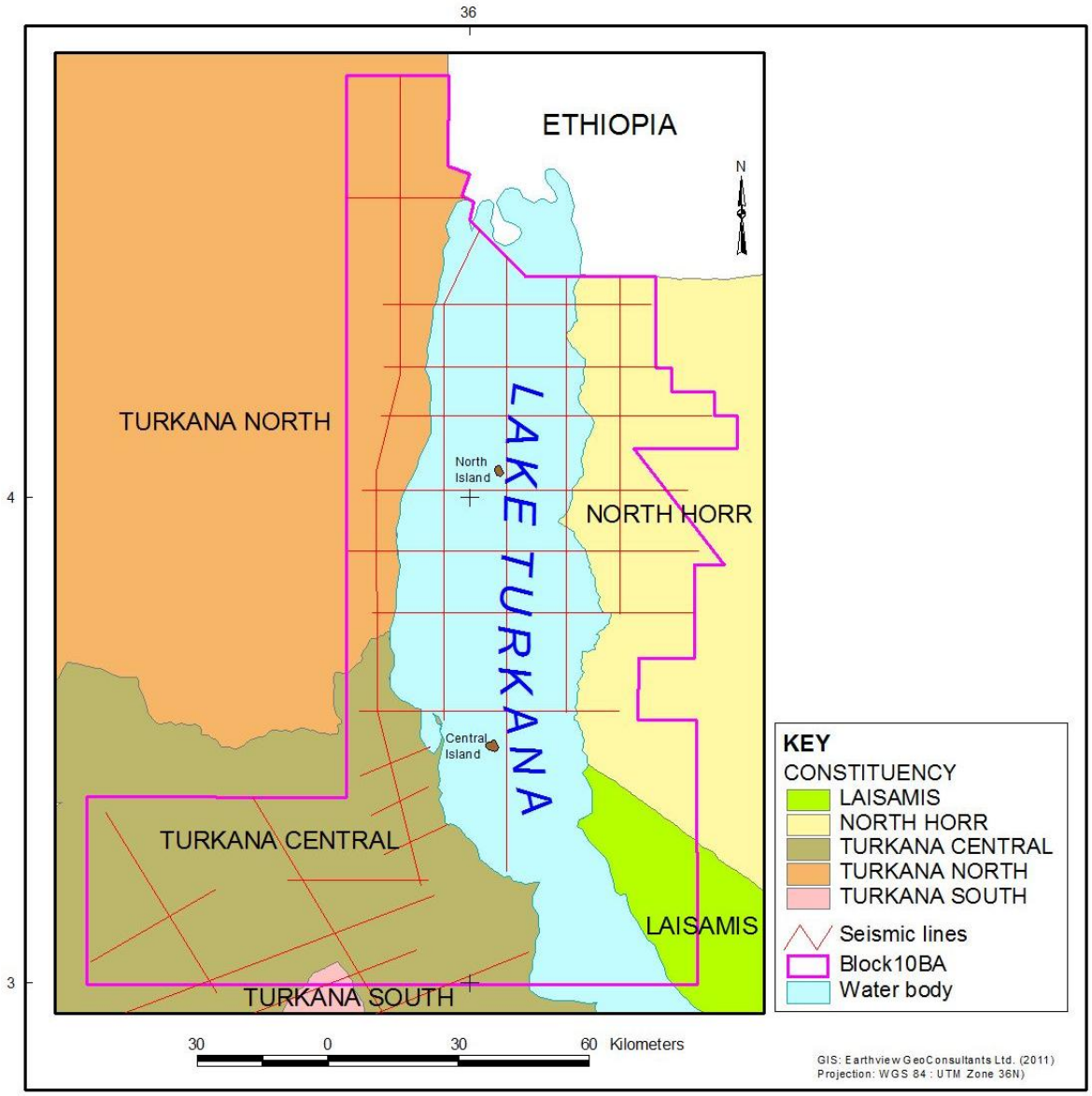


Figure 5.4: Administrative boundaries in the project area: Turkana North, Turkana Central and Turkana South constituencies are in Turkana County, while North Horr and Laisamis constituencies are in Marsabit County.

5.1.4 Communications and Transport

The transport and communications sector is not well developed within the project area (Plate 5.1). The road network is poor, especially in the eastern part of the project area. There is a tarmac road connecting Lodwar town and Kalokol, and the rest are earth roads with some sections being impassable during rainy seasons. Water transport in the lake is available, enabling connections between the eastern and western parts of the area, but it is very expensive.

Plate 5.1: A road section in Moite (Source: fieldwork 2011).

Several airstrips are found within the project area especially in major towns and centres (Plate 5.2). These include Lodwar, Lokitaung, Kalokol and Ileret towns, and Koobi Fora.

Plate 5.2: Ileret airstrip (Source: fieldwork 2011).

Block 10BA is not well covered by telecommunications services save for the major towns of Lodwar, Kalokol, Lokitaung and their environs. The land-based telephone network is extremely poor and unreliable. The mobile telephone network is much better and more reliable, though there are still vast areas that are not under coverage. Radio communications are not, as a rule, used by the public. They fall in the domain of security agencies (e.g. Kenya Police, Kenya army), some governmental agencies and Parastatals such as Kenya Wildlife Services (KWS), and tourist safari companies. These radio communications are not inter-linked, as they are run on different radio frequency bandwidths. Satellite telephones are therefore of prime importance for work in the region (covered by Thuraya) but are generally very expensive and therefore not in use by the general public.

5.1.5 Government, Non Governmental and Community-Based Organizations

The project area is much marginalised and a number of NGOs and community-based organizations are present in the area to assist the local communities (Plate 5.3). These organizations mainly focus on humanitarian aid, security, and provision of water supplies, primarily groundwater. Some of these organizations include World Vision, Merlin, Redcross, and Community Development Trust Fund (CDTF).

Plate 5.3: A sign showing an NGO project in Ileret (Source: fieldwork 2011).

5.2 ONSHORE BASELINE SURVEY

5.2.1 Physiography and Geology

5.2.1.1 Physiography

Coastal and Inland Plains: The western coastal plain that comprises of fine-textured and often diatomaceous sands (of Plio-Pleistocene to Recent age) extends up to 25 km inland from the lakeshore to the Lapur-Lothidok ranges, rising gently westwards to over 100 m above the lake level (Walsh and Dodson, 1969). In many localities the prevailing easterly winds have heaped up the sands to form barchan dunes (Plate 5.4). On the eastern side of the lake, the lacustrine sedimentary plain is bounded to the east by the Gombe Group basalts. The plains show a number of well-defined platforms, marking former lake levels.

Plate 5.4: Barchan dune, Kalimapus area. The dunes are stabilised by balanitis and palm.

Hills and Mountain Ranges: These border, to the west and east of the lake, the lacustrine plains discussed above. To the west of the lake is the impressive Lapur-Lothidok mountain range (Plate 5.5); while to the east of the lake are more gently raised basaltic lava platforms.

Plate 5.5: Lapur Range, photo taken from Todonyang area.

Drainage: In addition to the perennial or large quasi-perennial rivers mentioned in section 5.1.2 above, the entire project area is deeply dissected by numerous, east-west aligned seasonal river channels that drain into Lake Turkana (Figure 5.5) but their contribution to the total water and sediment flux input therein is very small. Locally, they are referred to as “luggas” and are heavily laden with sands.

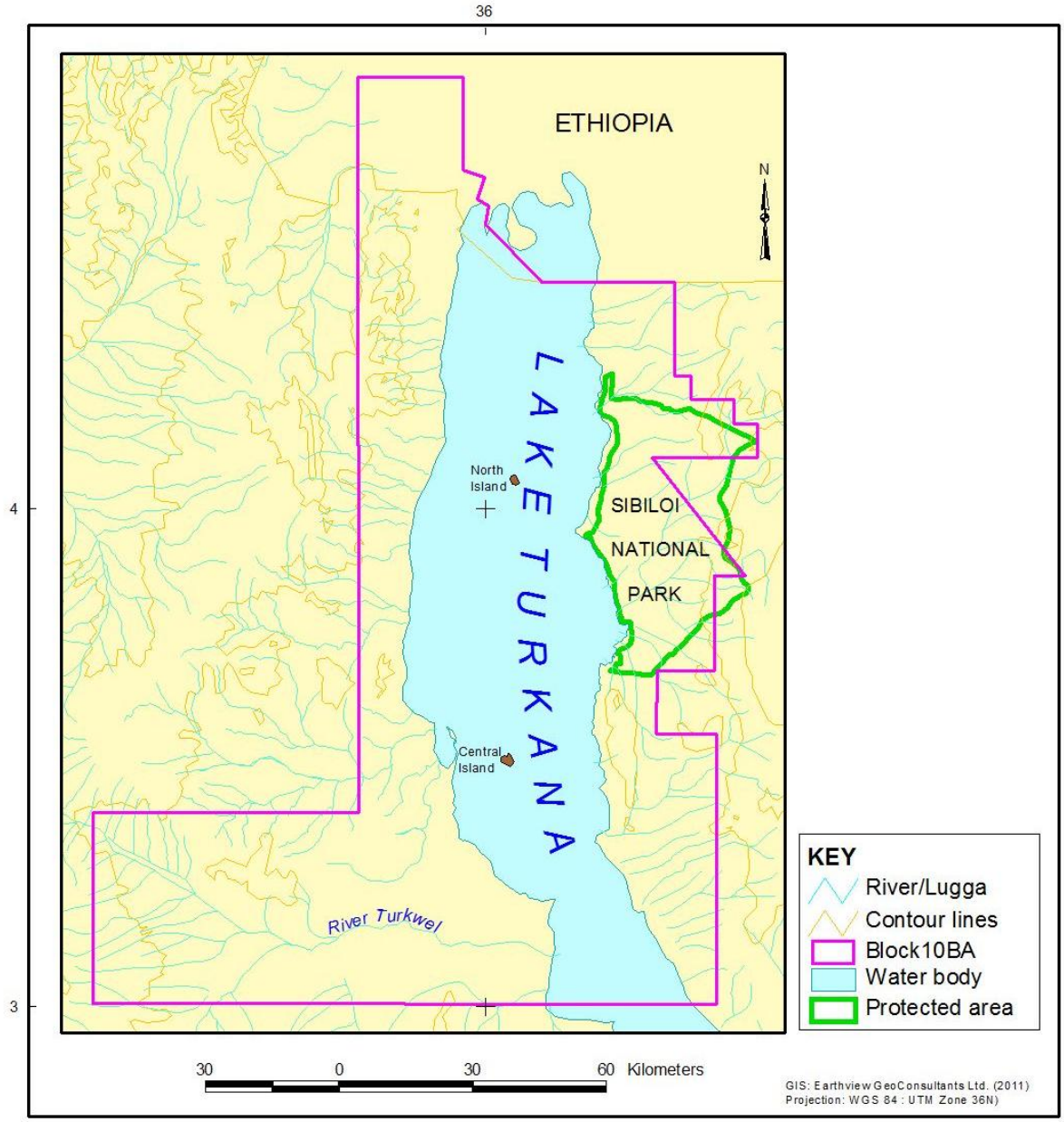


Figure 5.5: Drainage patterns of the project area.

The Turkwel Delta: The Turkwel River forms an extensive delta in the central part of the lake (Plate 5.6). The present sub-aerial part of the Turkwel Delta consists of three major lobes with fossil drainage channels recognizable to the north.

Plate 5.6: Aerial photograph of Turkwel River: note the large sand deposits.

The Omo Delta: Due to climate change and the extensive land use changes in the region, particularly in the Omo River catchment, the amount of fresh water entering the Lake has declined steadily over the years, resulting in the growth of the Omo delta by about 380 km^2 between 1973 and 1989 as seen from Landsat images (Haack & Messina 2001) (Plate 5.7, USGS, 2007); this growth is continuous. The current damming of the Omo River by the Ethiopia government is likely to result in reduced inflows from the Omo River, hence progradation of the delta area.

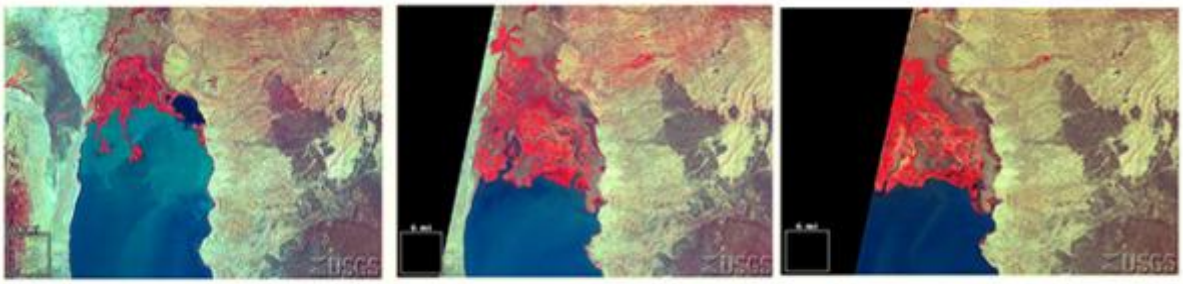


Plate 5.7: Earth shots: Satellite Imageries of Environmental Change, USGS, 2007 (The red section shows the delta).

The Lake Islands: Three active volcanic islands are present within the lake; North Island, Central Island and South Island (Figure 5.2). A fourth centre, presumed inactive and buried under sediments, has been interpreted from the seismic data in the Turkwel Basin (Dunkelman *et al.*, 1989).

Shoreline Features: Shoreline features of the Lake include major spits of the western lake shore; the shores around Longech, Lolibekai and Menar are associated with high energy (Ferguson & Harbott 1982). Primary spits of the eastern shore such as Mvite and Koobi Fora are subject to relatively little wave action but are maintained by currents running along both the

river and lake margins, creating extensive, submerged and often steep-sided sand bars (Ferguson & Harbott 1982).

5.2.1.2 Geology

5.2.1.2.1 Geological Setting

To the north of the lake, the bedrock geology consists of Tertiary to Pleistocene basalts, trachyte, phonolite and rhyolite in the Ethiopian highlands with outcrops of granitic gneiss basement in the lower regions to the south, an area covered largely by alluvium deposited by the Omo River (Figure 5.3). On the western side of the lake, most of the uplands consist of soda-rich basalts, trachytes and phonolites, remnants of Tertiary volcanism, with few and scattered outcrops of Precambrian Basement rocks (Figure 5.3). The alluvium cover is thin and runs in a narrow belt parallel to the lake margin (Figures 5.3 and 5.6).

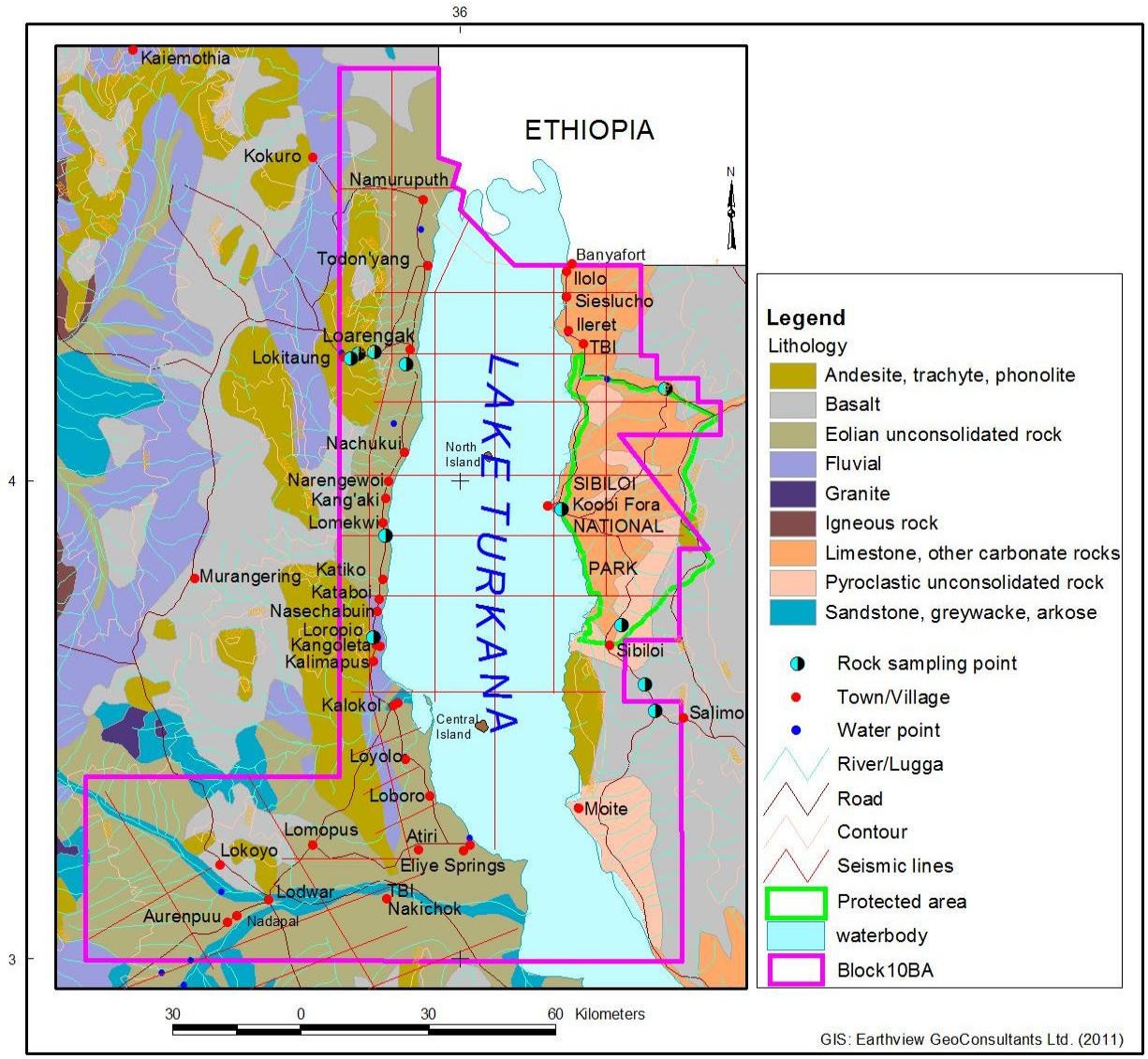


Figure 5.6: Geological map of the project area.

In the south-western hinterland of the lake, south of the project area, are extensive outcrops of Precambrian basement rocks, consisting of biotite gneisses, hornblende gneisses, migmatites and plagioclase amphibolites of the Upper Proterozoic Turbo-Kitale Group (Pallister, 1971) (Figure 5.3). The sediments adjacent to the Kerio-Turkwel drainage system contain quartz, feldspar, illite and smectite, derived from the Precambrian gneisses and schists which characterise the area (Halfman *et al*., 1989). Closer to the lakeshore, the alluvium cover is extensive, deposited by the Turkwel and Kerio Rivers as they wind their way to the lake (Figures 5.3 and 5.6). The southern part of the lake basin consists largely of basalts, trachytes and phonolites, with small and interspersed outcrops of granitic gneiss basement rocks (Figures 5.3 and 5.6). The eastern side is dominated by basalts and pyroclastics on higher ground and extensive alluvial deposits closer to the lake (Figures 5.3 and 5.6).

The major rock types exposed within the project area are: metamorphic rocks of the Precambrian Basement, later volcanic series which are quite extensive (basalts, trachytes, phonolites and pyroclastics) interspersed with sedimentary materials, and Neogene sedimentary deposits consisting of a complex of alluvial fan, fluvial, deltaic and lacustrine deposits exposed over an area of about 2500 km^2 (White and Harris, 1977) (Figure 5.6). Geologically and archaeologically important formations in the area are of Neogene age and include: the Pleistocene Koobi Fora Formation and the Holocene Galana Boi Beds to the east of the lake, and the Nachukui formation to the west.

The present-day Lake Turkana Basin is part of a string of major N-S oriented half-grabens that developed from Cretaceous through Eocene-Oligocene to Plio-Pleistocene times (Mugisha et al., 1997; Morley et al., 1999; Hautot et al., 2000; Tiercelin and Lezzar, 2002; Tiercelin et al., 2004). The northern end of this basin is a N-S trending half-graben that formed during middle to late Miocene times, following a major phase of volcanic activity dated late Eocene to middle Miocene, that resulted in the deposition of the 2.5 km-thick Turkana Volcanics (Bellieni et al., 1981, 1987; Zanettin et al., 1983). The structure of the northern half of the Turkana Basin has been partly imaged using offshore reflection seismic data of the PROBE Project (Rosendahl et al., 1986; Dunkleman et al., 1988, 1989) and few seismic lines acquired by Amoco Kenya Petroleum Company (Wescott et al., 1999). The major N-S oriented border faults that delineate (to the west) the Turkana Rift Basin are imaged on the onshore seismic line. The deep basin configuration below the Turkana Volcanics is almost unknown because of the considerably degraded quality of seismic data below the subsurface volcanics (Morley et al., 1992; Wescott et al., 1999).

5.2.1.2.2 Surface Geology

This section describes the geology of the area (Table 5.2) and currently active geological processes (Table 5.3), focusing on those rock-types and geological processes and hazards that are of significance or relevant with respect to the proposed seismic survey operation in the project area, based on field evaluations. Four large (>5 Richter Magnitude) earthquakes (two centred in the lake) have been recorded in the lake during the period 1900 to 2010 (no major earthquake is recorded after 1973).

Table 5.2: Rock types observed during the field survey that are significant for project logistics and EMP.

Type of Rock	Locality	Brief Description	Natural Hazards	Implications for the Project and EMP
Granitoid gness	Lapur range, Muruasigar west of Lodwar, and Muruanachok northwest of Lodwar	Form escarpments and cliff faces in Lapur range, craggy tors in the other areas	• Potential rock falls or topples	• Seismic lines may have to be deviated • Cut lines will leave long-lasting residual impacts • Rugged terrain • Occupational safety relating to rock falls and topples
Amphibolites	Lapur range	Mainly in the brecciated zone along the eastern margin	• Potential rock falls or topples	• Seismic lines may have to be deviated • Cut lines footprints wil be long-lasting • Rugged terrain
Turkana Grits	Lapur range, Muruangapoi hills, Muruanachok hills, and Lothidok Hills to the west of Lake Turkana. Porr-Sera Iltomia to the east of the lake	They comprise a succession of conglomerates, arkoses, quartzites and sandstones that were mostly deposited in a lacustrine basin. South of the Muruangapoi Hills they are well-gullied and eroded: vertical exposures up to about 8m high can be observed (Plate 5.8).	• Potential rock falls or topples	• Seismic lines may have to be deviated • Cut lines footprints will be long-lasting • Rugged (gullied) terrain a challenge for access roads and cut lines • Occupational safety relating to rock falls and topples
Olivine basalts	Widespread in the western part of the area and at intervals in the eastern part	Gives rise to a much more rugged and steep sided topography	• Potential rock falls along minor scarps with jointed and faulted blocks	• Cut lines will leave long-lasting residual impacts • Rough terrain a challenge for access roads and cut lines • Occupational safety relating to rock falls and topples
Phonolites and Nephelinites	Muruangapoi Hills and Lodwar cone	Have highly rugged topography (Plate5.9)	• Potential rock falls or topples	• Seismic lines may have to be deviated • Cut lines footprints will be long-lasting • Occupational safety relating to rock falls and topples

Plate 5.8: Outcrop of Turkana Grits, south of Turkwel River.

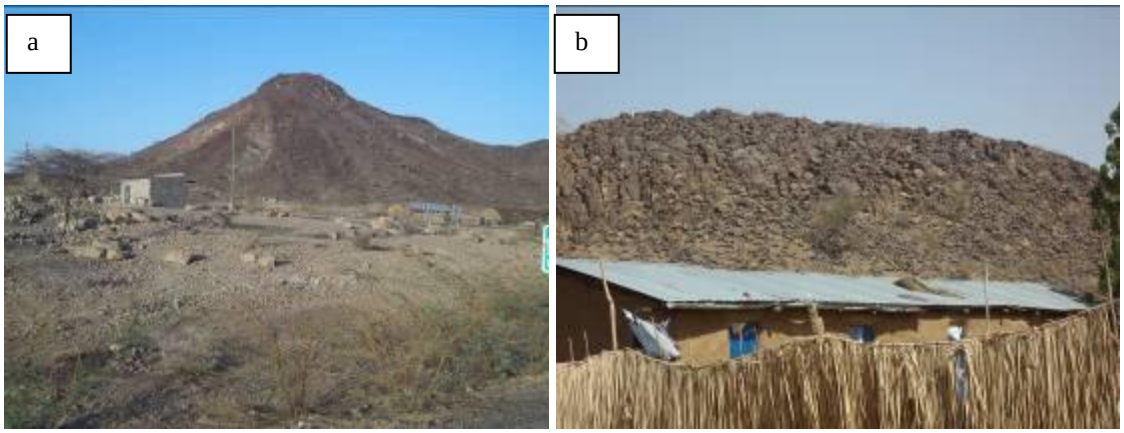


Plate 5.9: a) Lodwar cone and b) phonolites outcrop, Lodwar Township area.

Table 5.3: Active geological processes observed during the field survey that are significant for project logistics and EMP.

Feature	Locality	Brief Description	Natural Hazards	Implications for the Project and EMP
Dunes	Kalimapus area and Loyolo south of Ferguson's Gulf	Barchan dunes are common, reaching 15m from horn to horn and up to about 2m high. The ease of movement of these shore deposits, both by wind and wave action, leads to fairly rapid changes in the lake shoreline.	• Active wind blown dust	• Dunes will slow down vehicular movement • Vibroseis plate to ground surface contact may not be very good • Acoustic wave attenuation where sands are very thick • Cut lines footprint will be of short duration due to sand redistribution by aeolian processes • Wind blown dust can jam sensitive equipment such as cameras (this was experienced by the EIA team), and is a health hazard

Spits	Fergusons Gulf	In 1958 westward- pointing sand spits at the tip of the main spit of Ferguson's Gulf had closed the opening of the gulf to under half a mile, but in 1963 most of these secondary spits were gone (Dodson,1969).	• Unmapped spits below the water surface	• New spits formed or old ones extended may not be reflected on the old bathymetric charts, hence danger of grounding the boat. Bathymetric survey needs to be updated before lake operations commence
Beach and and Coastal Dune Sands	Western and eastern shorelines	Because of the prevailing easterly winds, dune formation is more prominent along the high-energy western side of the lakeshore. Dunes have developed along a belt, up to about 2km wide, north of the Turkwel Delta. The east-shore beaches, unlike the west-shore beaches, are developed in a low-energy environment. They are characterized by high clay content and mud admixtures which are frequently stablised by algal mats and shore vegetation.	• Active wind blown dust	• Sands will slow down vehicular movement • Vibroseis plate to ground surface contact may not be very good. • Acoustic wave attenuation where sands are very thick. • Cut lines footprint will be of short duration due to sand redistribution by aeolian processes. • On eastern lakeshore, heterogeneous, clayey sediments may impede vehicle movement and limit effectiveness of vibroseis, particularly when wet. • Wind blown dust can jam sensitive equipment such as cameras, and is a health hazard
Extensive alluvial fans	Eastern shoreline	Extensive alluvial fans particularly in the east. At lower elevations they formed coalescing fan fronts across the west; can also give rise to steep, sandy/silty slopes that can be difficult to maneuver on (Plate 5.10).	• Minor landslides and slumps on steep slopes with loosely- or un-consolidated materials	• Irregularly undulating sandy topography will slow down vehicular movement • Vibroseis plate to ground surface contact may not be very good. • Acoustic wave attenuation where sands are very thick. • Cut lines footprint will be of short duration due to sand redistribution by aeolian processes. • On eastern lakeshore, heterogeneous, clayey sediments may impede vehicle movement and limit effectiveness of vibroseis, particularly when wet.
Badlands	South of Fergusons Gulf (Plate 5.11)		• Minor land slips	• Irregular, rugged terrain will slow down vehicular movement • Cut lines may enhance gulleying and erosion • Cut lines footprint would probably be long-lasting. • Difficult to manuever vehicles, particularly when wet.

Plate 5.10: (a) and (b) Alluvial fans along the river banks of Seslucho and Ileret respectively.

Plate 5.11: Pleistocene lake sediments developing into badland, south of Ferguson's Gulf.

5.2.2 Soils

Soil Mapping Units

Block 10BA has varied topography consisting of hills, step-faulted scarps of the Rift Valley, plateaus and high level structural plains, footslopes, piedmont plains, lacustrine plains, floodplains and badlands. The major units within the project area are summarised below. The soil classification process follows the FAO-UNESCO legend that accommodates the worlds' soils in order to overcome gaps in national classification systems and to provide a common basis for soil correlation. The identification of soils is based on the presence of diagnostic horizons and diagnostic properties which are defined by measurable morphological, physical and chemical criteria related to soil characteristics that are the result of soil formation. Kenya has 23 of the 26 soil units recognized by FAO- UNESCO. The soil mapping unit description refers mainly to the characteristics of the subsoil usually 'B' horizon, to a depth of 100cm (less if impenetrable material such as bedrock occurs at a shallower depth). Among the parameters described are: drainage condition, effective soil depth, colour (moist condition), mottling (if present), consistency (moist condition), calcareousness (if present), salinity, sodicity (if present), rockiness (if present), stoniness (if present), cracking (if present), texture, additional information on special topsoil or subsoil features, landform, geology, inclusions of other soils (Sombroek *et al.,* 1982). For mapping unit classification, the first letter represents the landform while the second letter represents the geology of the unit.

Mapping units Hs1 and L6

The soils of the step-faulted scarps of the Rift Valley and plateaus and high level structural plains (Mapping units Hs1 and L6), support sparse to moderately dense vegetation (Figure 5.7). *The units are* stony and bouldery in places, severely eroded with deep and narrow gorges. Whereas L6 unit is accessible to machinery and equipment, save where it is severely eroded, Hs1 unit is only accessible via existing routes due to its topography. There is sparse human settlement in both units and L6 unit is grazed by livestock - predominantly goats and camels. Both units are habited by birdlife and wildlife especially at Sibiloi National Park where various birds species and *Gerenuk, Impala, Grants gazelle, Topi* were spotted. The units, especially on the western part of Lake Turkana, are a repository of fossilised material.

Mapping Unit F8

The footslopes (Mapping Unit F8) have poorly structured soils that are sodic in nature and have large bare patches with basalt boulders (Figure 5.7). It has sparse vegetation found in natural drains and suffers from overgrazing that contributes to further degrading of the surface soils. When these bare patches are trampled upon by grazing animals', the surface soil is pulverized and is susceptible to windblown erosion. Winds cause frequent duststorms of this soil type.

Mapping units Y5 and Y10

The piedmont plains (Mapping units Y5 and Y10) are dissected at different thresholds (Figure 5.7). These dissections form interfluves that sustain the vegetation and fauna within the luggas. Both units support livestock grazing, especially goats. However Y5 unit supports a moderately dense population found in many settlements within the unit and fishing is the dominant economic activity. There are fossil materials in Y5 unit from Kalokol to Kataboi. Y10 unit has degraded soils due to inadequate organic matter in the soil that causes surface sealing and capping. The surface sealing increases incidences of runoff causing increased soil erosion. Y5 unit with strongly sodic soils that are loose and powdery in nature is susceptible to increased wind-caused erosion.

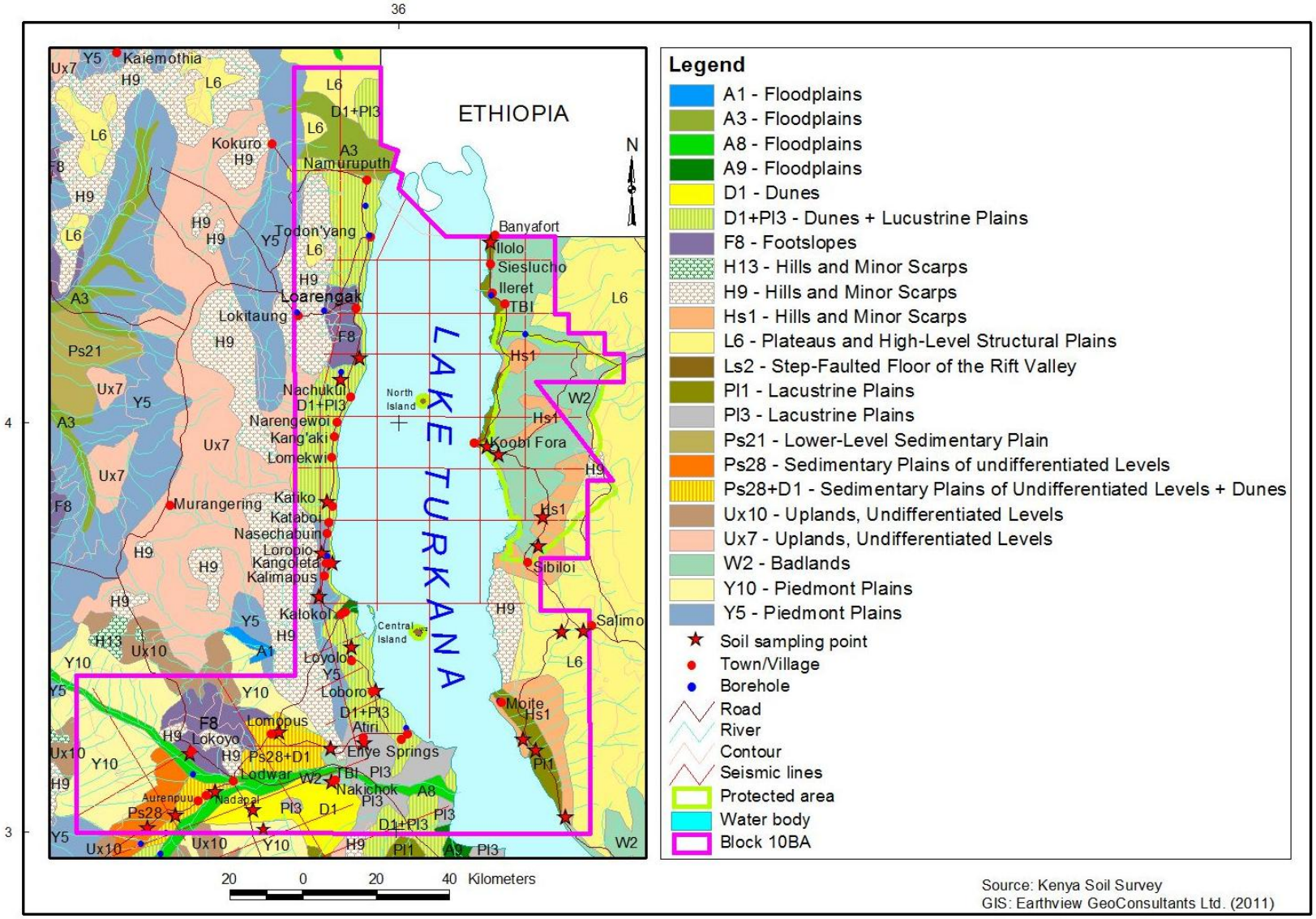


Figure 5.7: Soil map of the project area.

Mapping units PI1, PI3, and D1 + PI3

The lacustrine plains and dunes (Mapping units PI1, PI3, and D1 + PI3) border Lake Turkana and form the lakebed sediments (Figure 5.7). They are nearly level to gently sloping and are sparsely vegetated. They have saline-sodic soils at various thresholds. The units support fishing activities and extensive grazing since they are near the Lake and livestock and wildlife browse in the units. The PI1 and D1+ PI3 soil units occur in fossil-rich localities. While P13 and D1 + PI3 have dunes that continuously form due to strong winds. The units also support human settlement and a variety of birdlife.

Mapping units Ps28 and Ps28 + D1

The soils of the sedimentary plains and dunes (Mapping units Ps28 and Ps28 + D1) are sandy in nature and are moderately sodic (Figure 5.7). The Ps28 unit is fragile since it has extensive bare patches with sealing soils that support moderately dense vegetation found in waterways. Ps28 +D1 unit is still actively forming, with strong winds creating new small dunes that are eventually partially stabilized by mostly *Indigofera spinosa* dwarf shrubs. The surface soils are also degraded and are usually exhibiting sealing and capping which reduces infiltration and abets runoff incidences.

Mapping unit A8

The soils of the floodplains (Mapping unit A8) are imperfectly drained (Figure 5.7). They support agricultural practices in which mainly maize, bananas and millet are grown. The units also serve as grazing grounds for livestock. Seasonal flooding and ponding occurs in the units in a regular manner. The unit is also susceptible to periodic wind erosion.

Mapping unit D1

The dune mapping unit D1 borders Lake Turkana and has a meso-relief that is undulating to rolling (Figure 5.7). The soils are very deep and loose sandy soils. They support sparse to moderately dense shrubs of various species. The dunes are actively forming though some have been stabilized by the existing vegetation.

Mapping unit W2

The Badlands (Mapping unit W2) is severely eroded, deeply incised with an undulating to rolling meso-relief and in places forming gorges (Figure 5.7). The soils are strongly calcareous, moderately saline and strongly sodic silt loam to clay loams. The surface soils form crusts and are shallow, abetting soil erosion via runoff. The unit is also bouldery and supports sparse vegetation of various species. The unit is highly fossiliferous from Sibiloi National Park to the Ethiopian border.

Table 5.4: Soil Description within specified soil mapping units observed during the field survey and that are significant for project logistics and EMP.

Unit	Locality	Brief Description	Natural Hazards	Implications for the Project and EMP
Hilils (H9)	Found from Lomopus to Katiko bordering the Y5 unit. The unit is also found west and east of Lokitaung and northward to Namuruputh. On the east of the lake the unit is found around Moite and south west of Sibiloi	The soils are well-drained, shallow, dark reddish brown, friable, very calcareous, bouldery or stony, loam to clay loam, in many places saline. They classify as Lithosols, [*Sombroek et al. (1982)]*	• Potential rock falls or topples	• Seismic lines may have to be deviated due to difficulty in accessibility. • Rugged terrain • Occupational safety relating to rock falls and topples
Step-faulted scarps of the Rift valley (Mapping unit Hs1)	Found in the south-eastern tip of the project area and northward to Moite. It is also found in pockets around Sibiloi	The soils are well-drained, shallow, dark reddish brown, friable, strongly calcareous, rocky or stony, clay loam; in many places saline (The soil classifies as *Lithosols* with rock outcrops) (*Sombroek et al., 1982)*. The surface consists of basaltic stones and boulders. The unit is dissected with shallow and broad interfluves within the floors of the scarps. This unit is accessible via existing routes only.	• Shallow soils • This unit is a repository of fossil material especially on the eastern part of the Lake	• Seismic lines may have to be deviated due to difficulty in accessibility. • Any mechanical excavation of soil may expose the soil and encourage wind erosion and further degrade the unit • Compaction may damage archaeological material • Rugged terrain • The unit is accessible via existing routes only since it is bounded by steep scarps
Plateaus and high level structural plains (Mapping unit L6)	Found around Todonyang and Namuruputh in the west of the lake. On the east of the lake, the unit starts at the south western border of Block 10BA past Moite, Salimo and Sibiloi and along the western border past Ileret	The soils are well-drained, shallow to moderately deep, dark reddish brown, firm, strongly calcareous clay loam, with a stony to bouldery surface, partly saline and sodic	• Potential soil structure degradation	• Compaction due to machinery/equipment may further degrade the soil which also bears pressure from overgrazing (Plate 5.14) • Seismic lines may cause gulley formations along waterways • Cut lines footprints will be long-lasting
The Footslopes (Mapping Unit F8)	Found in north eastern around Lowareng'ak and south western part of block 10BA and just north of Lodwar at Lokoyo town	The soils are imperfectly drained, shallow to moderately deep, dark reddish brown to dark greyish brown, friable to firm, strongly calcareous, moderately saline and strongly sodic, stony clay loam, in many places with a bouldery surface (Plate 5.15). They classify as Xerosols. The surface consists of extensive bare patches with surface boulders. The surface soil is sodic clay	• Potential soil structure degradation • Potential gulley formation • Wind erosion caused by pulverizing soil degraded by machinery compaction	• Compaction due to machinery/equipment may further degrade the sodic soils • Seismic lines may trigger gulley formation during the rainy season • Dust generation due to equipment movement • Cut lines footprints will be long-lasting

Piedmont plains (Mapping Unit sY5 and Y10)	Found north of Lodwar and west of Eliye Springs around Nakirai and Kalokol	The soils are moderately well-drained, very deep, dark brown to greyish brown, firm, strongly calcareous, moderately to strongly saline and sodic, fine sandy loam to clay loam with a stone surface. The surface consists of sandy soils, surface pebbles, fossils and basaltic boulders	• Sodic soils • Capping and sealing soils • This unit contains some fossil material especially near Eliye Spring	• Compaction due to machinery/equipment may further degrade the sodic soils • Seismic lines may trigger gulley formation along the waterways • Cut lines footprints will be long-lasting
Sedimentary plains of undifferentiated levels (Mapping Unit Ps28 and Ps28 + D1)	The sedimentary plains are found at Eliye Springs and south west of Lodwar town. The unit borders the Turkwel River floodplain and the complex of plains and dunes unit borders the Kerio River floodplain to the south west and north east of Lodwar	The soils are well drained, very deep reddish brown, friable, moderately calcareous, moderately sodic, sealing sandy clay loam and sand	• Sealing and capping • Sodic soils • Wind erosion caused by poor soil structure with low organic matter	• Compaction due to machinery/equipment may further degrade the fragile soils • Dust formation during dune formation and compaction by machinery • Cutline footprints will be short lived • A fragile unit as a result of evolving dune formation • Occupational safety relating to dust generation
Dunes (Mapping unit D!)	This unit borders Lake Turkana	The soils are very deep and loose sandy soils	• Wind erosion • Active dune formation	• Seismic lines may have to be deviated due to difficulty in accessibility. • Any mechanical excavation of soil may expose the soil and encourage wind erosion • Sensitive breeding area for birds and animals near the lakeshore
Lacustrine plains and complex of lacustrine plains and dunes (Mapping Unit PI1, PI3, D1+PI3)	The lacustrine plains and complex of lacustrine plains and dunes border Lake Turkana and form the lakebed sediments	The soils are saline-sodic at various thresholds. The units support fishing activities and extensive grazing since they are near the Lake and livestock and wildlife browse in the units. PI1 and D1+ PI3 units are highly fossiliferous. While P13 and D1 + PI3 have dunes that continuously form due to strong winds. The units also support human settlement and a variety of birdlife.	• Rich fossil deposits • Sodic soils • Wind erosion resulting from poor soil structure and compaction by grazing animals	• Compaction may damage archaeological/fossil material • Seismic lines may trigger gulley formation especially where they cross narrow interfluves on the eastern part of the lake • Cut lines footprints will be long-lasting • Dust raised during dunes formation and compaction by machinery • Fragile unit with dune formation an evolving process • Potentially sensitive to human activities due to fossil deposits

Soils of the floodplains (Mapping unit A8)	This unit forms the Turkwel River floodplain	The soils are imperfectly drained, very deep, dark brown to yellowish brown, stratified, micaceous, loamy sand soils.	• Seasonal flooding and ponding • Support agriculture and human settlement	• Potential conflict area between proposed seismic activities and farming activities • Difficult to access during the rainy season by machinery/equipment
Soils of the badlands (Mapping unit W2)	This unit is found in the south eastern tip of the project area and north eastwards from Sibiloi to Banyafort at the Kenya/Ethiopian border	The soils are excessively drained, olive green to dark greyish brown, firm, strongly calcareous, moderately saline and strongly sodic, gravelly silt loam to clay loam. They classify as Xerosols (Plate 5.5.1)	• Rich fossil deposits • Shallow and sodic soils	• Seismic lines may have to be deviated due to difficulty in accessibility. • Rugged terrain • Occupational safety relating to rock falls and topples • Potential conflict area due to fossil deposits

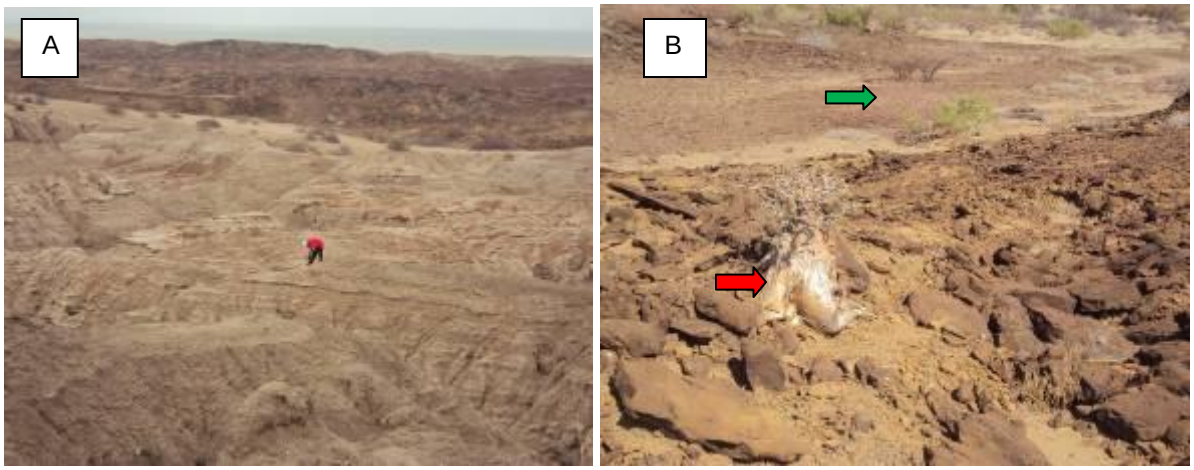


Plate 5.12: (a) W2 unit at Koobi Fora (area 102) showing a severely eroded surface with sodic clay soil and volcanic ash with sparse vegetation, on the background is the Koobi Fora ridge and (b) same unit showing foyaite boulders and desert rose plant (red arrow), and sandy soils that support vegetation (green arrow).

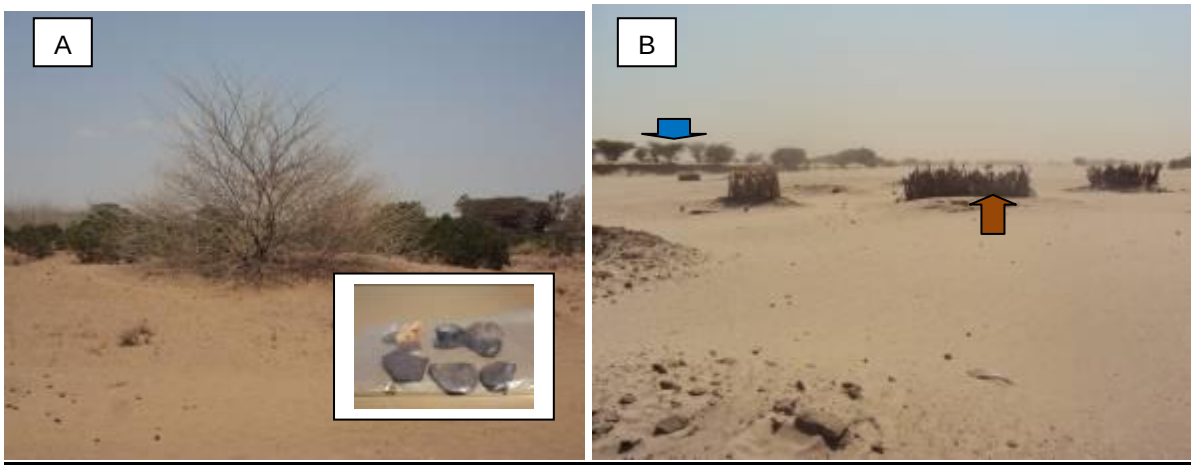


Plate 5.13: (a) D1+PI3 unit at Nareng'ewoi showing a dune being stabilized by Acacia nubica and Duomplams and inset, fossil material found on the surface; and (b) same unit at Loboro showing shallow water wells (brown arrow) in Kalorukogole lugga, that are partially fenced to ward off strong winds. Note the *Acacia tortilis* in the background (blue arrow).

5.2.3 Climate

In the entire project area, there is only one meteorological station, manned by the Kenya Meteorological Department, which has climate data for the entire project area. This data was not, however, available to the EIA team in its raw form for analysis. In addition, there is a general dearth of publications on the climate of the area; rather, there is only cursory mention of the general climatic features. This is a major constraint for evaluation of climate in this report.

The mean annual temperature is 30°C, mean annual rainfall is below 255 mm/year (Survey of Kenya 1977), and the evaporation rate is 2 335 mm/year (±0.347 mm) (Ferguson & Harbott 1982). The annual mean maximum temperature range is 30 to 34°C, while the annual mean minimum temperature is 23.7°C (Survey of Kenya 1977). The region is semi-arid. The majority of the yearly rainfall occurs in two seasons, from March to June, with a peak in April, and from October to December, with a lesser peak in November or December. The occurrence of rainfall is, however, erratic and unpredictable, and it tends to fall in brief, violent storms that result in flash floods (Republic of Kenya, 2002).

For most of the year, an easterly wind (the Low Turkana Jet Stream) prevails and is particularly strong near the lakeshore especially on the western side of Lake Turkana around Todonyang and south of the eastern side of the Block towards Loyangalani area, rising after sunset and blowing steadily until the following noon, when it is usually followed by several hours of calm. Wind speed measurements in the Loyangalani area (based on almost two years of measurements) indicate that the prevailing wind direction is ESE, the cumulated frequency of sectors E and ESE is greater than 93%, and the mean wind speed is 10.8 m/s at 38 m a.g.l. (above ground level) (Burlando et al., 2010). These data, although not from the project area itself, are indicative of the wind regime in the Lake Turkana basin, and can be taken as a guide to wind conditions in the area.

The area is prone to frequent droughts. Drought is reportedly occurring more frequently, with elders in Turkana recalling recent droughts in: 1984, 1992-93, 1996, 1997, 1999, and 2000 (Hain et al., 2003). Drought has exacted high economic costs in the region in terms of loss of livestock and pasture, lack of potable fresh water, resettlement and food aid (*cf*. Hain et al., 2003).

Relationship to Project and EMP

These climate characteristics have the following implications for the project team:

- Due to the high temperatures, the project team should have adequate water supplies, and shaded rest areas when carrying out the seismic acquisition in the field;
- Erratic, unpredictable and torrential rains that result in flash floods can pose a danger to crew especially at lugga crossings (where even huge trucks have been washed downstream in the past), and when working close to steeply inclined areas where there is risk of landslip or rock topples and falls. Transportation in the field can also be bogged down as a result of flooded and ponded areas, with the risk of crews being cut off for a number of hours or even days;
- Strong winds occasionally whip up dust storms that can reduce visibility and pose problems to sensitive electronic equipment, e.g. jamming of cameras which the EIA team experienced in the field.

The project operations will not affect any climate parameter.

5.2.4 Air Quality

There is no air quality data for the region, and this is likely primarily due to the fact that there are no major industries or significantly large towns to warrant investigations and data collection. As such, air quality was qualitatively assessed in the project region.

The project area is generally sparsely populated, and consists of many small settlements along the lakeshore. It is basically undeveloped but has a number of small towns like Lodwar, Kalokol, Lowareng'ak, Lokitaung, Kataboi and Ilereti. It is more or less a rural setting. There is no significant industrial activity in the towns; hence pollution from industry is non-existent. The naturally strong winds are the main distributor of air-borne dust , as they raise frequent dust storms over the sparsely vegetated land that continuously move detrital wind-borne particles from one area to another. The other source of air pollution is from biomass burning due to burning of firewood for cooking and charcoal-making. Offensive odours were only associated with pit latrines and garbage dumps in settlement areas, and shorelines where the locals dump fish and fish remains.

Relationship to Project and EMP

The ambient air quality in the region is good, but frequent dust storms and generally high levels of dust resulting from the strong winds may affect the working conditions. Care is, therefore, needed to shield the workers and sensitive equipment from dust effects. The project operations are only likely to affect air quality locally in work areas, during transportation of the workforce and equipment from one area to another, and during operation of machinery. Abatement of these effects is considered in the mitigations in Chapter 7.

5.2.5 Surface and Groundwater Resources

5.2.5.1 Surface Water Resources

Water sources include the Lake, influent rivers (Omo and Kerio) and luggas, shallow and deep wells, springs, and a few small dams (Plates 5.14 to 5.17). Water pans are conspicuously absent in the area. The freshwater shortage is related to many factors. The lake, which is an expansive water reservoir with a surface area of 6,750 km^2, an average depth of 35 m and a maximum depth of 115 m in its southern basin, is moderately saline and alkaline (Yuretich and Cerling, 1983), and its water level is sensitive to climate fluctuations. The water is drunk by both the area residents and their livestock, but is not so palatable on account of its limited natural quality. The influent perennial Omo River and quasi-perennial Turkwel River also have registered reduced flows in fairly recent times as a consequence of modification of the stream flow, primarily damming, and also due to climate change (Odada et al., 2006). Diversion and abstraction of water from the Omo River in Ethiopia for use in several small irrigation schemes has reduced the Omo River inflow into Lake Turkana by 50% (Haack and Messina, 2001). Development of the large Turkwel River dam at Turkwel Gorge has also significantly impeded the flow of freshwater in the Turkwel River, and this has negatively impacted on the fisheries in Ferguson's Gulf. Ferguson's Gulf on the west shore is now an enclosed lake because lowered lake levels have exposed the inlet bottom (Haack and Messina, 2001).

Plate 5.14: Turkwel River.

Plate 5.15: Lake Turkana, Kalimapus area.

Plate 5.16: Lomulango lugga. Note that the lugga is dry as it passes through Lokitaung gorge.

Lomulango lugga has been dammed south of Lokitaung town for watering livestock (Nadokoro dam) (Plate 5.16). Flows in the seasonal luggas are often of short duration (a few hours or days) during the rainy seasons, but tend to be torrential and often cause flooding.

Plate 5.17: Nadokoro dam, Lokitaung area.

5.2.5.2 Groundwater Resources

The deep groundwater in the region occurs in weathered and fractured zones in metamorphic and volcanic rocks and in sediments inter-bedded between volcanic rocks. Such geology, where it outcrops, is also a source of spring water. Shallow groundwater is mostly found in the numerous luggas that traverse the area. The groundwaters are recharged from the surrounding mountains. The water sources in the basin are, unfortunately, not evenly distributed. Reflecting this, boreholes are sparsely distributed and very few are found on the eastern side of Lake Turkana.

The groundwater in the project area is exploited mainly through boreholes and shallow wells excavated in luggas, and tends to have widely variable quality, from human-potable through livestock-potable to saline and non-potable (Plates 5.18 to 5.20). In the Turkwel delta area, water is readily obtainable from shallow wells dug in the river beds, and appears to be adequate for the low human population and their livestock whose size is limited by the low carrying capacity of the grazing grounds. The groundwater is sensitive to rainfall fluctuations, and during the dry seasons the water levels in these wells fall rapidly.

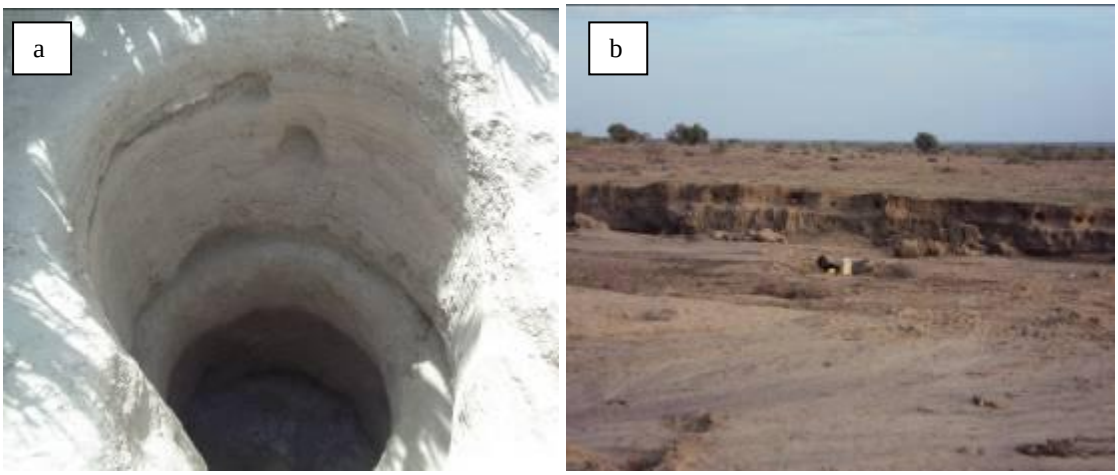


Plate 5.18: a) Dry hand dug sand well, Kalorukogole lugga, and b) A child drawing water from a shallow hand dug sand well, Seslucho lugga north of Ileret town.

Plate 5.19: Newly drilled borehole at Ileret. The borehole is drilled by TBI and its water is saline (not operational).

Some boreholes have dried up (e.g. boreholes at Nachukui) and others such as the one drilled by Turkana Basin Institute (TBI) in Illeret were saline (Plate 5.19). As a rule of thumb, groundwater salinity tends to increase as one moves away from the luggas. The wells are usually sited where there are naturally occuring sub-surface rock dams across the luggas as they yield fairly good water supplies, e.g. the Lomulango borehole located within the Lomulango River valley. This borehole was drilled by the General Service Unit (GSU) that is based at Todonyang, and it yields a lot of water throughout the year. A few boreholes that are drilled far away from luggas may, however, yield good water supplies, such as the Atiri borehole (Plate 5.20).

Plate 5.20: The locals drawing water from Atiri borehole, Atiri area.

The project area has several cold and hot springs (Plates 5.21 and 5.22). Cold springs occur at Eliye, Loropio and Lokitaung. Spring water is also relatively common in the high basement terrains north of Lokitaung, in Lapur and Lothidok hills especially in Loropio area (Loropio spring) and in the volcanic terrains. Loropio spring produces fresh water which is used by the community to water their livestock and for domestic purposes. All the springs encountered during the study east of Lake Turkana were producing warm to hot water, and are alkaline.

Plate 5.21:(a) Cold spring oozing from fractured ryolitic rock, Lokitaung area, and (b) Locals fetching water from Loropio spring, Loropio area.

Plate 5.22: Eliye Spring.

Relationship to Project and EMP

Due to the scarcity of water resources, TKBV would have to find its own water supply (e.g. drill a borehole) for the personnel that would be residing in the camp and working within the project area, rather than share an already existing resource with the neighboring community as this can cause problems particularly if the water is in short supply. Such a borehole could be handed over to the neighbouring community at the end of the project. The only potential project impact on water resources (quantity) would be the possible compaction of near-surface aquifers, particularly close to where springs emerge, by heavy vehicles and/or machinery. Compaction would reduce the aquifer storage capacity and transmissivity, resulting in lower yields at the spring outlet.

5.2.6 Water Quality

Surface (river) and groundwater will generally not be exposed to major threats related to the seismic operations project. Potential ground and surface water pollution will need to be considered in the context of sanitation and domestic waste discharge facilities and systems that will be installed at the campsites (see Chapter 2) and to leakages of oils and/or chemicals at the campsites and in the field working areas. Water samples were collected at the localities indicated in Figure 5.8 below.

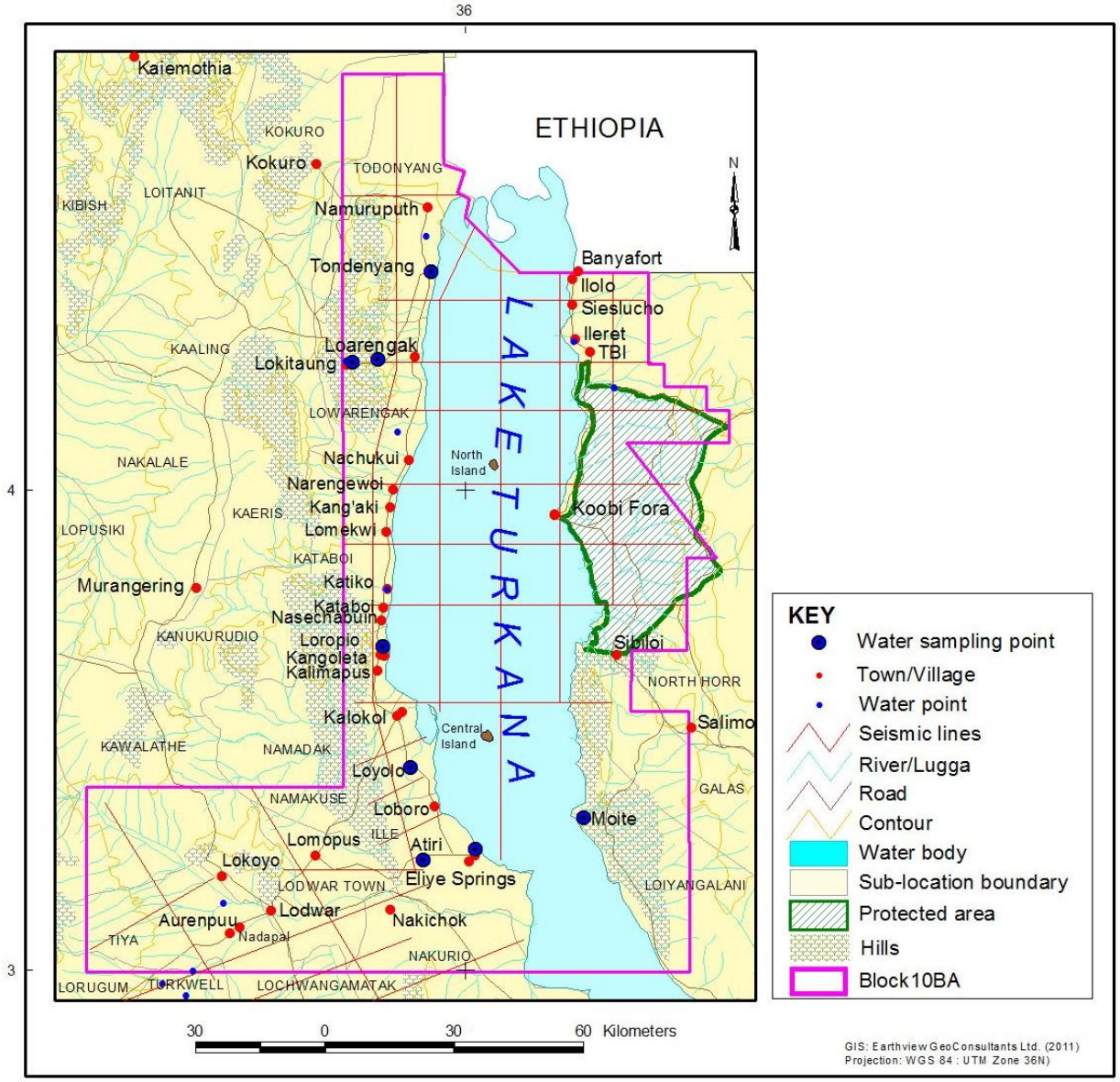


Figure 5.8: Water sampling points.

The borehole water quality is generally good for use as drinking water, but is high in sulphates in the Atiri borehole, and fluoride in the Lomulangu borehole (Table 5.5). Borehole water is the cleanest source of potable water. The springs are the second best sources of water, though they have slightly high pH, and in the case of Eliye Springs, high fluoride levels as well. The high nitrate content in the water of Loropio spring may reflect pollution from livestock waste (Table 5.5). The shallow wells and surface dams are the least desirable for drinking water as they have turbid, coloured water and relatively high salinities and iron content (Table 5.5.).

Table 5.5: Water quality in the project area (SW – Shallow Well; BH – Borehole). WHO limits are for drinking water quality: grey shaded boxes show the limits are exceeded.

PARAMETERS								
Lab Sample Nos.	**2576**	**2580**	**2578**	**2575**	**2574**	**2573**	**2579**	**WHO limits**
	Kopa SW	**Nadokoro Dam**	**Lomulangu BH**	**Todonyang SW**	**Loropio Spring**	**Atiri BH**	**Eliye Spring**	
pH	8.6	7.98	8.24	9.29	8.41	8.25	8.89	6.5-8.5
Colour (mgPt/l)	70	5	5	20	5	5	5	15
Turbidity (NTU)	395	78	0	168	1	1	0	5
PV (mgO_2/l)	15.8	2.37	0.79	7.9	0.4	0.4	<0.4	
Conductivity (25°C) (µS/l)	1165	296	932	3460	1816	258	573	
Fe (mg/l)	2.76	0.94	< 0.01	1.5	< 0.01	< 0.01	0.14	0.3
Mn (mg/l)	0.02	0.12	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.1
Ca (mg/l)	16	40.8	35.2	24	20	8	0.8	
Mg (mg/l)	2.93	7.31	27.72	4.9	35.5	2.43	1.94	
Na (mg/l)	243.5	7.0	120.7	757.6	325.9	45.4	129.2	200
K (mg/l)	0.6	0.3	0.1	2	1.2	0.2	0	
Total Hardness ($mgCaCO_3$/l)	52	132	202	80	196	30	10	500
Total Alkalinity ($mgCaCO_3$/l)	508	110	344	824	562	114	234	
Cl (mg/l)	15	10	51	500	95	4	5	250
F (mg/l)	12	7.4	8.0	0.8	1.1	0.64	11.0	1.5
Nitrate (mg/l)	6.0	0.54	1.7	2.8	30	0.7	0.50	10
Nitrite (mg/l)	<0.01	<0.01	< 0.01	< 0.01	0.015	< 0.01	< 0.01	
Sulphate (mg/l)	0.3	2.57	21.71	17.14	96.9	486	14	400
Free Carbon Dioxide (mg/l)	0	16	22	0	0	12	0	
Total Disolved Solids (mg/l)	722	183.5	578	2139	1126	160	355	1000

Relationship to Project and EMP

Water resources contribute enormously to economic productivity and the social well-being of the human populace. The most critical issue in the basin is deterioration of the water quality of the lake (high sediment loads from influent rivers, rivers (microbiological from livestock and human use upstream of water use sites), springs and groundwater (point-source pollution at the water collection points by humans and livestock), resulting in water resources becoming unfit for human consumption and other uses, thereby making the water resources scarce.

5.2.7 Terrestrial Environment

The information available on the terrestrial environment is based on research, surveys and old published literature and reports – no new work is apparently being carried out on species inventory and ecology in the area, or on human impacts such as land degradation and deforestation, that may have some implications on ecosystem integrity, species diversity, and resilience. The remoteness, inaccessibility and insecurity in some parts of the area have hampered these activities. Nevertheless, the ecosystem remains largely pristine due to the nomadic nature of the people, with fragmentation being the most significant factor due to the growing human and livestock populations.

The vegetation of the project area belongs to the Somali-Masai ecoregion, (White, 1983) comprising of deciduous bushland and thicket, semi-desert grassland, bushland and thorny shrubland (eastern side) with *Acacia* spp., *Commiphora africana, Balanites aegyptiaca*,

Euphorbiaceae, and abundant dryland taxa (Figure 5.9). The fairly high alkali content of the lake's waters greatly limits the range of species of vegetation along its shoreline. *Salvadora persica* forms a bushland on Central and South Islands (Hughes and Hughes, 1992). The grasses, shrubs and trees of the ecoregion are fire-tolerant because fires are frequent in the dry season. The environment is the setting for the fauna that is discussed in section 5.2.7.2 below.

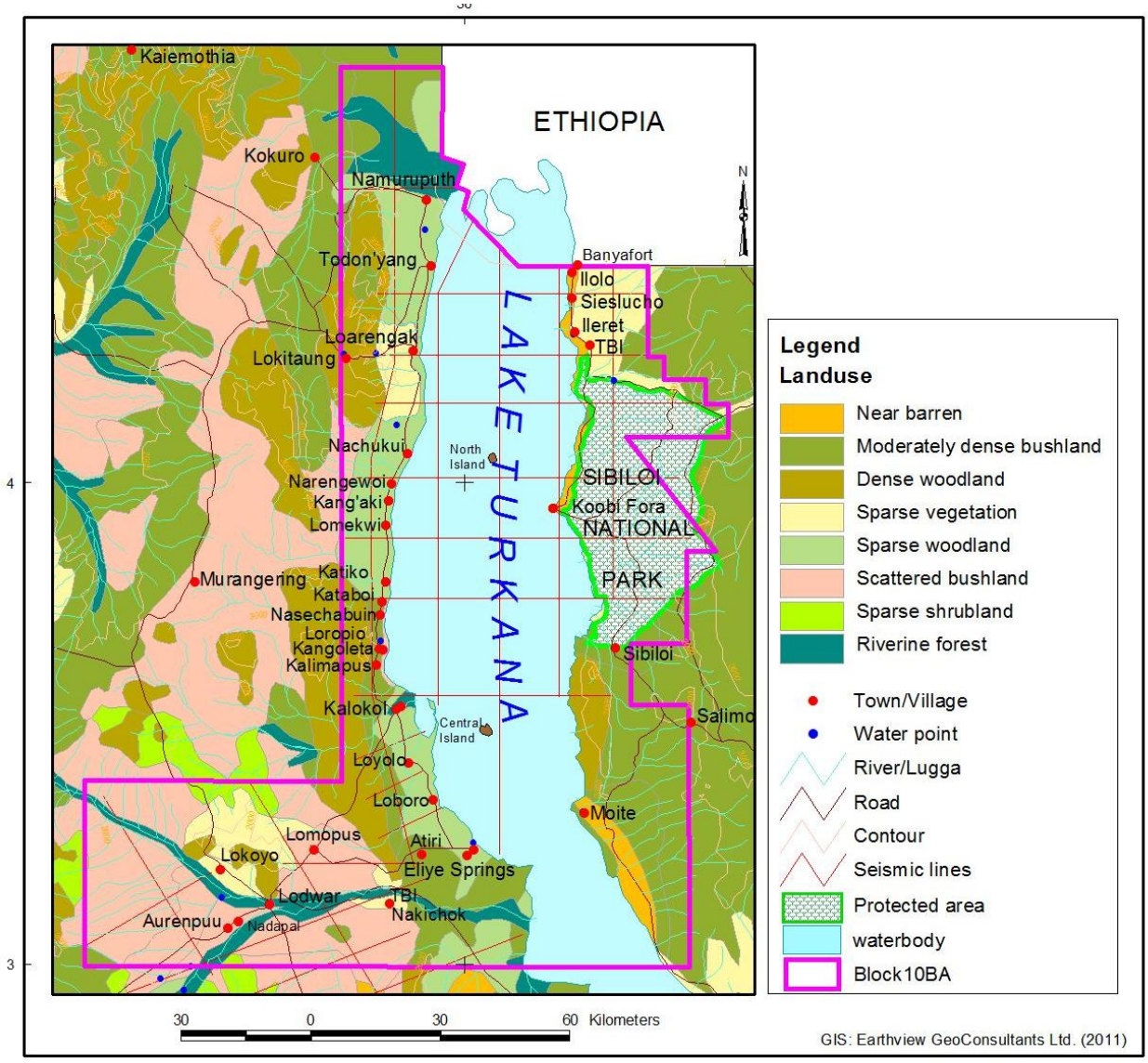


Figure 5.9: Vegetation of the block.

In terms of wildlife, the eastern and western areas are sharply contrasted: in the eastern part there is a fairly diverse composition of wild fauna particularly within the Sibiloi National Park, while the western sector is almost devoid of wildlife due to human pressure. The Sibiloi National Park is a Natural World Heritage Site. Mammals include Burchell's and Grevy's zebras *Equus burchelli* and *E. grevyi* (T), Grants gazelle *Gazella granti*, Beisa oryx *Oryx gazella beisa*, hartebeest *Alcelaphus buselaphus*, topi *Damaliscus lunatus*, Lesser Kudu *Tragelaphus imberbis*, lion *Panthera leo*, and cheetah *Acinonyx jubatus* (T). There are many crocodiles along the lakeshore and on Central Island – the species are *Crocodylus niloticus* and *Varanus niloticus* (Hughes and Hughes, 1992). There are also a number of terrestrial and water birds.

The common terrestrial birds include: Fork tailed drongo, Yellow vented bulbul, Superb starling, Kori bastard, Brown necked crow, Mourning dove, White bellied Cuckoo, Abysinnian roller, Rufous-crowned roller, Pied wagtail, White browed sparrow weaver, Crested lark, Shinning sunbird, Speckled pigeon, Blue headed bee-eater, Carmine bee eater, Paradise flycatcher, Namaqua dove, White headed buffallo weaver, White browed sparrow weaver, Ring neck dove, Eastern pale chanting goshawk, Sacred ibis, Red billed hornbill, White headed moosebird, and Somali ostrich.

5.2.7.1 Habitat Types

The habitat types that are outlined in Figure 5.9 were related, in the field, to underlying topography and geology of the area in order to better understand their associations.

(a) Moderately dense bushland - Stepped faulted scarps

This is a habitat that is born out of the fault steps of the rift valley, and occurs along the fault-stepped fringes of the project area both in the east and the west (Figure 5.9). The soils tend to be saline which makes it structurally unstable and therefore not conducive for vigorous vegetation growth. Vegetation composition is moderately dense *Acacia tortilis* and *Salvadora persica* bushes; its surface is also carpeted by the *Indigofera spinosa* dwarf shrub.

Plate 5.23: Vegetation of a step fault in the block. Note the *Indigofera spinosa* dwarf shrub carpet which can tolerate heavy defoliation and drought, and is thereby a species that is browsed upon by goats during drought periods.

(b) Moderately dense bushland - lacustrine undifferentiated sediments

Vegetation in the area is moderately dense and follows the waterways where they increase in density (Figure 5.9). In areas that are away from the waterways they tend to be sparse with bare patches noticeable in some areas. In other sections of this landscape, especially in areas where the landscape is rolling, the species present include: *Acacia tortilis, Acacia mellifera* and *Balanites aegyptica* bushes with *Indigofera spinosa* dwarf shrub found adjacent to the waterways/interfluves. Additionally, at elevations above 400 m.a.s.l., *Acacia nubica* can be observed as well. This habitat can be seen in the Nakichok area in the southern part of the block (Figure 5.9). This habitat is illustrated in the plate 5.24 below.

Plate 5.24: Typical vegetation in Kapalia area.

(c) Moderately dense bushland - Piedmont plain

Piedmonts are found on the foot of hills or mountains, where they form continuous plains that are gently sloping and contain alluvial deposits. Species include: *Commiphora spp, Indigofera spinosa, Caralluma spp, Balanites glabbra* and *Hyphaena compressa* (Plates 5.25 a and b).

Plate 5.25: A sedimentary plain in Nakira area, vegetation was characteristically dense in areas adjacent to the waterways/interfluves.

(d) Moderately dense bushland - plateau

The habitat, such as in Salimo area (Plate 5.26) on the south eastern side corner of the block, had wide but shallow waterways traversing the landscape, with vegetation concentrated along the waterways. The sandy clay soils support *Euphorbia cuneata* and *Indigofera spinosa* dwarf shrubs. Other species include *Acacia tortilis, Acacia reficiens, Acacia mellifera, Acacia senegal, Commiphora spp, Grewia spp, Sarcostema andogense* and *Boscia coriaceae*.

Plate 5.26: Typical plateau vegetation in salimo area of the block.

(e) Near barren - lacustrine plains developed on pyroclastics and basalts

These habitats are found in areas such as Nakwakwelia and Todonyang in areas that were once under Lake Turkana (Figure 5.9). In these landscapes vegetation was found to comprise mainly of *Commiphora spp.*, *Hirpicum diffusum* and *Indigofera spinosa* dwarf shrubs and interspersed with the spiky *Austrostripa spp* grasses. The sodic and loose soils do not support robust vegetation (Plate 5.27). However, in certain areas, evidence of succession can be seen, transforming from near barren landscape into a scattered shrubland. The major shrub species observed to be leading the succession was *Balanites aegyptica* in Nayanakolong area (Plate 5.28).

Plate 5.27: A lacustrine plain in Nakwakwelia area, Note the bareness of the ground and the near lack of vegetation.

Plate 5.28: Colonization of the near barren landscapes of a lacustrine plain in Nayanakolong area of the block. Note the *Balanites aegyptica* shrubs scattered on the habitat (Red arrows).

(f) Near barren - badlands

These are nearly barren landscapes with sparse vegetation broken by numerous intermittent drainage channels or gullies. This kind of habitat was found, for example, in Namorutunga (Plate 5.29 and 5.30), near Eliye Springs, and Loarengak where they were partially stabilized by *Prosopis juliflora* (Mathenge weed) (Figure 5.9). In the badlands of Koobi Fora, shrubs and herbs were found to be growing in gullies and crevices. Species found include: *Commiphora africana, Euphorbia cuneata, Euphorbia uhligiana, Euphorbia heterochroma, Adenium obesum*, and *Balanites aegyptica.*

Plate 5.29: Badland in Namorutunga area near Lodwar.

Plate 5.30: A badland adjacent to the Turkana Basin Institute (TBI) on the western side of the block.

(g) Scattered shrubland - dunes

This type of habitat is highly dynamic and is heavily influenced by the erosive properties of wind (Figure 5.9). The dunes in the block were partially stabilized by *Acacia tortilis*, *Balanites aegyptica* and *Hyphaene compressa* shrubs, these shrubs formed barriers that settle the loose soil that is being shifted by the wind.

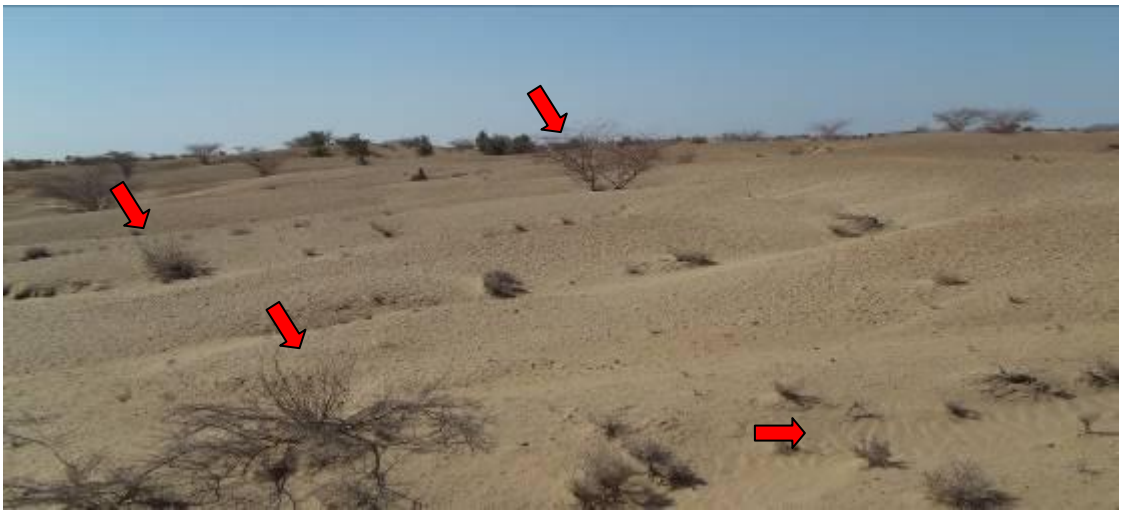


Plate 5.31: Scattered vegetation on sand dunes in Nakichok area. Note the Acacia shrubs settling the soil (Red arrows).

(h) Scattered bushlands - sedimentary plains

Vegetation in this habitat tends to be scattered, following interfluves and waterways (Figure 5.9). A good example of such an environment was found in Aurenpuu area in the south western corner of the block. (Plate 5.32).

Plate 5.32: Sedimentary plain showing scattered vegetation. Note the sandy nature of the underlying soil.

A variation of the sedimentary plains can be found 6km south west of Lodwar; the habitat is located in a windy area with an undulating topography. The area has natural drains leading into the lake and sand dunes that are commonly less than 2m in height. The soil in this habitat tends to be sandy-clay which implies that the habitat is susceptible to seasonal ponding and surface run-off. Flora in the area can be classified as scattered with vegetation following the waterways. On the dunes the common species are *Balanites aegyptica* and *Indigofera spinosa* shrubs (Plate 5.33). Other species include: *Acacia mellifera, Cadaba spp, Salvadora persica* and *Prosopis juliflora.*

Plate 5.33: Sedimentary plain with dune complexes in Lodwar.

(i) Sparse vegetation - footslopes

This habitat occurs on hills with gentle slopes (Figure 5.9). In some places the surface is covered with stones and vegetation which is oriented towards the waterways. The habitat exhibits bare patches as the soils are saline-sodic in nature, making them unfavorable for vegetation that cannot tolerate high levels of salinity (Plate 5.34). Dominant species present are *Acacia tortilis, Acacia mellifera, Balanites aegyptica* and *Indigofera spinosa*.

Plate 5.34: Footslope habitat at Lokoyo area. Note the surface stoniness and the lack of vegetation in the foreground.

Relationship to Project and EMP

Due to the scattered nature of the bushes found in the block area, TKBV will not have a problem laying seismic lines as vegetation clearance is expected to be minimal. However, TKBV should avoid felling mature trees and species of particular significance to the local community. Species of greatest interest to the community are:

- *Salvadora persica* (It is also known as the toothbrush tree, it can be used as a toothbrush and is used to treat ailments such as: gonorrhoea, stomach, and chest pains),
- *Boscia coriacea* (It is an evergreen shrub that produces a fruit that is boiled for hours on end before it is consumed, it is eaten as a fruit of last resort during drought periods)
- *Balanities aegyptiaca* (It is an evergreen shrub that produces a fruit and is eaten during drought periods. An infusion of its roots can also be used to treat malaria and stomach pains).

The activities of TKBV are not expected to significantly alter the flora of the region and the impacts are expected to be short- to medium-term. The area has sound ecosystem integrity, species diversity and is capable of regenerating itself, if left to regenerate, once seismic activities are complete.

5.2.7.2 Fauna

The mix of desert, savanna woodland, wetland, and bushland support varied fauna. Though the ecoregion is moderately rich in species, it has a low level of endemism. In the drier areas several large mammal species occur, such as cheetah, lion, elephant, beisa oryx, Grevy's zebra and reticulated giraffe. Drought and pastoralism have significantly degraded (in some areas to a desert-like state) the habitats of the area, resulting in major reductions in the populations of many of the large mammals. Black rhinoceros (*Diceros bicornis*) has been extirpated from the ecoregion (Magin and Burdette, 2001). The semi arid to arid climate in the block creates suitable environment for reptilian life and thus it is expected that many amphibian (such as frogs) and reptilian species (e.g. Snakes, Lizards, Tortoise, Crocodile, Gecko and Skinks) are present.

5.2.7.2.1 Mammals

Mammalian habitats are diverse, with a host of staple available in the region, but are confined to the eastern side of the lake. The arid-adapted mammalian fauna include Burchell's zebra (*Equus burchelli*), Grevy's zebra (*Equus grevyi*, EN), beisa oryx (*Oryx beisa beisa*, LR), Grant's gazelle (*Gazella granti*), topi (*Damaliscus lunatus*), lion (*Panthera leo*), and cheetah (*Acinonyx jubatus*, VU) (Boitani 1999, East 1999). These species are all found in Sibiloi National Park and other areas within the ecoregion. Other mammals include leopard (*Panthera pardus*), reticulated giraffe (*Giraffa camelpardalis reticulata*), and elephant (*Loxodonta africana*). Among the small mammals there is also a near-endemic gerbil, *Gerbillus pulvinatus*.

A few live observations were made but a majority of the mammalian life observed was made indirectly by signs of their activity (Plate 5.35). The animals that were observed include: Greater kudu, Dik dik, Cape hare, Silver backed jackal, Hedgehog, Porcupine, Impala, Topi, Buffallo, Grants gazelle, Cheetah, Leopard, Hyena, Vervet monkey, and Olive baboon among others.

Plate 5.35: Signs of animal activity could be spotted within the block, squirrel midden.

5.2.7.2.2 Reptiles and Amphibians

The Lake hosts the world's single largest crocodile population. Here, they grow to record size, with some of the largest specimens found on the remote windswept Central Island. Additionally, the Turkana Mud Turtle (*Pelusios broadleyi*) is a species of turtle in the Pelomedusidae family and it is endemic to Kenya. During the course of the field trip not many reptiles were encountered presumably because they usually hide between crevices, rubble and brush (Plate 5.36).

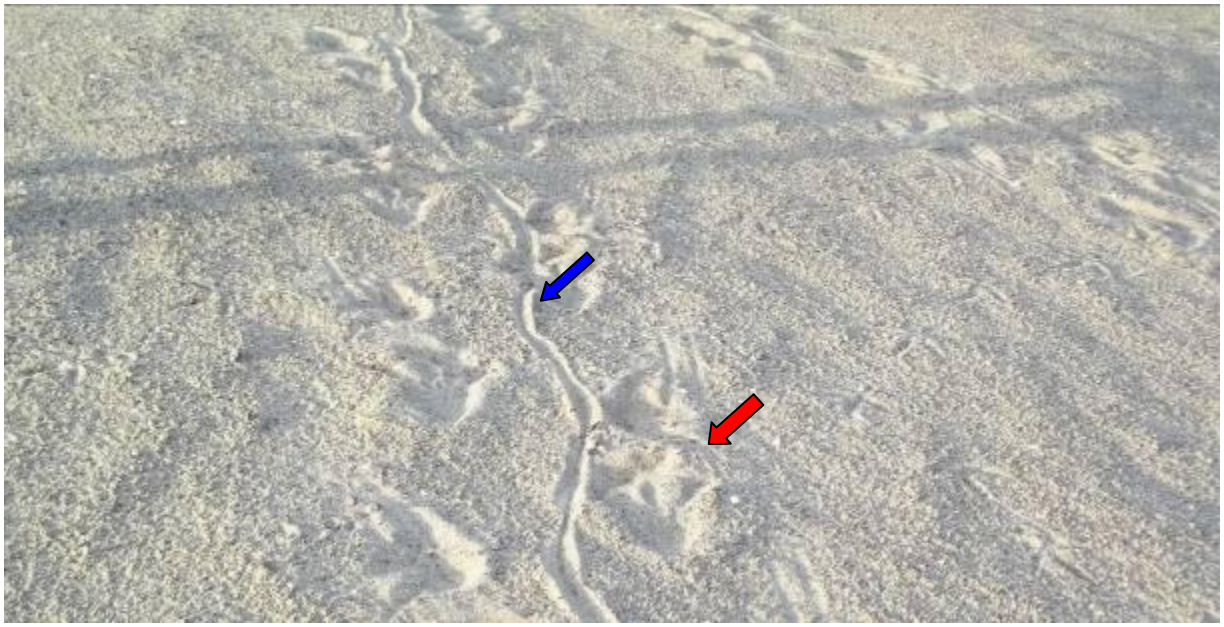


Plate 5.36: Signs of crocodile activity at the shores of lake turkana at the koobi fora area. Note the crocodile footprints (red arrow) and the trail left behind by its tail (blue arrow).

This region has three endemic species of amphibians: two species of toads (*Bufo chappuisi, Bufo turkanae*), and a frog (*Phrynobatrachus zavattarii*) (Hilton-Taylor 2000).

5.2.7.2.3 Birds

A rich birdlife thrives in the block, with the majority of the birds observed being waterbirds and a few palearctic migrants like the yellow wagtail observed at the shores of Lake Turkana (Plates 5.37 and 5.38). Other species observed included: Fork tailed drongo, Yellow vented bulbul, Superb starling, Rupelles long tailed glossy starling, White crested helmet shrike, Kori bastard, Northern white-crowned shrike, red backed shrike, Brown necked crow, Mourning dove, White bellied Cuckoo, Martial eagle, Abysinnian roller, Rufous-crowned roller, Blue headed coucal, African scops owl, Grey headed kingfisher, Pied Kingfisher, Pied wagtail, White browed sparrow weaver, Crested lark, Variable sunbird, Shinning sunbird, Speckled pigeon, Blue headed bee-eater, Carmine bee eater, Paradise flycatcher, Namaqua dove, White headed buffallo weaver, White browed sparrow weaver, Ring neck dove, Eastern pale chanting goshawk, Sacred ibis, Lesser Flamingo, Greater Flamingo, Lesser egret, Intermediate egret, Greater egret, Goliath Heron, Yellow billed stork, Red billed hornbill, White headed moosebird, Somali ostrich, Great white pelican and African hoopoe among others.

Plate 5.37: Brown necked crow, Koobi fora.

Plate 5.38: Crested lark.

5.2.7.2.4 Arthropods

This ecosystem has a rich diversity of invertebrate species ranging from insects which include: Odonata (Dragon flies), Orthoptera (Grasshoppers and crickets), Isoptera (termites), Coleoptera (Beetles), Lepidoptera (Butterflies and Moths), Diptera (Flies and Mosquitoes), Hymenoptera (wasp and bees), Blattodea (Cockroaches) and Phasmida (Walking sticks). Arachnids present include ticks, spiders and scorpions. Acacia is a common host for a great dversity of ants and arachnids (Plate 5.39).

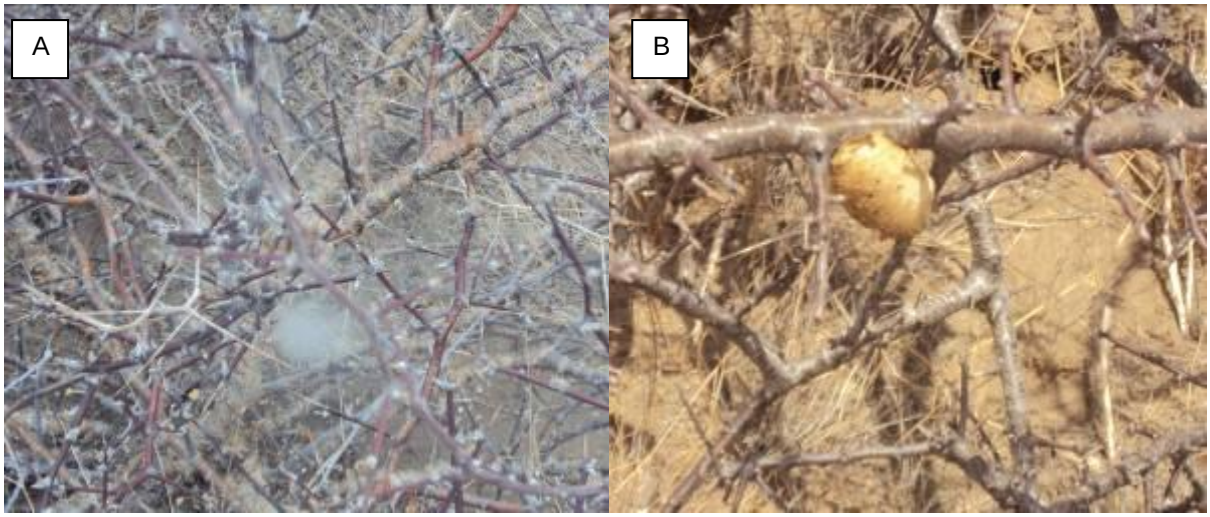


Plate 5.39: Signs of arthropod activity a) spider web and b) a hornet's nest.

Relationship to Project and EMP

The block is home to endangered and vulnerable species of mammal, reptiles and birds (see section 5.2.7.2.1) and therefore TKBV needs to carry out its activity with caution avoiding areas where they occur and breed (See sensitivity map Figure 5.16). The Sibiloi National Park is the area where most fauna in the block is concentrated. If TKBV is to lay seismic lines in the park they will have to consult with KWS, TBI and the NMK.

Seismic operations and activity to be undertaken by TKBV are not expected to have a major impact on the wild animals within the block, with seismic activity expected not to alter wildlife habitats.

5.2.8 Land Resources and National Parks

The project area has varied land resources ranging from vast tracts of land with sparse to moderately dense vegetation to water resources like Turkwel River and the numerous luggas (Figure 5.1). Residents in the area are largely pastoralists and the main livestock types are camels, goats, donkeys and sheep. Vegetation that includes *Acacia spp.*, *Balanities aegyptica and Commiphora africana*, *Salvadora persica,* Duom Palms and *Indigofera spinosa* dwarf shrub are useful browse for their livestock. Near the lake the residents practice both livestock-keeping and fishing.

Sibiloi National Park east of Lake Turkana is the major park in the project area (Figure 5.1). The Park was established in 1973 by the Government of Kenya for the protection of wildlife and palaeontological sites found in the area, and is administered by the KWS. It covers 1570 km². Internationally, the park is known for its fossils and was listed as a UNESCO World Heritage Site in 1997. The most famous remains from the park are the Australopithecus and early homo fossils. The Park is home to topis, Grant's gazelles, impala, hyenas among other animals. There is also a rich birdlife within the park. IUCN has categorised Sibiloi National Park as a Category II Protected Area[6]. It was also classified by UNESCO as a World Heritage Site under Natural Criteria categories vii, viii and x in 1997.

[6] 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).

The main threats to natural resources in protected areas are: the rapid increases in both human and livestock populations which have caused widespread overgrazing, soil erosion and compaction; and accelerated desertification particularly in the north. Only one comparatively small area of good quality habitat remains within the project area – the Sibiloi National Park on the eastern edge of Lake Turkana (Magin and Burdette, 2001).

Relationship to Project and EMP

The nature and scale of the project will not significantly affect the land resources: vegetation will be cleared along thin (4m wide) and linear transects totalling a length of 570.1 km: this translates to only 0.02% of the assigned project land area, and will still be considerably less, given the large expanses of almost bare ground. Issues relating to water resources have been addressed in sections 5.2.5 and 5.2.6 above. Permissions will have to sought from Kenya Wildlife Services and/or the Minister for Forestry and Wildlife in relation to seismic operations in the national parks, if it is deemed that such operations are necessary, in accordance with the Wildlife (Conservation and Management Act) Cap. 376 (see section 4.3.14).

5.2.9 Archaeological, Historical and Cultural Sites

5.2.9.1 Archaeological and Historical Sites

The reason for Turkana's worldwide fame as the purported 'Cradle of Mankind', are the finds of early hominids, including remains of various *Australopithecus* species, *Homo habilis*, *Homo erectus* and *Homo sapiens* (Finke, 2001). Ample fossil evidence indicates that the lake's shores were teeming with wildlife, including prehistoric elephants and three-toed ancestors of the horse, and before them some truly enormous dinosaurs such as the 50-tonne, 25-metre long Diplodocus, a fossil of which was found near Lokitaung on the west side of the lake (Finke, 2001). Other animal fossil finds include both black and white rhino, the extinct giant otter, hippo and the extinct pygmy hippo, elephant, monkeys, wild camels and lion (Finke, 2001). Existing archaeological sites are shown in Figure 5.10 below.

Among its most celebrated findings is the 1.5 million years old ‘Turkana Boy’. Turkana Boy, also is the common name of a fossil labelled (KNM-WT 15000), a nearly complete skeleton of a hominid, classified as either *Homo erectus* or *Homo ergaster*, who died in the early Pleistocene. This specimen is the most complete early human skeleton ever found, and was discovered in 1984 by Kamoya Kimeu, a member of a team led by Richard Leakey, at Nariokotome on the western shores of Lake Turkana. Block 10BA also covers the famous Koobi Fora, a region around Koobi Fora Ridge, located on the eastern shore of Lake Turkana. The ridge itself is an outcrop of mainly Pliocene/Pleistocene sediments that preserve numerous fossils of terrestrial mammals, including early hominin species. Stone tools dating to 2 million years ago resemble certain Oldowan industry artifacts from Olduvai Gorge in Tanzania. Currently, the ridge is being eroded into badlands by a series of transient rivers that drain into the north-eastern portion of modern Lake Turkana. In 1968 Richard Leakey established the Koobi Fora Base Camp on a large sandspit projecting into the lake near the ridge, which he called the Koobi Fora Spit.

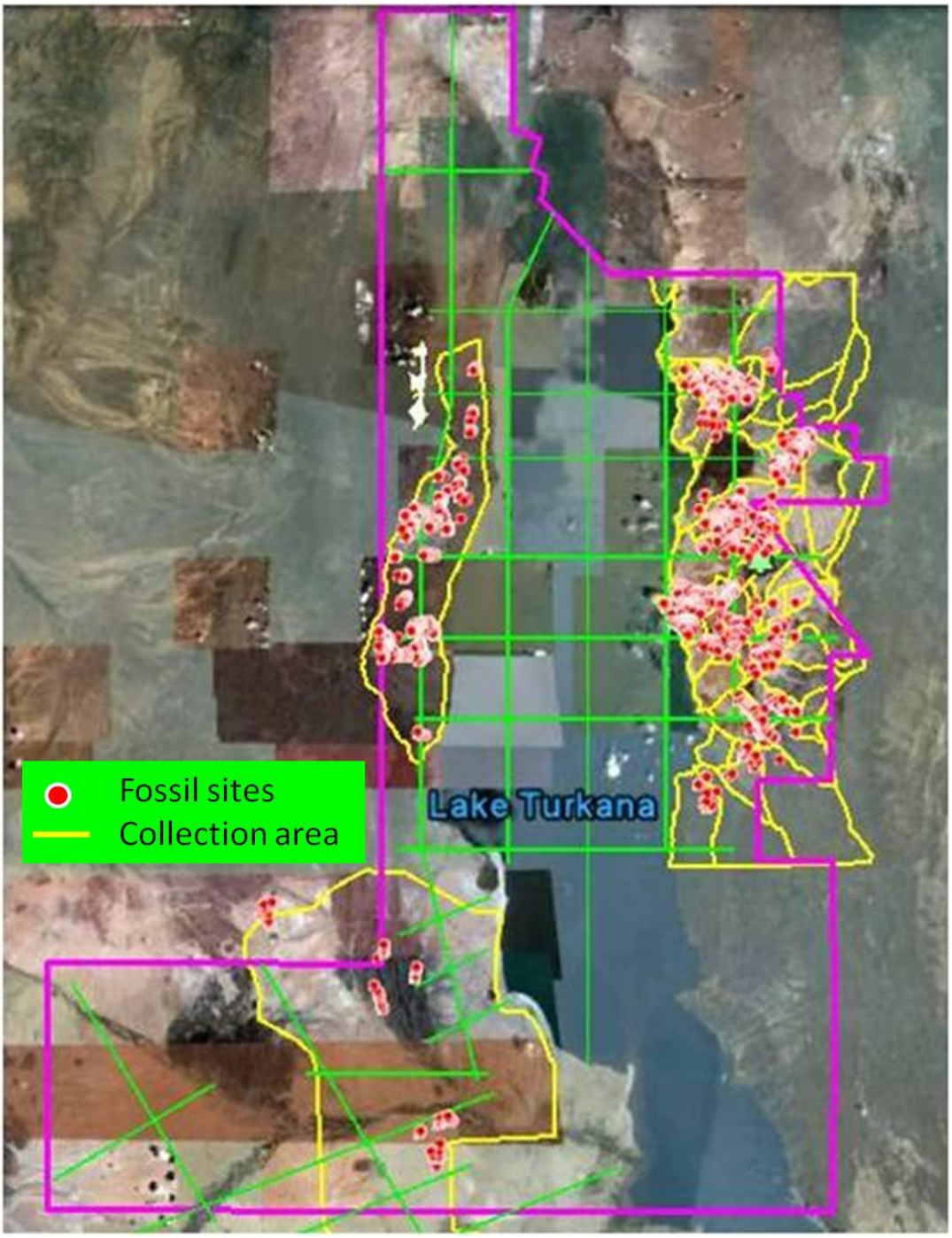


Figure 5.10: Fossil sites within block 10BA, (Source: Turkana Basin Institute).

Block 10BA is also home to the Turkana Basin Institute, established by Dr Richard Leakey, the primary function of which is carrying research in human prehistory and related earth and natural science studies within the Lake Turkana Basin. This is done in collaboration with the National Museums of Kenya as well as local and foreign institutes of higher learning. Other archaeological sites are found in the greater Sibiloi National Park, and some areas of the western parts of Lake Turkana from Kalokol to Lowareng'ak.

5.2.9.2 Cultural Sites

Turkana region is culturally rich. There are several cultural sites outside the project area that have a huge significance to the locals within Block 10 BA. These include the El Molo villages

and El molo Shrines. Namorutung'a cultural site on the western side of the block, near Lodwar along the Lodwar-Kalokol route, attracts visitors.

Relationship to Project and EMP
Known and well-documented archaeological, historical and cultural sites will, of necessity, have to be avoided. GPS coordinates of these sites should be obtained from the relevant authority or institution, as they will serve to inform on the selection of seismic line transects. In such areas, the use of vibroseis is not recommended due to weight pressure on the ground and the release of acoustic energy on the ground surface. The dynamite shote hole method is preferred as the small diameter shot holes are drilled a couple of meters into the ground, and the energy discharged is directed downwards. Lighter vehicles are also used during this operation. Buffer zones as specified in the mitigations section will need to be strictly observed. Personnel from the relevant Authority and/or institutions with good knowledge of the sites may need to accompany the seismic team so that areas which may need to be avoided do not have a seismic line running through them, as some sites may not have been recorded with accurate coordinates.

5.2.10 Visual Aesthetics

The area has pristine and rugged scenic beauty with hills, extensive plains, several sand rivers (luggas), and the emerald Lake Turkana with its three volcanic islands that are important natural heritage sites. The tourism potential is quite high due to these aesthetic features, but is today still underexploited on account of the poor infrastructure of this remote area. The proposed seismic activities will have an effect on the visual aesthetics of the area (line clearance, vehicle tracks, camps etc.), but these will be mitigated as far as possible.

Relationship to Project and EMP
Principles of "green" architecture and eco-friendly technologies and considerations should be employed when building the campsite and carrying out the seismic survey work, respectively.

5.2.11 Noise and Vibrations

Ambient noise in the project area is low level as it is a rural setting where there are neither industries nor significant traffic save for Lodwar which is characterized by transit vehicle movement. Seismic surveying and associated activities will increase noise and vibration levels locally for short periods during the proposed project.

Relationship to Project and EMP
All potential noise sources should have their noise levels reduced at source (e.g. purchasing of equipment with noise reduction mechanisms, minimising number of vehicles and traffic to the level required to efficiently carry out the work, regular servicing of equipment, use of personal protective equipment such as ear muffs, and setting up of buffer zones in areas of active seismic survey to keep away unauthorised personnel.

5.2.12 Solid and Liquid Waste

There are no significant solid or liquid wastes that are generated within the project area. There are minimal activities concentrated in small town centres that can generate solid waste or oil waste at present.

Relationship to Project and EMP

The area is essentially pristine with respect to solid and liquid wastes, and there is no public or private waste management service available in most of the project area. TKBV will have to ensure that the systems for treating solid and liquid wastes generated in the course of rolling out the project are properly selected, installed, managed and decommissioned according to national legislation, regulations, and international best practices in order to minimise or eliminate their potential environmental impacts.

5.3 OFFSHORE BASELINE SURVEY – LAKE TURKANA

5.3.1 Lake Bathymetry and Hydrography

The major features of the lake, including lake bathymetry, have been discussed in section 5.1.2.

The lake is well-mixed by strong, diurnal, south-easterly winds that are dominant for most of the year, and that are particularly strong near the lakeshore (Yuretich, 1979). These winds drive the surface currents of the lake, and, coupled with the basin morphometry, lead to closed-gyre circulations in the North Basin, which are periodically reversed during the Omo river flood seasons (Yuretich, 1979; Wright and Nydegger, 1980; Yuretich and Cerling, 1983; Olago and Odada, 1996) (Figure 5.11).

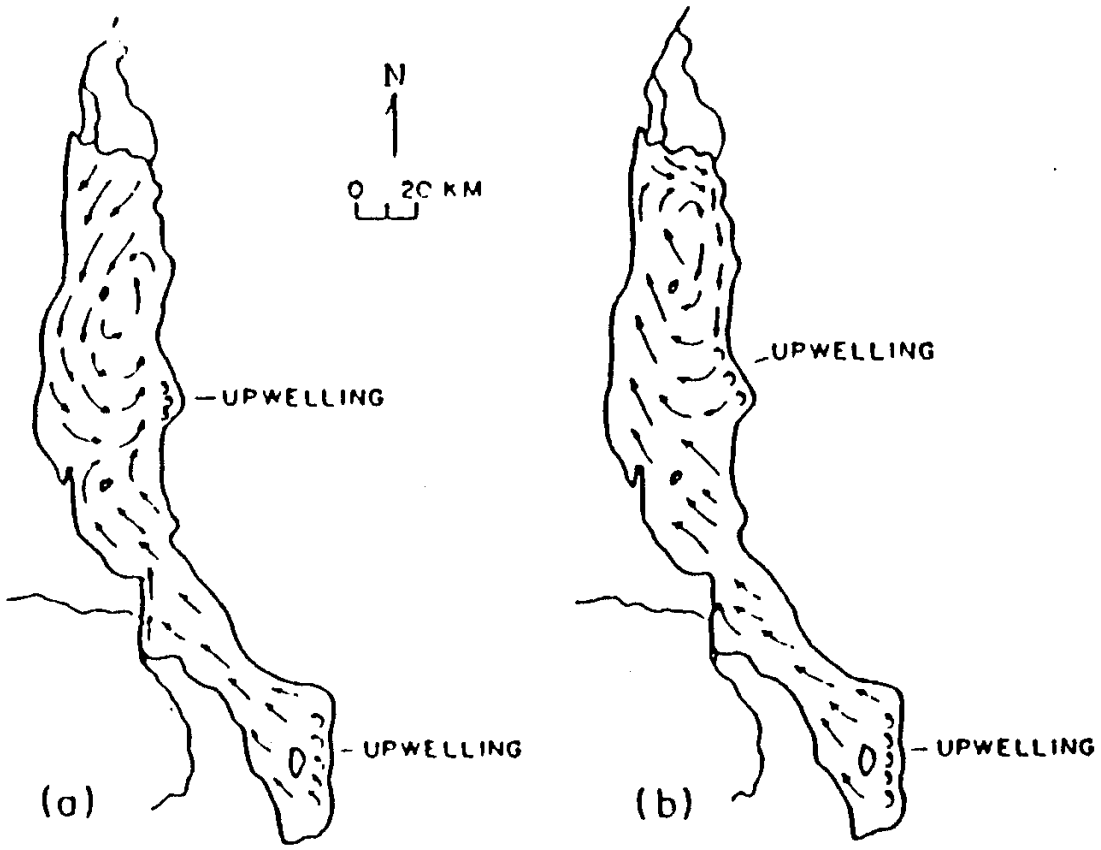


Figure 5.11: Circulation patterns within Lake Turkana. (a) Principal currents during Omo River flood seasons (May to November). (b) Current patterns during low Omo River discharge (December to April). (From Yuretich, 1979).

The closed-gyre circulation pattern is centred along the basin's north-south trending axis, and is additionally influenced by geostrophic effects (Wright and Nydegger, 1980). The Omo river plume seasonally augments the subsurface currents and effects reductions in salinity (Olago and Odada, 1996). Thus, removed from the Omo River influence, a north-westerly flowing surface current dominates, driven by the prevailing, strong south-easterly winds (Yuretich and Cerling, 1983). The wind-induced surface currents are restricted to the top 6 or 7 meters but are strong enough to create subsurface countercurrents which in turn cause mixing throughout the entire water column (Ferguson and Harbott, 1982). Circulation patterns are further modified by the seasonally deep incursions of the Omo river plume into the North Basin, which probably result in decreased strengths of the north-westerly surface currents and enhanced subsurface currents. In deeper parts of the basin during the Omo

river excursions, physical energy is therefore supplied principally by the Omo river plume: the mainstream of the plume occurs at 10 to 15m depth and is centred close to the western shoreline (Olago and Odada, 1996). Geostrophic effects (Coriolis force) are superimposed on these circulation patterns, causing a deflection to the right. During periods of low Omo River discharge (December to April), the gyre within the North Basin may be reversed and Omo River water is carried to the north-eastern corner of the lake (Figure 5.11) (Yuretich and Cerling, 1983). Hopson (1982) observed upwelling of deeper water at Loiyengalani in the south-eastern part of the lake, and upwelling may occur in numerous other areas along the shore (Yuretich and Cerling, 1983).

Relationship to Project and EMP

Data is lacking on current strengths as well as wave heights during different weather conditions. For the safety of the crew, these parameters can be established before offshore work begins in order to be able to better assess the risks that the boat crew may face.

5.3.2 Lake Sediments

Several different depositional environments, including alluvial fan, fluvial, shallow lacustrine, deep lacustrine and interbedded fluvial-lacustrine deposits, can be recognised in the Turkana basin (Cerling *et al.,* 1988). The sediments were described by Yuretich (1979, 1986) as mostly sandy and silty clays, which are well laminated throughout much of the lake, despite the well oxygenated bottom waters. Benthic populations that could potentially mix the sediment and destroy the laminations are restricted to the nearshore regions; farther offshore they are much smaller and epibenthic, presumably due to a low influx of edible detritus (Cohen, 1984). The laminations, which occur as light-dark couplets, are differentiated by carbonate content and are interpreted as reflecting an inter-annual rainfall variation of about four years' cycle length in the Ethiopian Highlands (source of the Omo River) (Yuretich, 1979; Halfman and Johnson, 1988), that could be related to the El Nino Southern Oscillation (ENSO) events in the tropical oceans (Halfman and Johnson, 1988). The average sedimentation rate, based on radiocarbon dating by Halfman and Johnson (1988), has been estimated at 2.7mm/yr and constitutes the most reliable rate for Lake Turkana.

The differences in source area geology, climate, the lake water's chemical balance, lake bathymetry, and lake productivity, impart distinctive characteristics to the sediments of Lake Turkana (Olago and Odada, 2000). The mineralogical assemblages within the three basins of Lake Turkana are similar, consisting mainly of the clay minerals kaolinite, smectite and illite, as well as calcite (inorganic and biogenic), feldspar, minor quartz and biogenic silica (Olago and Odada, 2000). The main sediment populations in the profundal sediments of Lake Turkana are: the fluvial population (fine silt to clay) prevalent in the North and Central Basins, largely responsible for the input of kaolinite, illite, iron oxides, feldspars and minor quartz; the ubiquitous authigenic fraction, contributing dominantly to smectite (produced diagenetically) and calcite (precipitated from the surface waters); and *in situ* biogenic (ostracods and diatoms) populations, which are most prevalent in the South Basin, contributing largely to the coarse to medium silt fractions (calcite and silica) (Olago and Odada, 2000). The aeolian fraction derived mainly from sources south-east of the lake (very fine sand size), is a minor but important component of the sediments of Lake Turkana (Olago and Odada, 2000).

5.3.3 Climate and Climate Change Sensitivity

Lake Turkana is sensitive to climate change as a result of its arid setting, topographically closed basin (i.e. no outlet), and high dependency on Omo River inflow. The level of Lake Turkana has varied by 20 m within the past century alone (Figure 5.12) (Butzer, 1971; Owen

et al., 1982). On a perennial basis the lake level fluctuates about 1 m every year from the seasonal flooding of the Omo iver (Ferguson and Harbott, 1982). It was 15m higher at the end of the 19th century and 5 m lower in the 1950s. These changes were primarily of climatic origin.

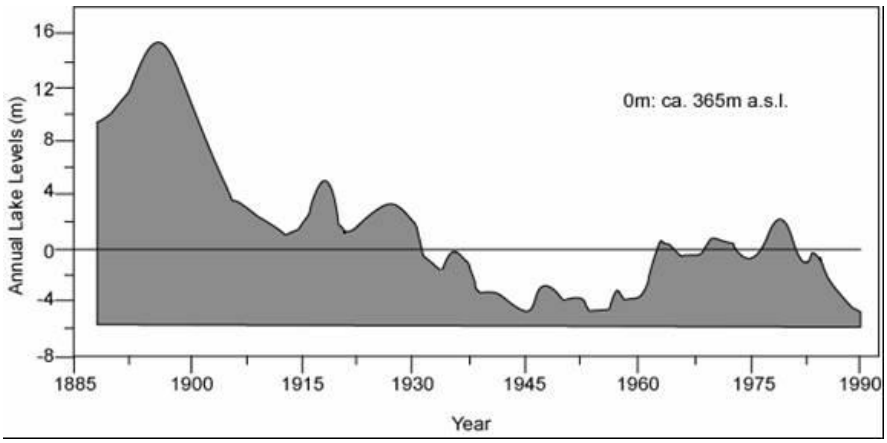


Figure 5.12: Fluctuations in the level of Lake Turkana from 1888 to 1989 (in metres) (From, World Lakes Database, 2002).

Relationship to Project and EMP

The seasonal and long-term changes in lake level are important in that baseline conditions are established and effects of anthropogenic activities in the watershed can be assessed, for e.g. the planned damming of the Omo River in Ethiopia. Further, it is important for engineering purposes, such as the siting and building of piers for docking of boats.

5.3.4 Lake Resources and National Parks

The lake provides for the needs of the local communities through fishing (Plate 5.40) and is also used as a means for transportation. The lake's fishery industry is not well-developed commercially. Alia Bay is important in that it serves as a key crocodile and fish breeding site, with mature individuals spilling over to the main lake where they are harvested. Ferguson's Gulf on the western side of the lake is an important fishing site for artisanal fishermen.

Plate 5.40: a) Drawn nets with assorted fish species, and b) fishing nets and fishing gear at Ferguson Gulf.

Parts of the lake are protected under the Wildlife Act, including Sibilio National Park on the north-eastern shores (the park borders extend 2km into the lake), and North, Central and Southern Island National Parks. The Central Island has three saline crater lakes (Crocodile

Lake, Flamingo Lake and Tilapia Lake). The Central Island (sometimes referred to as Crocodile Island) was gazetted as a National Park in 1973 but only established in 1985; this Park covers an area of 5km^2 and is governed by KWS.

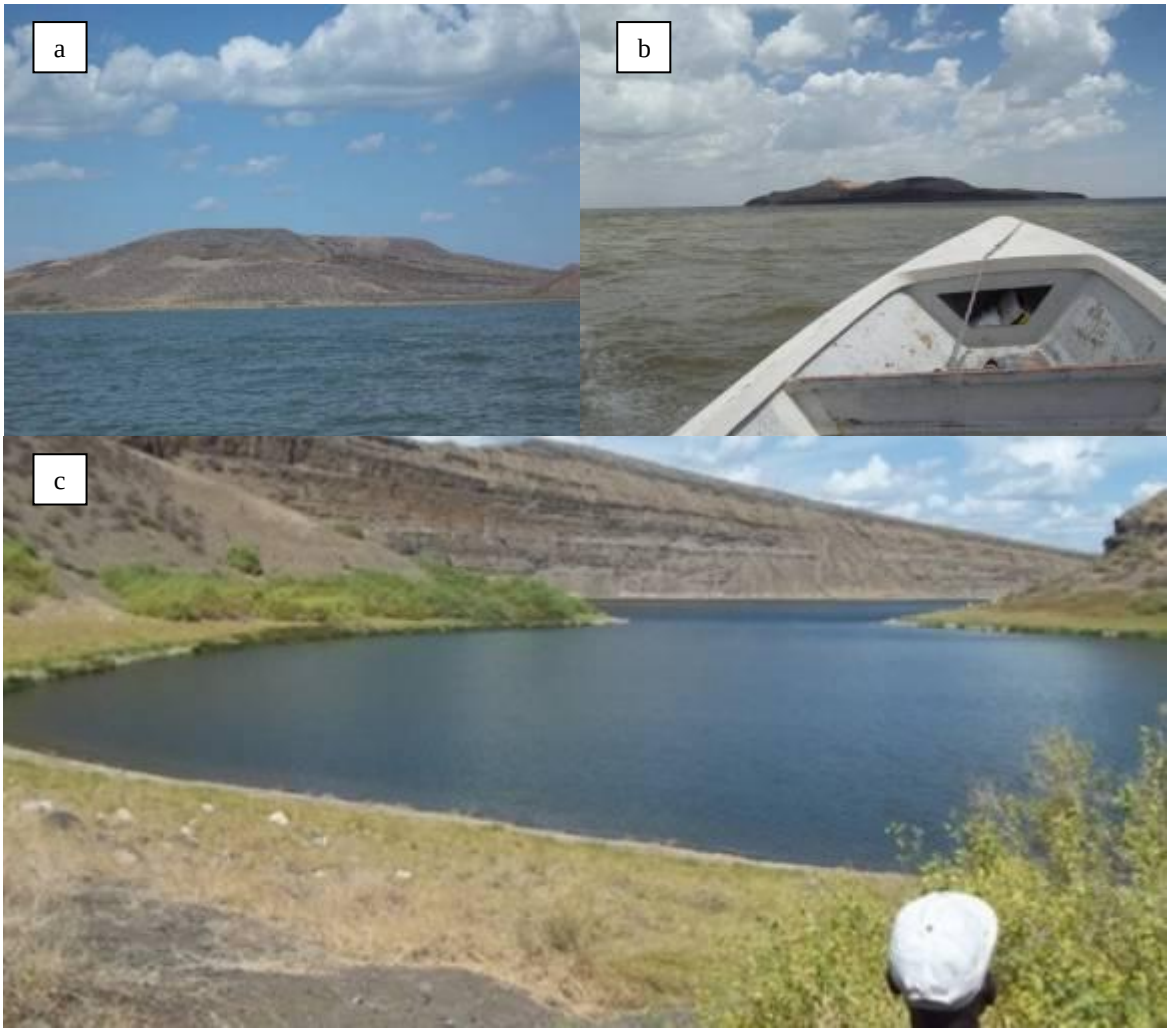


Plate 5.41: a) North Island viewed from Koobi Fora, b) Central Island, and c) Crocodile Lake; a crater lake within Central Island. This lake is an important crocodile breeding site, while the adjacent sites around the Central Island are key fish-breeding sites.

A total of over 350 species of aquatic and terrestrial birds have been recorded in Lake Turkana area, and Central Island has a breeding population of African skimmer, which nests in banks. It is also an important staging post for migrating birds including warblers, wagtails and little stints (Plate 5.41). The IUCN has categorised the two islands as Category II Protected Areas[7], while Central Island National Park was classified by UNESCO as a World Heritage Site Natural Criteria categories vii, viii and x in 1997 (along with Sibiloi National Park), while South Island National Park was classified under Natural Criteria categories vii, ix and x[8] in 2001. Each of these protected areas has a buffer zone of at least 2 km where no

[7] 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).

[8] **World Heritage Sites Natural criteria**

- (vii) "contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance"
- (viii) "is an outstanding example representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features"

fishing is allowed. For instance, Alia Bay on the eastern shore is the buffer zone for Sibiloi National Park. The Island Parks, administered by KWS, act as fish, crocodile and pelican breeding grounds.

Relationship to Project and EMP

The major resources of the lake are key to the livelihoods of the local people and the sustenance of the aquatic ecosystems. Permissions will have to be sought from Kenya Wildlife Services and/or the Minister for Forestry and Wildlife in relation to seismic operations in protected areas of the lake, if it is deemed that such operations are necessary, in accordance with the Wildlife (Conservation and Management Act) Cap. 376 (see section 4.3.14). Consultations with other stakeholders, such as fishermen, would have to take place to ensure no or minimum disruption of their livelihoods, or compensation in lieu thereof.

5.3.5 Lake Water Quality

There is not much data that has been collected on the quality of the lake water, and available data are also now fairly old (Table 5.6 below). The lake is moderately saline (2.5‰), alkaline (pH = 9.2), and is well mixed by strong diurnal winds (Yuretich and Cerling, 1983). The principal ions are Na^+, HCO_3^-, and Cl^-, with relatively low concentrations of Ca^{2+}, Mg^{2+}, and $(SO_4)^{2-}$ (Halfman *et al.*, 1989; Olago and Odada, 1996). In the north, salinity isseasonally reduced through mixing with dilute Omo River floodwaters. The data indicate that between 1954 and 1990, there were significant changes in the water quality (Table 5.6). Today, the lake level is lower than it has been in the past, so it is likely that its salinity has increased, but probably not significantly (see Figure 5.12, section 5.3.3). The microbiological load in the water has not been assessed.

Table 5.6: Water quality in Lake Turkana (from Olago and Odada, 1996).

Year	Source*	No.	Site	Cond. (mS/cm)	pH	Mg (mg/l)	Ca (mg/l)	Na (mg/l)	K (mg/l)	SiO_2 (mg/l)	Cl (mg/l)	PO4 (mg/l)	Alk. (meq/l)
1954	1	1	NB	3190	9.5	2.4	2.45	-	-	72	245	2	23
1954	2	1	Omo	80	-	1.05	8	-	-	26	trace	0.05	8.4
1956/57	3	1	Omo	-	-	0.66	1.1	-	-	-	2.8	-	2.5
1975	4	3	Omo	-	7	3.5	9.5	9.7	1.8	-	2.7	-	-
1973-75	5	4	Omo	1156	-	2.15	4.68	462	12.49	-	265	-	10.85(2)
1973-75	6	3	NB	3140	-	2.68(2)	3.93	820	24.3	-	454(2)	-	22.65(2)
1990	7	27	NB	2763.1	8.7	2.28	5.671	822.6	1.05	5.762	242.6	1.445	29.184

***: 1. Fish, 1954; 2: Fish, 1965; 2. Dodson, 1963; 4. Yuretich, 1976; 5. Hopson, 1982; 6. Hopson, 1982; 7. Olago, 1992.**

The lake waters were sampled for various analyses at the sampling points indicated in Table 5.7 and Figure 5.13 below. Depths to lake bottom were also measured at the sampling points using an echo sounder (Table 5.7).

- (ix) "is an outstanding example representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems, and communities of plants and animals"
- (x) "contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation

Table 5.7: Sampling stations and depth to lake bottom at sampling points.

Sampling Point	Latitude	Longitude	Reference Location	Depth (m)
1	3.588488^0	36.160003^0	Moite Area	15.8
2	3.825222^0	36.070394^0	Central Island Area	54.2
3	3.657286^0	35.913263^0	Kalokol/ Ferguson Gulf Area	9.3
4	4.096955^0	35.966293^0	Narengewoi/ Nachukui/North Island Area	15.3
5	4.303151^0	35.976208^0	Koobi Fora / Illeret Area	21.0
6	4.248768^0	36.136470^0	Loarengak/ Tondenyang Area	15.5

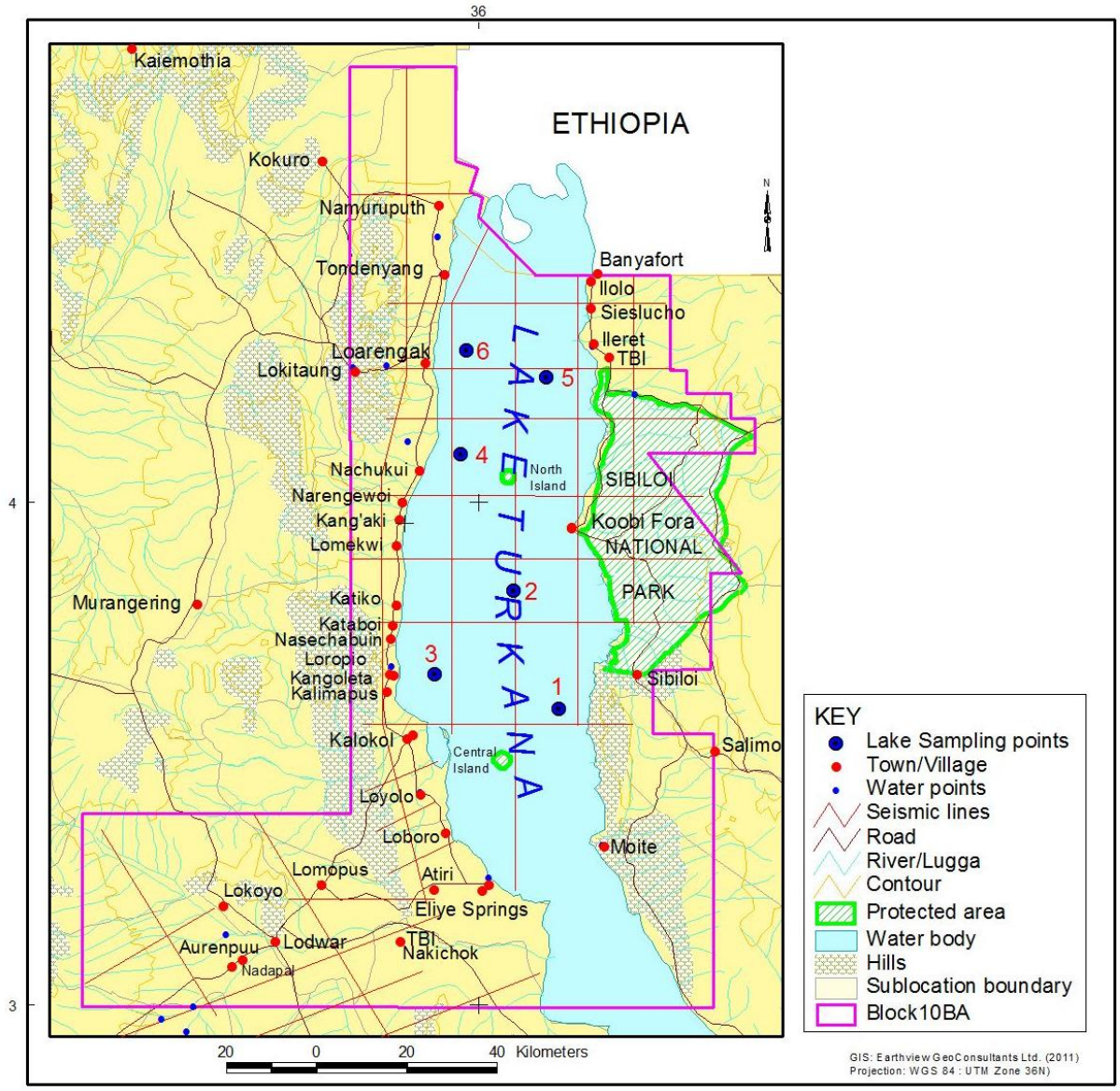


Figure 5.13: sampling points on the lake.

5.3.5.1 pH and Salinity

Sites sampled showed that the water had an average pH of 9.53 indicating that the lake is alkaline in nature (Table 5.8 below). This is supported by previous literature (UNEP, 2004, Table 5.6 above) which reported the lake to have an average pH of 9.2. The high alkalinity has been reported to promote rapid equilibrium of CO_2 with the atmosphere. Salinity levels

based on published reports indicate that the lake has a moderate salinity of 2.5‰ (UNEP, 2004).

The primary ions sodium (Na^+), bicarbonate (HCO_3^-), chloride (CL^-), calcium (Ca^{2+}), magnesium (Mg^{2+}) and sulphate $(SO_4)^{2-}$ Salinity levels in the northern section of the lake are reduced on a seasonal basis when the lake water mixes with dilute water of the Omo floodwaters. Lake Turkana has been reported to undergo greater variations in salinity than in temperature (UNEP, 2004).

Table 5.8 pH measurements for sampled stations.

Sampling Point	Latitude	Longitude	Reference Location	pH
1	3.588488^0	36.160003^0	Moite Area	9.45
2	3.825222^0	36.070394^0	Central Island Area	9.50
3	3.657286^0	35.913263^0	Kalokol/ Ferguson Gulf Area	9.80
4	4.096955^0	35.966293^0	Narengewoi/ Nachukui/North Island Area	9.45
5	4.303151^0	35.976208^0	Koobi Fora / Illeret Area	9.53
6	4.248768^0	36.136470^0	Loarengak/ Tondenyang Area	9.48

5.3.5.2 Temperature

The average subsurface temperature of the lake-water is 30.2°C (Table 5.9). This is supported by published work that reported the lake to have minimal annual temperature variations with subsurface temperature ranging from 27.5°C to 31°C and bottom temperature (70 m) ranging from 25.5 °C -27.0°C (ILEC, 2002 (Fig 3.9) An annual cycle of stratification has been observed: stable stratification from March to May (dissolved oxygen at 70m reduced from 2.4mg/l in June 1987 to 0.2 mg/l in May 1988) and complete circulation in June to July (Kallqvist *et al.*, 1988). For the rest of the year, there is partly restricted vertical mixing with temperature gradient of 1 to 2°C from the surface to the bottom at 70m (Kallqvist *et al.*, 1988).

Table 5.9: Temperature measurement for sampled stations.

Sampling Point	Latitude	Longitude	Reference Location	Temp(°C)
1	3.588488^0	36.160003^0	Moite Area	29.5
2	3.825222^0	36.070394^0	Central Island Area	30.6
3	3.657286^0	35.913263^0	Kalokol/ Ferguson Gulf Area	32.4
4	4.096955^0	35.966293^0	Narengewoi/ Nachukui/North Island Area	30.5
5	4.303151^0	35.976208^0	Koobi Fora / Illeret Area	28.7
6	4.248768^0	36.136470^0	Loarengak/ Tondenyang Area	29.5

Prior published records indicate that dissolved oxygen concentration especially in the northern section of the lake is about 70% saturation level even close to the bottom (UNEP, 2004) (Figure 5.14). Shore areas and southern-eastern parts of the lake experience constant upwelling regimes.

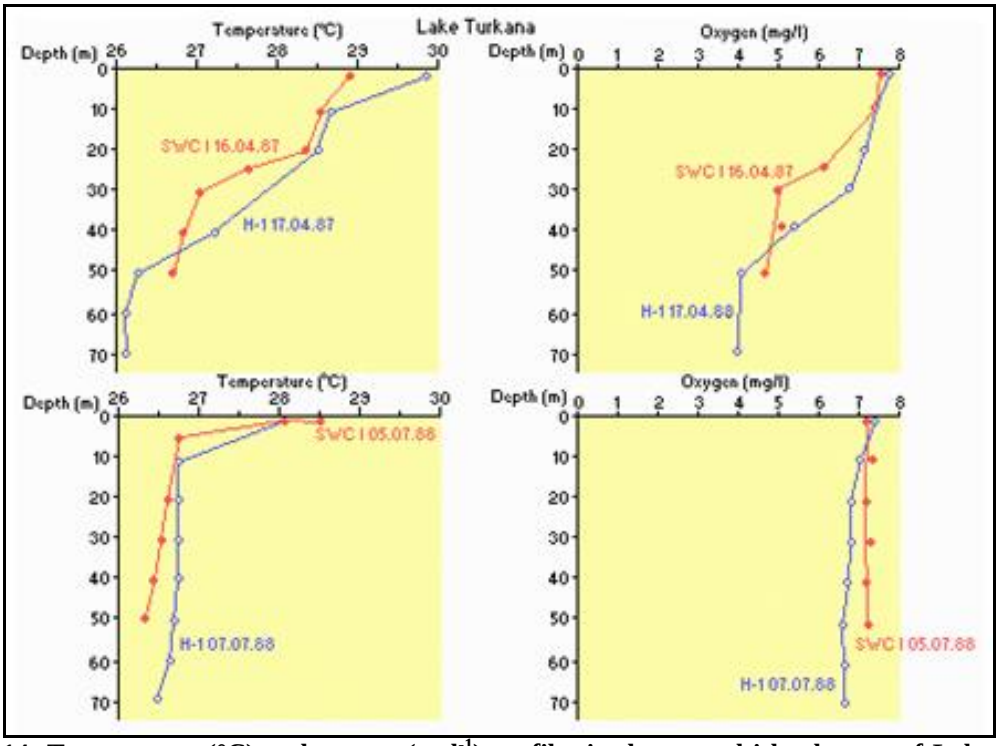


Figure 5.14: Temperature (°C) and oxygen (mgl^{-1}) profiles in the central island areas of Lake Turkana *(Adapted from ILEC, 2002)*.

5.3.5.3 Total Suspended Solids (TSS)

The various sections of the lake have varying amounts of TSS loads. High levels of TSS in sampling point 3 can be attributed to the high density of phytoplankton which support a thriving artisanal fisheries specifically for tilapine species around Kalokol and Ferguson Gulf areas, while the high TSS in sampling point 6 can be attributed to the proximity of the area to the mouth of River Omo. The lake is reported to be always turbid with a euphotic zone of about 6m. During the rainy seasons, sediment plumes measuring up to 100m long have been reported to extend southward from the Omo River delta (UNEP, 2004).

Table 5.10: TSS levels of sampled stations: TSS <20mg/l = clear water; TSS between 40-80mg/l = cloudy water; TSS >150mg/l = dirty water.

Sampling Point	Latitude	Longitude	Reference Location	TSS in mg/l
1	3.588488°	36.160003°	Moite Area	8
2	3.825222°	36.070394°	Central Island Area	19
3	3.657286°	35.913263°	Kalokol/ Ferguson Gulf Area	61
4	4.096955°	35.966293°	Narengewoi/ Nachukui/North Island Area	53
5	4.303151°	35.976208°	Koobi Fora / Illeret Area	47
6	4.248768°	36.136470°	Loarengak/ Tondenyang Area	68

5.3.5.4 Nitrates

Nitrate levels reported from sampled points are below the reported contaminant levels (maximum contaminant level (MCL) in drinking water as nitrate (NO_3) is 45 mg/l, whereas the MCL as NO_3-N is 10 mg/l).

Table 5.11: Nitrates amounts for sampled points

Sampling Point	Latitude	Longitude	Reference Location	Nitrates (µg/l)
1	3.588488°	36.160003°	Moite Area	0.44
2	3.825222°	36.070394°	Central Island Area	0.73
3	3.657286°	35.913263°	Kalokol/ Ferguson Gulf Area	0.21
4	4.096955°	35.966293°	Narengewoi/ Nachukui/ North Island Area	1.20
5	4.303151°	35.976208°	Koobi Fora / Illeret Area	0.47
6	4.248768°	36.136470°	Loarengak/ Tondenyang Area	0.70

5.3.5.5 Phosphorus

Phosphorus is often a limiting nutrient in freshwater environments, and its availability may govern the rate of growth of organisms. Nitrogen is more often the limiting nutrient in seawater environments. Addition of high levels of phosphate to environments and to micro-environments in which it is typically rare can have significant ecological consequences, such as algal blooms and eutrophication that can lead to collapse of populations deprived of oxygen. In the context of pollution, phosphates are one component of total dissolved solids, a major indicator of water quality. Results in Tables 5.11 and 5.12 show that the water in the lake is uncontaminated (cf. Table 5.13).

Table 5.12: Phosphates levels for sampled points

Sampling Point	Latitude	Longitude	Reference Location	Phosphates (µg/l)
1	3.588488°	36.160003°	Moite Area	31.61
2	3.825222°	36.070394°	Central Island Area	28.06
3	3.657286°	35.913263°	Kalokol/ Ferguson Gulf Area	26.15
4	4.096955°	35.966293°	Narengewoi/ Nachukui/North Island Area	27.25
5	4.303151°	35.976208°	Koobi Fora / Illeret Area	24.28
6	4.248768°	36.136470°	Loarengak/ Tondenyang Area	21.81

Table 5.13: Indictor levels for phosphates concentrations in water for water quality assessment

Indicator level	Remark
0.01 - 0.03 mg/L	the level in uncontaminated lakes
0.025 - 0.1 mg/L	level at which plant growth is stimulated
0.1 mg/L	maximum acceptable to avoid accelerated eutrophication
> 0.1 mg/L	accelerated growth and consequent problems

Source: HACH Company, 1983

Relationship to Project and EMP

Baseline conditions are established for the lake-water in the northern basin, which is the least saline sub-basin of the lake. These data will form a basis for monitoring of pollution within the lake, and will underpin the waste management on the boat during marine operations.

5.3.6 Aquatic Environment

Several habitat types are found within the lake ecosystem and include sand dunes, sand bars, spits, delta, bay, islands, gulf and sand beaches. Lake Turkana is the only desert lake in the world with a shore generally devoid of pronounced vegetation. In general, areas that have macrophytic plants are dominated by grasses such as *Paspadium germinatum and Sporobolus spicatus* which inhabit shallows. Within the bays *Potamogeton* beds are prominent. The macrophytic habitats are an important breeding and nursery ground for a variety of fish species (UNEP,2004).

5.3.6.1 Phytoplankton

The most dominant phytoplankton species include *Microcystis aeruginosa, Anabaenopsis arnoldii, Botryococcus braunii, Planctonema lauterbornii, Oocystis gigas, Sphaerocystis schroeteri, Coscinodiscus* sp, and Surirella sp. (Tables 5.14 and 5.15).

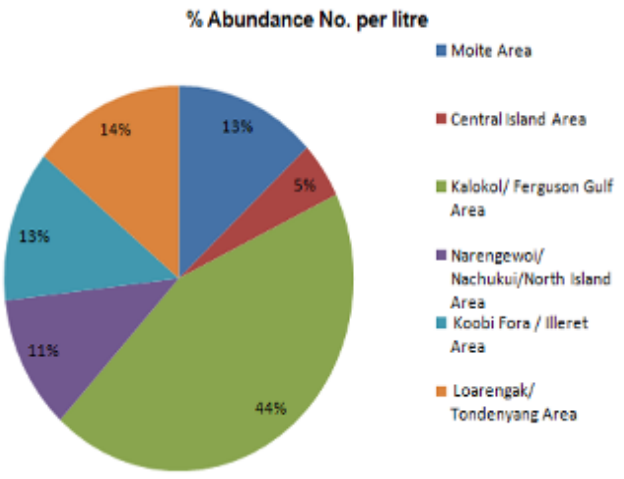
Table 5.14: Phytoplankton occurrences.

	Sampling Reference Location	Chlorophyta (green algae)	Cryptomonadales	Cynobacteria	Diatoms	Flagellates
1	Moite Area	√	√	√	√	√
2	Central Island Area	√	√	√	√	√
3	Kalokol/ Ferguson Gulf Area	√		√	√	√
4	Narengewoi/ Nachukui/North Island Area	√	√	√	√	√
5	Koobi Fora / Illeret Area	√		√	√	√
6	Loarengak/ Tondenyang Area	√		√	√	√

Phytoplankton in the aquatic environment is limited by the availability of nitrates, turbidity and vertical mixing. Areas such as Kalokol/Ferguson Gulf, Moite and Loarengak/Tondenyang Area that reported a high number of phytoplankton per litre have a thriving artisanal fisheries industry with the phytoplankton dominant species in these ares being *Anabaena circinalis and Botrycoccus braunii*. These sites are also very rich in terms of presence of fish-eating bird species.

Table 5.15: Phytoplankton abundance.

Sampling Reference Location	**Abundance (No. per litre)**
Moite Area	6228
Central Island Area	2250
Kalokol/ Ferguson Gulf Area	20917
Narengewoi/ Nachukui/North Island Area	5363
Koobi Fora / Illeret Area	6071
Loarengak/ Tondenyang Area	6675



5.3.6.2 Zooplankton

Ecologically important protozoan zooplankton groups include the cladocerans, ostracods, insect and diptera. Others include molluscs and chordates e.g. juvenile fish. Through their consumption and processing of phytoplankton (and other food sources), zooplankton play an important role in aquatic food webs, both as a resource for consumers on higher trophic levels (including fish), and as a conduit for packaging the organic material in the biological pump. Since they are typically of small size, zooplankton can respond relatively rapidly to increases in phytoplankton abundance, for instance, during the spring bloom. Zooplankton abundance per sampling point is indicated in Tables 5.16, 5.17 and 5.18 and Figure 5.15 below. Common zooplankton species in Lake Turkana include Copepoda (*Tropodiaptomus banforanus, Mesocyclops leuckarti, and Thermocyclops hyalinus*); Cladocera (*Diaphanosoma excisum, Ceriodaphnia rigaudi, Moina* spp.); Protozoa (*Vaginicola* sp.) (ILEC, 2002; UNEP, 2004). Lake Turkana is reported to have five gastropod molluscs: *Bellamya unicolor, Ceratophallus natalensis, Gabiella rosea* and *Melanoides tuberculata*, and two species of shrimps: *Caradina nilotica and Macrobrachium niloticum* (Hughes and Hughes, 1992).

Table 5.16: Zooplankton abundance.

Sampling Reference Location	No./ m^3
Moite Area	2435
Central Island Area	65
Kalokol/ Ferguson Gulf Area	485
Narengewoi/ Nachukui/North Island Area	2545
Koobi Fora / Illeret Area	2265
Loarengak/ Tondenyang Area	690

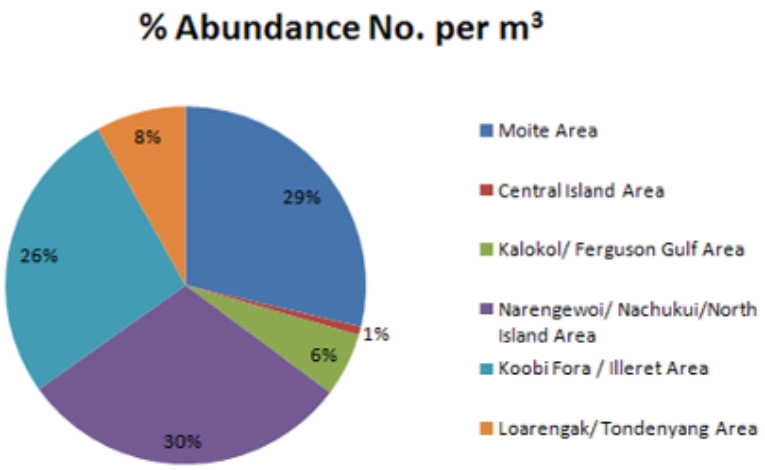


Figure 5.15: Zooplankton abundance per m^3.

Table 5.17: Presence or absence of the most common zooplankton genera.

Sampling Reference Location	Cladocerans	Cyclopoida	Diaptomus	Diptera	Eubranchipus	Fish eggs	Insecta	Ostracoda	Rotifer
Moite Area	√	√	√					√	
Central Island Area	√		√	√					
Kalokol/ Ferguson Gulf Area	√	√	√	√		√		√	√
Narengewoi/ Nachukui/North Island Area	√	√	√	√					
Koobi Fora / Illeret Area	√	√	√		√	√	√	√	√
Loarengak/ Tondenyang Area	√	√	√			√		√	

Table 5.18: Zooplankton common genera abundance.

Sampling Reference Location	Cladocerans	Cyclopoida	Diaptomus	Diptera	Eubranchipus	Fish eggs	Insecta	Ostracoda	Rotifer
Moite Area	590	1615	215	0	0	0	0	15	0
Central Island Area	15	0	20	30	0	0	0	0	0
Kalokol/ Ferguson Gulf Area	20	140	20	35	0	0	0	30	240
Narengewoi/ Nachukui/North Island Area	320	330	1875	20	0	0	0	0	0
Koobi Fora / Illeret Area	1045	390	780	0	10	10	10	10	10
Loarengak/ Tondenyang Area	125	315	220	0	0	20	0	10	0

5.3.6.3 Birds

Lake Turkana is an important flyway for north-bound migrants, and also has 84 waterbird species, including 34 palearctic migrants (cf. Hughes and Hughes, 1992; Birdlife International, 2001). For these reasons, it has been classified as an Important Bird Area (IBA) KE028 (Birdlife, 2011). It serves as a key stop-over, breeding, foraging and roosting site for resident and migrant bird species. For instance, over 100,000 little stints (*Calidris minuta)*, representing more than 10% of the entire East African/South East Asian wintering population have been recorded within this ecosystem. 23 birds breed within the ecosystem: examples include Goliath Heron *(Ardea goliath)*, up to 50 pairs of the regionally threatened African Skimmer (*Rynchops flavirostris)* (Birdlife, 2011). Common resident birds in Lake Turkana include pelicans, flamingoes and herons (Gichuki and Gichuki, 1992), as well as little egrets, yellow-billed storks, ibis, spoonbills, plovers, fish eagles, African spoonbills and gulls (Plate 5.42).

Plate 5.42: (a) Yellow billed storks and grey headed gulls at Ferguson Gulf, (b) Greater white Pelicans, and (c) Yellow billed stork and African spoonbills at Koobi Fora. North Island in the background.

Turkana is also an important resting site for large numbers of visiting water-edge birds such as Kentish Plover (*Charadrius alexandrinus*), Broad-billed Sandpiper (*Limicola falcinellus*), Long-tailed Skua (*Stercorarius longicaudus*) and Pomerine Skua (*S. pomarinus*) (Gichuki and Gichuki, 1992). Most of the birds breed between March and May, and in November.

Central Island has a breeding population of African skimmer *Rhyncops flavirostris* which nests in banks. It is also an important staging post for migrating birds including warblers, wagtails and little stints *Calidris minuta* (Cunningham Van-Someren, 1981). Ferguson's Gulf has a large number of water birds but it has no protected area status (Gichuki and Gichuki, 1992). Waterbirds are distributed all around the lake, but the highest densities are on mud and pebble shores; particular concentrations occur in sheltered muddy bays and the Omo delta. At least 23 species breed here, including *Ardea goliath*.

Regionally threatened species include: Great egret (*Casmerodius albus*), Saddle billed stork (*Ephippiorhynchus senegalensis*), Western banded snake eagle (*Circaetus cinerascens*), African skimmer.

5.3.6.4 Fish

At least 48 species of fish have been identified in Lake Turkana (UNEP 2004, Birdlife, 2011). The main fish breeding periods in the lake are January to March and July to September, and coincide with increases in rainfall. The fish are of great economic value as they support a vibrant artisanal fisheries industry within the Lake Turkana ecosystem. The fish are sold while fresh or are sun-dried, packed and sold in major towns such as Kisumu, Kitale, Eldoret and Nairobi. Plate 5.43 shows some fish species encountered in the lake. A detailed list of the common fish species is contained in Table 5.19 below.

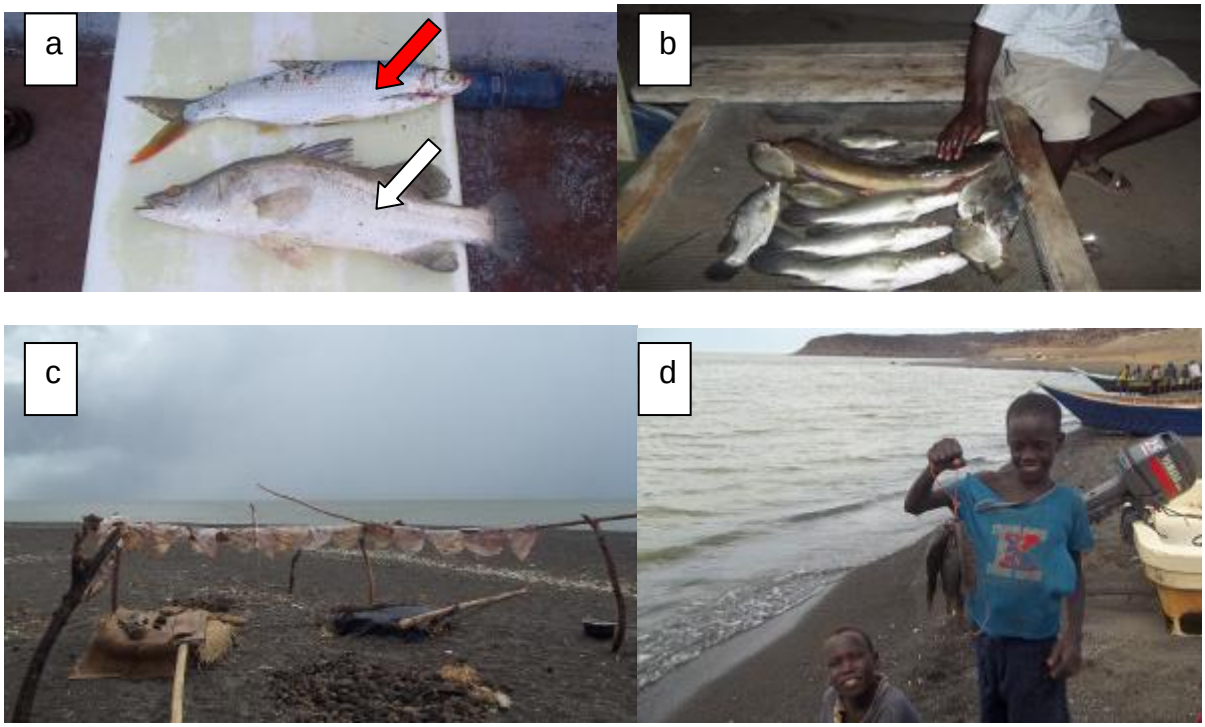


Plate 5.43: a) *Alestes* spp - red arrow and Nile perch - white arrow, b) freshly caught cat fish, Nile perch and tilapia, c) Nile perch fillet hanged to sun-dry at the North Island shores, and d) Turkana boy with a catch of Tilapia fish at North Island.

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Table 5.19: Lake Turkana common fish species, habitat type and status.

Fish Species in Lake Turkana						
Species	**Common Names**	**Family**	**Habitat**	**Length (cm)**	**Trophic level**	**Status**
Alestes dextrex	African Tetras	Alestiidae	pelagic	55 TL	2.9	endemic
Alestes baremose						
Alestes imberi						
Alestes minutes						
Alestes nurse						
Brycinus macrolepidotus				65 TL	2.3	
Brycinus nurse				25 TL	2.4	
Bagrus bayad	Cat fish	Clarias	benthopelagic			
Distichodus niloticus	Nile distichodus	Distichodontidae	pelagic	83 TL	2.0	endemic
Gymnarchus niloticus	African knifefish	Gymnarchidae	demersal	204 TL	3.7	endemic
Haplochromis rudolfianus	Tilapia	Cichlidae	benthopelagic	32TL	3.5	endemic
Heterotis niloticus		Osteoglossidae	demersal	120 TL	3.0	endemic
Hydrocynus forskalii	Curler	Alestiidae	pelagic	96 TL	4.0	rare
Hydrocynus vittatus		Alestiidae	demersal	117 TL	4.5	endemic
Lates niloticus	Nile Perch	Latidae	benthopelagic	over 195 cm long	5	endemic
Lates Longispina	Rudolph lates					
Labeo horie	Barbels	Cyprinidae	benthos			
Micralestes elongatus		Alestiidae	pelagic	6 TL	3.3	endemic
Mormyrus kannume	Elephant fish	Mormyridae	demersal	122 TL	3.2	endemic
Oreochromis niloticus	Tilapia	Cichlidae	benthopelagic	74 TL	2.0	endemic
Oreochromis niloticus vulcani				32 TL	2.9	
Polypterus bichir bichir	Bichir	Polypteridae	demersal	68 TL	4.5	endemic
Polypterus senegalus senegalus				51 TL	3.5	
Synodontis schall	Nile Squeakers	Mochokidae	Benthopelagic	49.0 TL		endemic

Source: Adapted and modified from Fishbase, 2002, UNEP 2004.

Out of the 48 species reported to occur in Lake Turkana, only 12 are of economic importance. They include *Lates niloticus, Tilapia spp., Barbus bynie, Labeo hori, Clarias lazera, Alestes spp, Citharinus citharus, Disticodus niloticus, Bagrus docmac,* and *Hydrocynus forskalii.*These species are captured using passive equipment such as gill nets and long lines.

Spawning migrations of fish are synchronized with seasonal flooding of the lake due to rains in the Ethiopian highlands, which occurs from June through September. During this time, various fish species migrate up the Omo River (*Hydrocynus forskalii*, *Alestes baremoze*, *Citharinus citharus*, *Distichodus niloticus*, *Barbus bynni*) and other ephemeral affluents (*Brycinus nurse, Labeo horie, Clarias gariepinus, Synodontis schall*) to breed, for periods of both long and short duration (Beadle 1981; Hopson 1982). Within the lake, peak fish breeding is between January and March, and July to September.

5.3.6.5 Aquatic Reptiles

Lake Turkana is a renowned site for the presence of a high number of crocodiles *(Crocodylus niloticus)* which are supported by an ample supply of fish species within the lake. The lake environment serves as an important breeding and foraging ground for the Nile crocodile. The crocodiles breed between November and December. It is estimated that the lake supports a crocodile population of at least 12,000 individuals. According to IUCN, the Nile crocodile is accorded a conservation status of least concern, while CITES classifies the species under Appendix I (threatened with extinction) in most of its range; and under Appendix II (not threatened, but trade must be controlled) (Crocodile Specialist Group, 1996). The site also harbours the Nile monitor lizard, a species that is widely distributed within the lake environment (Spawls et.al, 2006). The crocodiles breed during the dry season from November to December (rain and wind inhibit their reproductive behaviour): peak laying of eggs is in December and peak hatching is in March (Modha, 1967). On Central Island, the crocodiles make their nests in the sand under *S. persica* trees (Modha, 1967).

In addition to the Turkana Mud Turtle (*Pelusios broadleyi*) (see section 5.2.7.2.2), another important turtle species is found in the area, the Nile Soft-shelled Turtle/African Soft-shell turtle (*Trionyx triunguis*) (Plate 5.44). A large number of individuals have been reported to be found around Central and Northern Island. The Nile Soft-shelled Turtle is listed by IUCN–The World Conservation Union in the “Red List of Threatened Species” as “critically endangered” (a taxon is “Critically Endangered” when it is facing an extremely high risk of extinction in the wild in the immediate future). The species is also listed in Appendix II of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), and is subject to conservation recommendation 26 (1991). *Trionyx triunguis* has also been included in Appendix III of CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which means that the species needs special conservation. Turtles, like the crocodiles, also breed (or nest) during the dry season between November and December. Nesting localities are usually sandy shores, dry stream beds, or riverbanks, and eggs are laid a few meters onshore in holes up to 50 cm deep.

Plate 5.44: The shell of a Nile soft shell turtle at the North Island shores.

5.3.6.6 Mammals

Hippos are also found in the lake (*Hippopotamus amphibius)*. The Sibiloi, Central Island, and South Island National Parks are important breeding areas for hippos (Hughes and Hughes, 1992). They are also found in the Omo delta region and along the northern shorelines of the lake.

5.3.6.7 Sensitivity Map

The sensitivity map below (Figure 5.16) has been developed on the basis of the field survey assessment and reviews of existing literature, supported by stakeholder inputs given during the meetings held in the field. It should be interpreted in conjunction with Table 5.20 below on the breeding seasons of various fauna in the lake region.

Relationship to Project and EMP

Due to the fact that the breeding, spawning and migration seasons of the lake and lake-related fauna (fish, invertebrates, reptiles, water birds, hippos) are all different and are spread throughout the calendar year (Table 5.20), avoidance of operations during such seasons is impractical. The seismic survey operations will need to be well planned, taking particular care to avoid disturbing the fauna in their breeding, nesting and spawning areas.

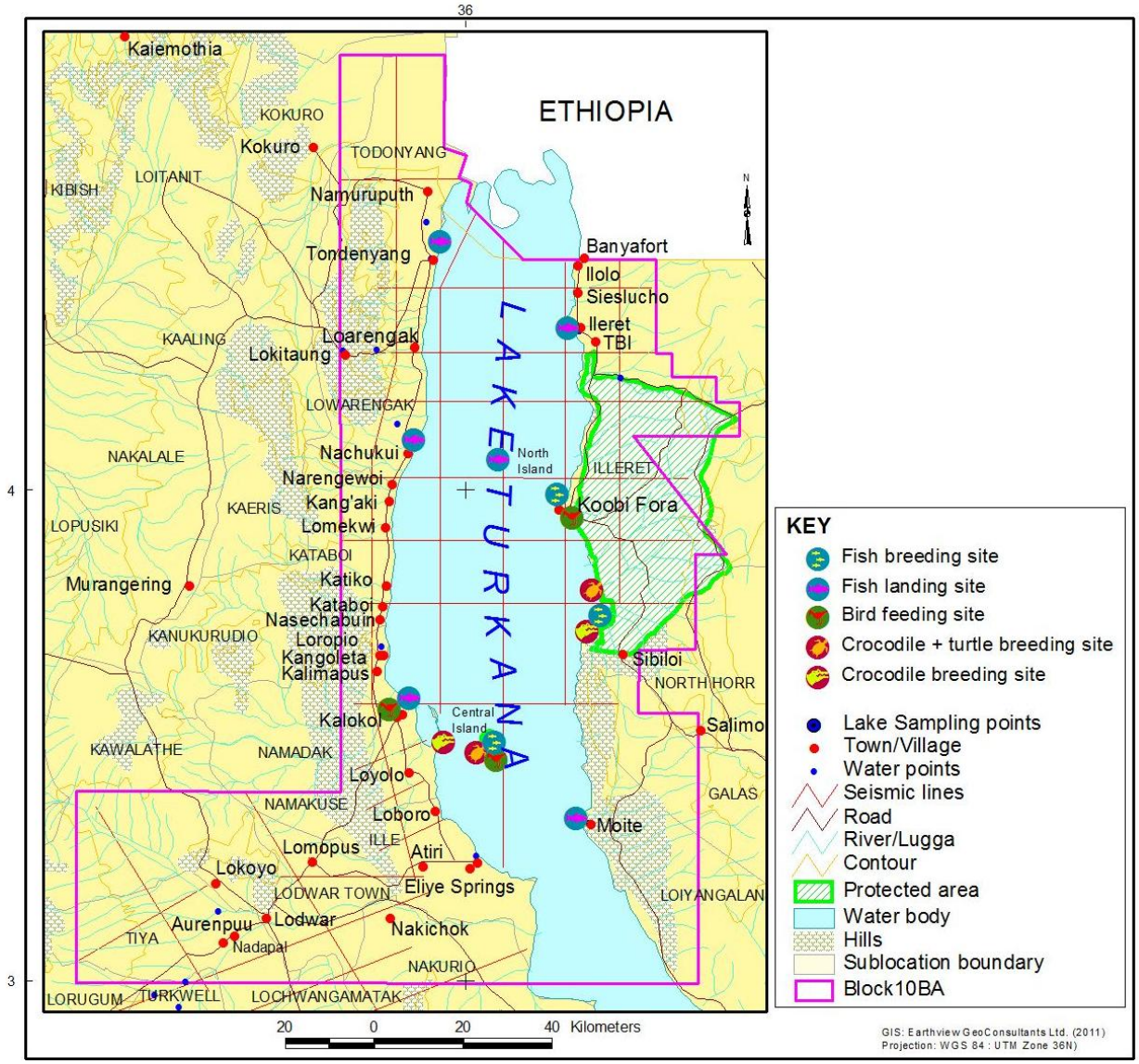

Figure 5.16: Sensitivity map for Lake Turkana.

Table 5.20: Breeding seasons for fauna of the Lake Turkana area.

Fauna	Breeding/Nesting Season
Fish	January to March and July to September
Crocodiles	November to December, Peak hatching in March
Turtles	November to December
Birds	March and May, and in November

5.4 SOCIO-ECONOMIC BASELINE

This section provides information on key socio-economic issues and activities relevant to the project. It includes an overview of social characteristics, economic settings, health, education, and demography. While the team acquired as much information as possible, it should be noted that detailed information on some of the issues are either not available or they date back several years.

The population census undertaken in 2009 was cancelled in some of the areas due to the as yet unresolved ambiguity in the data collected.

5.4.1 Social Characteristics

5.4.1.1 Demography

The area is thinly populated, with mainly Turkana pastoralists to the west, and Gabra and Daasnach pastoralists to the east of the Lake respectively, but there is considerable crossover (Figure 5.17). Across the border in Ethiopia, are the Karo, Hammer and Geleb pastoralists who occupy the lower Omo Valley. According to the 2009 Kenya national population census, the project area has a very low population and density as shown below (source: 2009 Kenya Population and Housing Census, KNBS).

DISTRICTS COVERED:

NO.	Districts	Male	Female	Total	Total household	Area in sq. Km.	Density
1	TURKANA CENTRAL	126,539	128,067	254,606	41,120	14,590.7	17
2	TURKANA NORTH	197,508	176,906	374,414	53,634	35,418.8	11
3	LOYANGALANI	-	-	-	-	-	-
4	NORTH HORR	14,991	12,016	27,007	5,164	11,764.4	2

Source: Population census data, 2009

DIVISIONS COVERED:

No.	Divisions	Male	Female	Total	Total household	Area in sq. Km.	Density
1	LODWAR	28,531	29,759	58,290	11,437	831.8	70
2	KALOKOL	20,715	21,457	42,172	7,282	2,139.9	20
3	KATABOI	4,524	4,237	8,761	1,460	908.6	10
4	LOKITAUNG	20,029	18,713	38,742	6,166	1,857.8	21
5	LAPUR	9,777	7,702	17,479	2,352	2,436.0	7
6	LOYANGALANI	12,888	13,223	26,111	5,944	11,730.5	2
7	NORTH HORR	6,597	5,560	12,157	2,788	5,367.9	2

Source: Population census data, 2009

LOCATIONS COVERED:

No.	Locations	Male	Female	Total	Total household	Area in sq. Km.	Density
1	LODWAR	17,690	17,816	35,506	7,072	544.4	65
2	KALOKOL	9,484	9,993	19,477	3,684	1,134.9	17
3	KANG'ATOTHA	5,772	6,061	11,833	1,969	865.3	14
4	KATABOI	2,203	2,000	4,203	683	287.8	15
5	NG'ISIGER	7,199	6,601	13,800	2,210	397.5	35
6	LOKITAUNG	3,535	3,704	7,239	1,284	316.2	23

7	TODONYANG	1,725	1,061	2,786	438	527.0	5
8	LOYANGALANI	5,796	5,773	11,569	2,396	2,648.3	4
9	ILLERET	5,255	4,535	9,790	1,527	4,041.5	2

Source: Population census data, 2009

SUB LOCATIONS COVERED:

No.	Sub Locations	Male	Female	Total	Total household	Area in sq. Km.	Density
1	KALOKOL	5,654	5,826	11,480	2,311	384.2	30
2	NACHUKUI	3,208	2,880	6,088	988	188.5	32
3	LOWARENG'AK	2,743	2,738	5,481	883	172.7	32
4	LOYANGALANI	3,310	3,941	7,251	1,493	645.6	11
5	MOITE	1,097	764	1,861	365	435.2	4

Source: Population census data, 2009

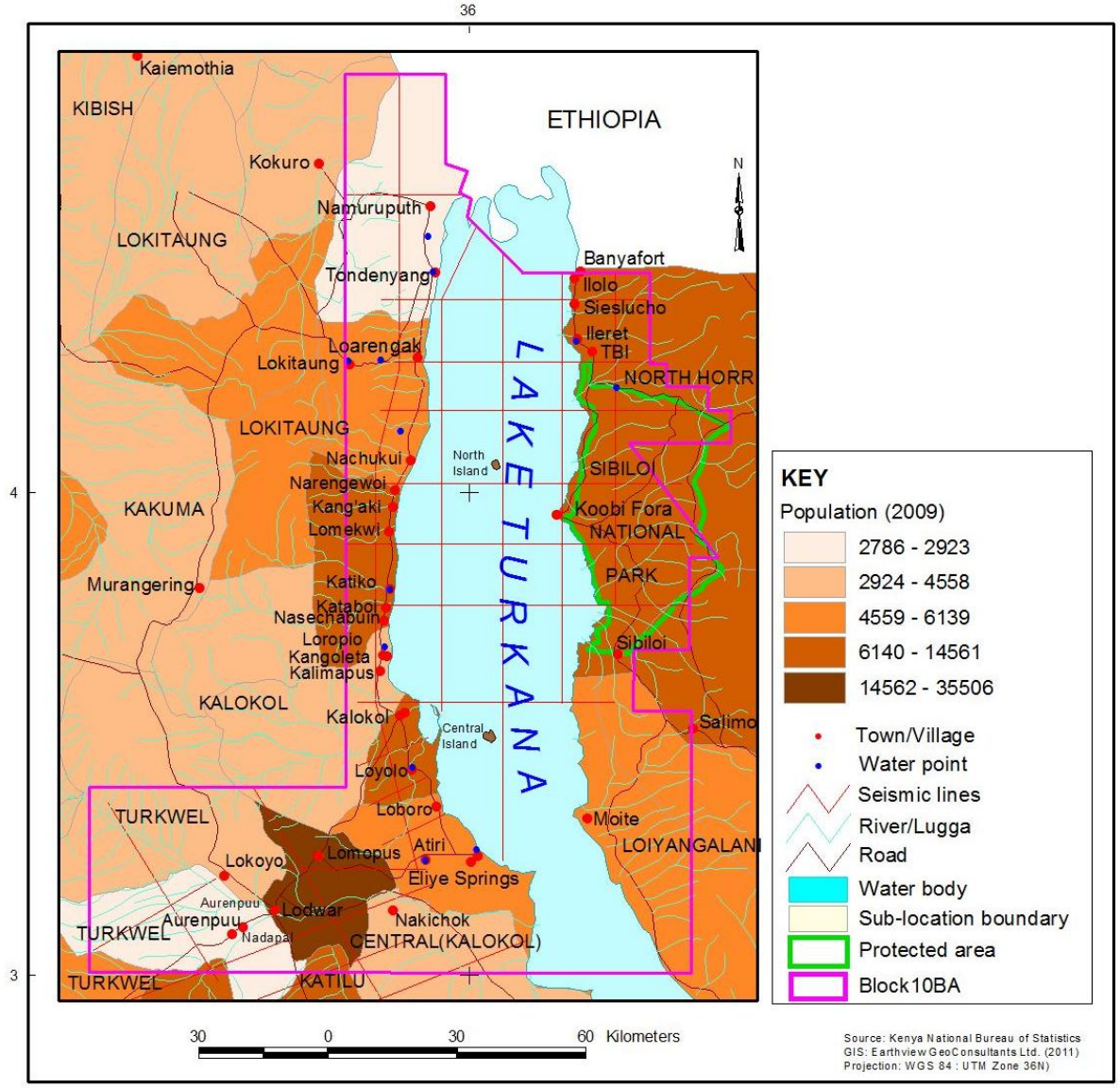

Figure 5.17: Population distribution map.

5.4.1.2 Education

The project area is marginalised with respect to education; infrastructure is poor and cultures of the local communities contribute to the very low literacy levels. Missionaries have helped establish some institutions in the area like in Todonyang, but insecurity in the area remains a challenge and schools have been closed indefinitely as a result of this situation. Lodwar Town has several tertiary institutions, while primary and secondary schools are available in the entire Block (Plate 5.45).

Plate 5.45: A boarding primary school in Todonyang (Source: fieldwork, 2011).

5.4.1.3 Housing

Housing within the project area ranges from semi-permanent to temporary (Plate 5.46). This can be attributed to the nomadic nature of the mainly pastoral communities. Locally available materials for construction also affect the nature of houses in the area. Most people within Block 10 BA use Doum Palm branches for their housing construction.

Plate 5.46: Daasanach settlement in Ileret (Source: fieldwork, 2011).

5.4.1.4 Energy Sources

The Kenya Rural Electrification Authority has installed diesel electric power generators in Lodwar and Lokitaung towns (Plate 5.47). In other small centres, more diverse sources of electricity generation are used, including: privately owned diesel generators, solar power systems, and windmills. Within the households, charcoal and firewood are the main sources of fuel.

Plate 5.47: A windmill within Eliye springs (Source: fieldwork, 2011).

5.4.1.5 Land Tenure System

The land tenure system within the project area ranges from government owned to trust land. There is no privately owned land in Block 10 BA. The trust land is under the Turkana and Marsabit County Councils.

5.4.2 Economic Setting

5.4.2.1 Labour Force

The project area has a very low and scattered population. The literacy levels are also very low owing to the poor educational infrastructure. The bulk of the labour force is unskilled save for a few professionals who may have obtained their skills elsewhere.

5.4.2.2 Livestock and Crop Production

Cattle, sheep, goats, donkeys and camels are the main livestock kept within this area (Plate 5.48). The major challenges facing this sector are cattle rustling, drought, diseases, lack of and access to markets, and inadequate support services.

Plate 5.48: A herd of camels near Sibiloi National Park (Source: fieldwork, 2011).

Crop farming is not well-developed within the project area. This is largely because of the pastoralist nature of the local communities and the unfavourable climatic conditions. Despite all these challenges, subsistence crop farming is on-going around Eliye Spring (Plate 5.49). This was introduced courtesy of the Turkana Basin Institute (TBI) as an incentive for the locals to reduce reliance on livestock keeping, which is faced by many challenges.

Plate 5.49: Maize farming within Eliye springs area (Source: fieldwork, 2011).

5.4.2.3 Trade, Commerce and Industry

Fishing is a significant subsistence activity within this area, but at a commercial scale it fares poorly since its peak in the 1980s (Plate 5.50). There used to be a fish-processing plant in Kalokol but it collapsed twenty years ago. The fisheries industry is faced with various challenges including poor infrastructure, low technological know-how among the artisanal

fishermen, lack of capital to acquire modern fishing gear, and cross-border conflicts amongst fishermen.

Plate 5.50: Fish being dried in Todonyang and Kalokol Centres respectively (Source: fieldwork, 2011).

Within the towns and centres, several trade and commercial activities are undertaken. These range from retail and wholesale of basic commodities and also provision of services. This sector's development has been curtailed by the poor infrastructure within the area, a factor that makes the prices of these commodities and services fairly expensive. Weaving is done at a small scale, but much needs to be done for this industry to develop further.

Tourism is ranked second only to fishing in terms of income generation in the area. This is due to several factors, among them the presence of Sibiloi National Park, Lake Turkana, and the many internationally important and acclaimed archaeological sites (Plate 5.51).

Plate 5.51: Karsa Gate, Sibiloi National Park (Source: fieldwork, 2011).

5.4.3 Health Setting

The project area is marginalized as far as health facilities are concerned. The available facilities are few and far between, and are usually under-equipped and under- or inappropriately staffed. To help alleviate this situation, there is a heavy presence of non-governmental organizations and missionaries dealing with health issues in the region, even though their own services are also inadequate.

5.4.4 Security and Public Safety

The insecurity in the region is largely related to recurrent cattle rustling, conflicts over fish resources within the lake, and conflicts over grazing lands and access to watering points. The currently most insecure place is Todonyang (Plate 5.52) (and north of it) where there is rivalry between the Turkanas and Merile from Ethiopia. On the eastern side of the lake, the Illeret area also comes under cross-border attacks by Ethiopian militia. Even though government agencies provide security to the general public, illegal arms are quite prevalent.

Plate 5.52: An armed resident in Todonyang (Source: fieldwork, 2011).

5.4.5 Community Views and Concerns

A number of concerns were expressed during the EIA field study in relation to the communities' perceptions of the project:

- Increase in social decadence like prostitution and robbery
- Eruption of war with neighbouring countries
- Damage caused by project machines
- Spread of diseases like airborne diseases and HIV/AIDS
- Loss of livestock and grazing lands
- Pollution of environment due to oil spills

- Loss of fish in Lake Turkana
- Increased insecurity
- Increase in population
- Displacement of people
- Destruction of Lake Turkana

The communities, however, also expressed views on potential positive impacts, including:

- Employment of the local community members
- Improvement of businesses and living standards
- Improvement of infrastructure
- Population increase leading to intermarriages hence enhancement of security
- Provision of water to the community

Most of the community concerns are based on perceptions of the potential effects without evidence of experience on the ground, as none of the above effects have been experienced during any of seismic surveys that have been carried out in recent years. However, mitigations will be put in place to ensure that these negative community perceptions are not realized.

Relationship to Project and EMP

Social, cultural, health, and the economic situation in the project area will influence how TKBV relates with the communities within the area. The communities have strong social and cultural networks. The area is, however, one of the least developed and neglected regions of Kenya, with inadequate support services from the national government and regional authorities. The communities also dwell in a harsh environment, and are faced with frequent and recurrent droughts, coupled with widespread and frequent water shortages, that make their daily livelihoods very difficult. Almost every year, they need to have relief and emergency services to provide food, healthcare and shelter. Despite these conditions, they do have a thriving pastoral-livestock system which also broker ethnic and cross-border conflicts related to cattle rustling. There are several NGOs that have stepped in to fill this needs gap, but their activities are uncoordinated and mostly site-specific in scale.

5.4.6 Corporate Social Responsibility

The EIA team made extensive field visits in the project area, held public meetings with the local people and administered questionnaires to households. While the community members are aware that TKBV cannot meet all their needs, they requested the company to consider the following projects as part of the CSR:

- Fresh water supply projects such as drilling of boreholes to needy areas. This was a major issue especially in areas to the north where water supply is a major problem unlike the southern side of the block where water is available;
- Assistance to schools and dispensaries such as building of new classrooms and dispensary blocks where there are none;
- Provision of education bursaries, particularly to needy students who excel in their examinations;

- Some parts of the block are insecure, especially towards the border. The communities feel that the presence of the company in that area may help reduce the security incidences that occur often in that area;
- Provision of job opportunities to the locals; and
- The company should help in community-based projects such as construction of toilets and provision of farming tools and equipment for irrigation schemes.

The team involved in the seismic survey will put up camp(s) away from populated areas, but position them in such a manner as to effectively and efficiently traverse the project area. Such camps should be located in areas that are secure. Other key considerations when siting the base camp(s) will be availability of easy access, water, and a source of fresh farm produce for use by employees at the base camp. The company will consider drilling a borehole of their own to avoid conflict with the local population on sharing the scarce water resources.

CHAPTER 6:

ANALYSIS OF PROJECT ALTERNATIVES

6.1 INTRODUCTION

Alternatives to the project are defined as functionally different ways of achieving the same end (CEA Agency, 1997). Currently, seismic testing, both on land and in marine settings, is a critical and proven technology for refining knowledge about geological formations with a relatively high potential for containing petroleum hydrocarbons in commercial quantities. There are no functionally different alternatives for defining potential for hydrocarbon resources that are not cost prohibitive.

Under the “no-go” or “no-action” alternative, the project does not go ahead, thus the status quo remains. Oil and gas production, however, cannot occur in the absence of exploration activities. It should be noted that this project is a data acquisition project that will enable evaluation of the newly acquired data to identify potential oil and gas prospects. If no oil and gas prospects can be delineated based on the data acquired, then the project will end at that point. If, however, the data indicates that potential oil and gas prospects are likely, then the project would move on (with a time interval of several months during which the seismic data will be processed and analysed, and likely prospects delineated) to an exploratory drilling phase to determine actual presence and amounts of oil and/or gas. In this case, a new EIA would have to be carried out. As a precursor to the drilling of petroleum exploration wells, seismic acquisition is an accepted and well-developed method of petroleum reservoir delineation. While surface mapping, gravity, magnetics, and other forms of geophysical exploration are commonly employed to further understand the geological character of a sedimentary basin, they are generally considered complimentary techniques rather than stand-alone methods of data collection and interpretation. It is, therefore, considered that the proposed seismic acquisition activity is the only viable means to assess the hydrocarbon prospectivity of the 10BA licence area. If the project does not go on at this stage, then the potential benefits that have been outlined in Chapter 1, section 1.5.3, will stand foregone.

6.2 PROJECT SITE ALTERNATIVES

One alternative to the project is to leave the assigned project area. The Kenyan Government through previous exploration work by various companies has identified a number of ‘blocks’ with potential for oil and gas. These blocks are found in the Coast, Eastern, North-eastern and Rift Valley Provinces (including their inland waters) and Kenya’s territorial waters and exclusive economic zones in the Indian Ocean. TKBV has been granted the exploration licence for Block 10BA in the Kenya Rift Valley therefore the concept of ‘alternative site’ does not apply, as each block within the country is agreed upon by the Government of Kenya and the interested party and subsequently licensed. Other blocks have been licensed to other companies under the terms of the PSC, and some of these have already been approved and licensed by NEMA to carry out onshore (land based) and offshore (lake) seismic surveys. A number of companies have recently completed onshore and offshore seismic surveys with no reported adverse environmental impacts.

6.3 SURVEY DESIGN ALTERNATIVE TECHNOLOGIES AND RECOMMENDATIONS

The technology to be employed for the seismic survey is the latest state-of-the-art for activities of this nature, and has been outlined in Chapter 2. About 1534 line kilometers of land and marine/lake seismic data acquisition will be carried out in the project area. The company will construct, on land, a number of seismic survey lines (track lines) along which seismic data will be collected. For the lake-based survey, the company will employ the use of vessels to carry the equipment needed, including airgun, recording equipment (geophones, hydrophones, Ocean Bottom Cable receiver arrays). The seismic survey operations and related activities will be constrained to the seismic survey lines once they are confirmed, and to the base camp, fly camps and access roads to these areas within the block 10BA. On an area-wide survey such as this, there is considerable scope to adjust line placements and program size to bypass habitations or areas of particular sensitivity. A detailed evaluation of each line will be carried out as work progresses and line placements will be adjusted to achieve the survey objectives (see section 2.4.1) with minimum disruption and impact to the environment and resident communities. Thus, the actual coordinates of the proposed survey lines on land and in the lake shall be based on analysis of pre-existing data and the information acquired on the area through this EIA study, and will be subject to adjustments based on specific issues or conditions encountered when the operation is ongoing. Three methods will be used to generate the seismic waves (1) Truck mounted vibroseis units (2) dynamite charged shot holes for land-based seismic data acquisition, and (3) airgun energy source for lake seismic data acquisition.

The following equipment which will be dedicated solely to the proposed seismic survey activity that will be carried out in Block 10BA:

- Seismic source generators (vibroseis, dynamite charges for land-based data acquisition and airgun technology for lake-based data acquisition) and recording equipment (geophones, hydrophones, Ocean Bottom Cable receiver arrays, cables, computers etc.);
- Data recording truck (on land) and recording vessel (on water);
- Transport equipment: e.g. trucks, pick-ups, 4WD vehicles, boats;
- Communication equipment including handheld satellite phones, and vehicle-mounted VHF radio, and will also establish a communication base station at the main camp site;
- Mulchers, bulldozers, and light-cutting hand-held equipment for clearing of seismic lines;
- Surveying equipment;
- GPS equipment;
- Associated electronics, data processing and printing equipment; and
- Ambulance

Additional equipment and facilities that will be available will include:

- Fully serviced and self-contained base camp for all personnel and equipment;
- Adequate fire-fighting equipment, and first aid kits;
- Fully equipped clinic for medical care of the personnel; and
- Emergency trained paramedic(s).

6.3.1 Acoustic Source Technologies

6.3.1.1 Vibroseis

In this case, truck-mounted “vibrators” provide the source.

(a) Alternative Technologies

The vibroseis technology (see section 2.3) is a state-of-the-art technology that is widely used to carry out seismic surveys around the world. The only other alternative to vibroseis is using a dynamite shot-hole (discussed in section 6.2.1.2 below). The commonly used vibrators generate a peak force of 282 kN (63,500 lbs). Vibroseis is generally preferred over dynamite shot-holes for the following reasons: lower cost than dynamite operations; vibrator settings can be adjusted in the field and hence can greatly improve the results of a survey; and vibroseis source points can easily be recorded again if for some reason the reflected signals are not of the required quality.

(b) Recommendations

Vibroseis units have the advantage of not requiring shot-hole drilling crews or detonation materials. However, in wooded areas these large vehicles require much wider lines to be cut or mulched and in water-logged soil the tyres may cause surface damage. Vibroseis will accordingly be restricted to dry, sparsely vegetated areas. Given the semi-arid conditions of the project area, and the fact that most of the area has a flat or gentle topography and is sparsely vegetated, vibroseis is the preferred option for seismic survey in most of the project area.

6.3.1.2 Dynamite Shot Holes

In this case, a small charge of explosive is placed in a narrow-diameter hole drilled five to fifteen metres into the ground, before being detonated remotely. Depth of hole, charge size, and type of explosives can affect the final quality of seismic data.

(a) Alternative Technologies

The only other alternative to dynamite shot-holes is vibroseis (discussed in Section 6.2.1.1 above). Dynamite shot-holes are normally used in cases where vibroseis method cannot be utilized, such as areas with steep slopes or rough terrain.

This method has some constraints. As earlier mentioned, shot-hole depth, charge size, and type of explosive must be predetermined prior to the actual survey: none of these variables can be easily adjusted to improve data recovery, while vibroseis field testing is easily conducted to determine optimum sweep frequencies and sweep lengths.

(b) Recommendations

This technique will be useful in sensitive areas such as archaeological sites, and is equally effective in dry or water-logged terrain. This method is not an option for the deep lake (marine) survey but may be used close to the shoreline. However, given the strong winds in the area, geophones may have to be buried (not pinned in at the ground surface), causing considerable delay in acquisition of the seismic data along the line.

Both hand-powered and machine-powered drill units will be used according to the hardness of the ground and depth of hole. There will be man-portable units in areas where access is very limited and the soil permits their use. In most areas, however, drill units will be mounted on wheeled or tracked vehicles as the terrain requires. The drilled “shot” holes are usually

destroyed by the detonations and will be backfilled on the surface after use. With this form of acquisition, seismic lines need only to be around two metres wide and can be meandered to avoid mature vegetation.

A flexible approach will be taken in the technique employed for shot-hole drilling. On the mainland either a tractor or man-portable rotary type rig capable of drilling up to 20m deep holes will be employed. A small tractor would be able to traverse the reasonably dry sections of line cleared by the mulcher. In wetter areas of the mainland (such as in river flood plains or water-logged areas), a man-portable shallow shot-hole drill rig, which could either be rotary or of a flush nature, could be used providing that the underlying rock is not close to the surface and a source of water is close by. In the wet areas (such as shorelines) flush drill must be used and the depth of the achievable hole will depend on logistics and subsurface geology.

In some areas, the near surface geology consists of a thin soil cover over hard rocks (such as basalt) that may in turn overlie loose unconsolidated materials beneath. To ensure that majority of the energy from the shot is focused downwards it will be necessary to employ a drilling technique capable of penetrating the overlying hard layer of rock and passing through the unconsolidated layers beneath to place the charge below the water table. In such drilling conditions, a sonic drill would be ideal: however, it may well be possible to achieve the desired depth by using a drill with a combination hammer bit and rotary head.

6.3.1.3 Airgun Technology

In this case, a pulse of compressed air under high pressure is released from a specialized chamber (the airgun) into the water, thus generating an acoustic signal.

(a) Alternative Technologies

Marine (and lake) seismic work today is dominated by use of airgun technology, in which energy is generated by a release of compressed air into the water (Askeland et al., 2007). Seismic airgun surveys produce loud, sharp impulses that can raise noise levels substantially over large areas. Though noise impacts on marine life (fish, marine mammals, and even invertebrates) from seismic surveys are well documented, the biological relevance of these impacts on wild populations remains controversial among the various stakeholders, and to-date airguns remain the most environmentally friendly method for generation of acoustic waves for seismic survey purposes (see Chapter 7).

Technologies are now being developed to be used as alternative technologies with airguns and/or instead of airguns (Weilgart, 2010), but it is unclear whether they are now operable at commercial scale, or whether they are in the pilot stages of testing, or even in the raw research and development stage.

(b) Recommendations

The airguns will be mounted on a boat for deeper water operations in the lake, and on a small, shallow-draft boat or a floating platform for very shallow work in the littoral and shoreline areas of the lake. As well as the airgun array used for the deeper lake areas, a smaller airgun array will be configured for deployment in water depths of less than 1.5m. Typically this will be either man-portable or mounted on a pontoon that can easily be maneuvered in shallow water. Careful consideration will be given to the configuration of the shallow water airgun array. Very

shallow water array principles will be considered which adhere to considerations of energy blow-out at these shallow depths.

Airgun array design can be optimized to reduce unwanted energy (Weilgart, 2010) as follows:

- Imaging deep geological targets requires a low frequency (<200Hz) acoustic source. Currently seismic airguns produce broad-band acoustic energy (0 to >200Hz) and in directions (both in-line and horizontal to the plane of interest) that are not of use. Thus, unnecessary acoustic energy (noise) should be reduced through array, source, and receiver design optimization.
- Lower source levels could be achieved through better system optimization, i.e. a better pairing of source and receiver characteristics, and better system gain(s). For example, new receiver technologies, such as fiber optic receivers, may allow the use of quieter sources through a higher receiver density and/or a lower system noise floor.

6.3.2 Ocean Bottom Cable (OBC) Receiver Array and Alternatives

(a) Alternative Technologies

There are two options to this. The first is to utilize the traditional towed marine seismic survey method. This is a well-developed technology, and offers project objective benefits such as the ability to cover significant areas of sub-surface geology, filling in knowledge gaps and enabling further targeted appraisals. It has a minimal risk of long-term, significant environmental impacts (see Chapter 7) that are not considered biologically significant. The second is to utilize ocean (lake) bed technique, referred to as Ocean Bottom Cable (OBC) . This option is constrained by the difficulty of covering a survey area within reasonable time and cost. It is more appropriate for use in shallower areas not covered by a towed streamer technique. However, there is potential for limited physical effects depending on the specific technology used. An acoustic source is still required, but is likely to be smaller and would lower the potential for acoustic impacts on fish and other marine fauna.

(b) Recommendations

It is recommended that the OBC marine seismic survey method is used rather than the towed streamer array technique because the latter has potential for some physical impacts on lakebed habitats and communities, depending on technologies utilized, and is environmentally not appropriate for the proposed lake survey in Block 10BA which has important breeding sites in shallow water.

6.3.3 Line Cutting Technologies

(a) Alternative Technologies

A few decades back, the lines used to be cut using bulldozers were not environmentally friendly because they removed vegetation entirely, as well as scraped off surface soils. The current state-of-the-art technology is the use of mulchers. The mulching units are self-powered vehicles mounted on low ground pressure tracks or wheels exerting only 3-3.75 psi pressure on the surface. These machines cut low-lying vegetation and leave behind fine, rapidly bio-degradable nutrient-rich mulch in their wake with seeds intact. Soil structures and root systems are also left intact. Regeneration of mulched vegetation is rapid and even in arid areas vegetation returns to its pre-cut state in one to two years.

(b) Recommendations

Line cutting will not be necessary in some parts of the project area on account of the bare or sparsely vegetated surface with thin soil cover overlying hard rock beneath. In areas where line cutting will be necessary, the method used will range from light hand cutting using machetes, to the use of mulchers to clear areas with relatively dense vegetation. The mulchers will cut a track of 2 metres in width without disturbing the top mat of soil. Using mulchers completely remove the need to have bulldozers and chainsaws on the crew and therefore remove significant safety hazards.

Line cutting does not apply to the lake survey.

6.3.4 Access Road Technologies

As far as is practicable, existing routes will be used to reach the seismic line acquisition areas. Where this is not possible, access roads may have to be constructed. These are typically done using a bulldozer (e.g. Caterpillar D8R or equivalent) and light hand-cutting of vegetation using machetes. Such access roads should be constructed by a licensed road constructor, and should be based on sound road engineering design. Some lines may have to be bulldozed to allow access for the vibroseis vehicles. Such routes should also be planned in liaison with the area authorities and community leaders, and there should be a win-win approach to this so that such access roads can benefit the local communities once the project is over.

6.3.5 Seismic Data Recording Equipment

On land, this will include a recorder and computer workstation mounted in a truck, cables with attached geophones (cables can be several kilometres long), and geophone testers.
In the lake, recording of the acoustic energy by the hydrophones along the streamer will be conducted over multiple channels, with a typical sampling rate of two milliseconds and a recording length of eight seconds. The specifications of the survey vessel are still to be confirmed with the seismic contractor. In addition to these seismic equipment, the survey vessel will also carry a range of other survey equipment including grab samplers, echo-sounders, side scan sonar, and will have a seismic processing capability (light table, digitizer, thermal and colour plotter and computer software).

6.3.6 Communications Equipment

The area, as mentioned before, has an unreliable, low coverage and patchy communications network. Communications equipment that would be used would include VSAT, hand-held satellite phones, vehicle mounted VHF radios, and mobile phones. Communications will be coordinated through a central communications base station that will be set up at the base camp. There are several technological options offered by communications equipment supplies companies. The option selected should be based on assessment of the peculiar requirements in the project area.

6.3.7 Surveying Equipment

Once the seismic line coordinates have been determined, it will be necessary, on land, to carry out a survey before line cutting commences. Typical survey instruments would include, for

example, the survey instrument itself (e.g. RTK), hand-held GPS, and plotters to print out the survey line maps. There are several state-of-the-art technological options that TKBV can choose from.

6.3.8 Transport Equipment

This will include the following: normal saloon/station wagon cars, pickups, water tanker, fuel tanker, personnel carrier, vibroseis service truck, recording truck, line-spreading truck, food transport truck, drill rig trucks and ambulance. Selection of the make and type of this equipment will be done later by TKBV, based on a consideration of the environmental setting and challenges posed to vehicles.

6.3.9 Lake Seismic Survey Vessel

The survey vessel has not been selected at this time; however, it should be a fit for purpose vessel equipped for lake operations. Typical vessel speed will be approximately c. 4.5 knots when the survey gear is deployed.. The operational turning radius is dependent on the vessel, water depth and source array. Deployment and retrieval of survey equipment will be weather and technique dependent.

CHAPTER 7:

ENVIRONMENTAL IMPACT ASSESSMENT

7.1 INTRODUCTION

The baseline biophysical and social environmental parameters established in Chapter 3 are critically examined in this section in relation to the potential environmental and socio-economic impacts of the proposed onshore and offshore seismic survey. In addition to adhering to the mitigations below, the proponent needs to comply with the requisite national legislation and regulations that are outlined in Chapter 4 of this report.

It should be noted that seismic surveys are of short duration, typically less than six months, and are generally considered to be a low impact activity that permits the immediate return of the operational sites to its previous land use. This is indirectly supported by the fact that a suite of seismic surveys have already been conducted in the onshore and offshore (marine) areas of Kenya, and no adverse or long-lasting impacts have been reported from these activities. All such seismic survey EIA project reports that have previously been submitted have been approved by NEMA.

This Chapter identifies the potential environmental and social impacts of the proposed project, based on the components of the proposed survey (Chapter 2), and in the context of the baseline conditions that have been established in Chapter 5, and with due regard to applicable legislation described in Chapter 4. The predicted impacts are then assessed using the methodology outlined in Chapter 3, section 3.2, and appropriate mitigation measures are determined.

7.2 ENVIRONMENTAL AND SOCIAL ASPECTS AND IMPACTS IDENTIFICATION FOR THE ONSHORE (LAND) SURVEY

The components of the seismic survey and survey-related activities that have been outlined in Chapter 2 and that could result in environmental and social impacts are indicated in Table 7.1 below.

Table 7.1: Onshore survey project Environmental and Social Aspects and Impacts.

	Parameters	Aspects	Potential Impacts
1.	• Physiography and Geology	• Vibroseis and associated equipment • Bulldozer • Dynamite shots	• Cut lines leave long-lasting residual impacts (tracks, and/or scarring on surface landscapes) • Vibrators/bulldozers and dynamite use near steep slopes may lead to minor landslips and rock topples
2.	• Soils	• Vibroseis and associated equipment • Bulldozer • Transport Vehicles	• Compaction of soft sediments in water-logged areas along cut lines • Disturbance of soil along cut lines • Cut lines may enhance gulleying and

		• Oil or chemical leaks from vehicles and machinery, garage and storage areas	erosion (wind and water) • Rutting in loose soils • Contamination of soils
3.	• Air Quality	• Vehicles and machinery • Sanitary systems • Waste disposal points	• Pollution from exhaust emissions • Fugitive dust generation from traffic • Offensive odours • Health risks
4.	• Surface and Groundwater Resources	• Water supply source for the camp • Heavy vehicles and machinery • Drilling of shot holes	• Conflict with neighbouring communities if water source is shared • Compaction of near-surface aquifers such as springs, reducing yield • Downward draining of groundwater through drill holes, reducing yield at springs
5.	• Water Quality	• Liquid effluent discharges from sanitation systems at the campsite • Oil or chemical leaks from garage and storage areas, vehicles and machinery • Subsurface detonation of dynamite charges	• Contamination of water supply source for the camp • Contamination of underlying aquifers
6.	• Terrestrial Environment (Habitats, Flora and Fauna)	• Vibroseis and associated equipment • Mulchers • Bulldozer • Transport vehicles	• Cutting of vegetation along cut lines • Disturbance of wildlife (physical presence and noise) • Introduced weeds and pests
7.	• Land Resources and National Parks	• Vibroseis, mulchers and associated equipment • Dynamite shots • Vehicles • Presence of humans	• Cut lines affect pastoral resources • Disturbance of animals in National Parks
8.	• Archaeological, Historical and Cultural Sites	• Vibroseis and associated equipment • Vehicles • Dynamite shots	• Compaction by heavy vehicles and machinery may damage fossils/artifacts buried in shallow soils • Vibrations and drilling of shot holes may disturb/break up near-surface archaeological materials
9.	• Visual Aesthetics	• Campsite design • Cut lines	• Poor campsite design does not blend in with the environment • Cut line footprints and vegetation cover removal lower aesthetic value of landscape
10.	• Noise and Vibrations	• Vibroseis and associated equipment • Dynamite charges and associated equipment • Vehicles traversing the area	• Disturbance to humans, animals and livestock • Disturbance to workers • Health risks
11.	• Solid and Liquid Wastes	• Campsite • Workplaces in the field	• Pollution of surface soils, waters and groundwaters • Offensive odours • Health risks
12.	• Social Characteristics	• Workforce influx • Activities along the seismic survey lines	• Possible increase in crime rate and prostitution • Possible increase in school drop out by individuals searching for jobs • Erosion of culture and social values as a result of intermingling with workers

			• May interfere with grazing lands and watering points
13.	• Economic Characteristics	• Employment opportunities • Tenders and supplies • Possibility of a successful exploration programme	• Improved livelihood • Improved short-term business opportunities for the locals • CSR project benefits • Social friction caused by sudden financial imbalances caused by introduction of cash via local workforce into local populace • Long term economic benefits to local and national economy should the exploration programme be successful
14.	• Occupational Health and Safety	• Campsite and fieldwork environment	• Injuries to workers, visitors and area residents arising from project operations • Fire hazard • Other health risks
15.	• Security and Public Safety	• Workforce security needs	• Improvement in security due to security enhancement for project activities

7.3 IMPACTS ASSESSMENT AND MITIGATION FOR THE ONSHORE (LAND) SURVEY

7.3.1 Physiography and Geology

Given that most of the area is sparsely vegetated, and that the hilly areas occur on the fringes of the east and western borders of the project area, the impacts identified (Table 7.1) will be insignificant. Some cut lines will touch on the east-facing slopes of the craggy hills and ranges marking the western (e.g. Lapur-Lothidok Range) and south-eastern borders of the project area, raising the potential of landscape scarring. The area, although in an active tectonic setting, has low earthquake and landslide risk. The risk of subsidence due to passage of heavy vehicles is lower still, though localised compaction of surface soils may occur in some places. Minor landslips may occur due to vibroseis/dynamite use in the steep slopes of the western margin hill ranges, or in the extensive relic and active alluvial fan network on the eastern hinterland of the lake. There are few existing roads in the area, but their north-south orientation, running along the western and eastern margins of the lake, enable much of the proposed cut lines to be more easily accessed (see Figure 5.1). There is also a network of earth roads in the east that were opened up to access the many archaeological sites in that area. Few access roads, and of only a few kilometres in length, may therefore be constructed. The only quasi-perennial river in the entire project area is the Turkwel River, which can be crossed at existing road crossings. The highly dissected and incised land surfaces particularly in upland and foot slope areas might impede easy movement during the seismic survey, as would the dunes that have developed along the western shoreline of the lake.

Mitigation:

- Use existing access roads to the extent possible;
- Pre-survey possible access routes, and use the selected routes rather than accessing work sites through free-ranging driving across the open country
- Explosives (dynamite) should be used as source instead of vibroseis in areas with highly dissected and incised surfaces (sections 4.3.3 and 4.3.4);

- When laying cut lines, use will be made of existing roads and tracks to avoid creating unnecessary tracks and trampling of pasture;
- Minimise, to the extent possible, the use of bulldozers to open up cut lines and access roads to minimise landscape scarring;
- Avoid cut lines on slopes steeper than 40º to minimise risk of landslips and rock topples;
- Optimise source energy to achieve the survey objectives to minimise risk of landslips and rock topples;
- Buffer zones of 50m should be maintained from areas posing landslip and topple hazards.

The potential residual impacts would be related to landscape scarring, and displaced sediments and boulders that may arise from landslips and rock topples related to use of the vibroseis and dynamite shots.

7.3.2 Soils

There are several different types of soils in the project area, each with its own peculiar geological, textural and weathering/erosion-driven properties, as well as anthropogenic footprints such as compaction by grazing animals, that are relevant to a number of issues that would need to be considered when executing the project. These issues include: ecosystem services e.g. the role of soil in support of vegetation and higher food chain members; erosion and ponding potential, as well as surface runoff and their resultant geomorphological features; wind deflation, transportation and deposition of soil-derived particulates; organic matter content, surface sealing and capping; agricultural potential.

In the areas where the soils have high sand content, particularly around the lake shoreline and the extensive east-west aligned seasonal alluvial drainage basins, compaction by vehicles and machinery will be slight. Cut lines that were done during a previous geophysical survey in the western part of the project area are generally not visible today, save for those that are now being used as access roads, for example near Lodwar town. Soils of the plains and hills of the project area that are more susceptible to compaction due to their higher clay contents would likely be compacted to some extent. However, if those soils are adequately dry (soil moisture content below the plastic limit) when activities occur and vehicles minimize the number of times they drive across those soils, compaction should be minimal and soil productivity (as measured by a plant's ability to grow) should not be noticeably affected.

Mitigation:

- Machinery and equipment should use existing routes as much as is practicable to avoid compaction of the surface soil (section 4.4.5);
- Construct drainage channels on cut lines where natural drainage may be affected;
- Turkwel River should be crossed only at the existing road crossing;
- Luggas should be crossed at road crossings, where such crossings exist, or in areas where the bank heights are less than 1m – banks at the lugga crossings should be mechanically restored;
- Vehicles should steer away from natural drains and waterways wherever practicable, but a buffer zone of 20m should be maintained except at crossing points;
- Minimize vegetation and grassland clearance as much as possible when cutting the survey line transects (section 4.4.5);

- Seismic survey should aim to be carried out as far as possible during the dry seasons;
- Use only essential vehicles and low pressure/low impact tyres in areas with wet soils or that are susceptible to ponding or are prone to erosion;
- Ensure that all vehicles and machinery operating in the field and in the campsite are properly maintained so as not to have oil leaks that could contaminate the soils (section 4.3.7);
- Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available;
- All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures;
- Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks; and
- Installation and proper management of camp sanitation facilities.

The potential residual impacts would be enhanced gulleying and erosion due to altered runoff and drainage patterns at local scales, necessitating the implementation of mitigation measures to eliminate any long term negative impact.

7.3.3 Air Quality

On meso- to micro-scales, air quality variation relates primarily to changes in the wind-speeds in the area, and the associated particulate dust that it transports from one place to another. These winds can raise substantial quantities of dust. The disturbance of fine grained (fine silt to clay sized particles) soils by vehicles traversing the area may lead to limited wind erosion in the area, leading to airborne dust during windy conditions. However, the scale of these transient fugitive dusts are insignificant (more so in relation to dusts raised by the strong winds in the area), and would not alter the ambient air quality. On a micro-scale, air quality may also be affected by exhaust emissions from vehicles and machinery, but this is also of a transient and insignificant nature. Sources of offensive but localised odours would include exhaust emissions from vehicles and other equipment, as well as poorly managed waste disposal and sanitary facilities at the camp site.

Mitigation:

- Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation;
- Field vehicles, trucks and any other machinery should be switched off when not in use;
- Regular servicing of all trucks, service vehicles, and any other machinery powered using fossil fuels to ensure efficient combustion and minimisation of exhaust emissions (section 4.4.8);
- Use low sulphur fuels if available and where suitable;
- Employees working in dusty conditions must use appropriate PPE;
- If litter is to be burned, it should be done at a time of low wind movement, and preferably in areas shielded from wind by vegetation;
- Installation and proper management of camp sanitation facilities.

There shall not be any residual impacts to air quality.

7.3.4 Surface and Ground Water Resources

The project area, being rural and undeveloped, lacks a mains, quality assured, water supply network. Water is sourced from shallow wells, shallow to deep boreholes, springs, rivers and luggas, and the lake. Its patchy distribution, and the low, erratic and unpredictable rainfall, means that water is generally scarce in most of the area. This scarcity has led to human-human and human-wildlife conflicts. The seismic crew will also need to access safe potable water. Effluents generated at the campsite(s) will also need to be managed so as not to contaminate any underlying shallow, unconfined aquifers or rivers and luggas.

Shallow groundwater aquifers occur throughout the project area, and could potentially be compacted by vibroseis and other equipment, thereby reducing yields. Drill holes can potentially affect the shallow groundwater flow near springs. They may, for example, penetrate underlying confining strata, which would allow groundwater to drain downward, rather than flow laterally to a spring. It is highly improbable that the drill holes could penetrate artesian aquifers as these are unknown in the area, and the shot holes will be very shallow.

Mitigation:

- A water supply borehole should be drilled to provide the water required for the project; this could be donated to the community on completion of the seismic survey;
- It is recommended that an efficient water-use policy be adopted by the project proponent at the camp site and other work areas (section 4.4.3);
- An efficient sanitation system should be put in place in the campsite(s) to handle effluents (section.4.3.8);
- Hazardous and toxic waste material should be managed according to international protocols and best practices and in complicance with Kenyan legislation, specifically the Environment Management and Coordination (Waste Management) Regulations;
- Buffer zone distances between seismic lines and water sources will be established through extensive in-field ground vibration testing. Distances may vary between seismic source types, as per IAGC Guidelines.
- When water is encountered during shot hole drilling, bentonite, or a tapered concrete (or other suitable material widely accepted in the industry), can be used to plug the hole up to 3m above the static water level or to a depth of 1m from the ground surface;
- Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available;
- Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks.

Residual impacts on surface and groundwater resources are not expected if the mitigations outlined above are effected.

7.3.5 Water Quality

The impacts on and mitigation of water quality relating to the lake survey is covered in section 7.5.2 below. Liquid effluent discharges and oil or chemical leaks at the campsite, if not properly managed, can potentially lead to pollution of an underlying shallow groundwater source. Along the cut lines, subsurface detonation of charges could leave localized small residuals of gases and solids (e.g. water/stream, carbon-dioxide gas, nitrogen gas, calcium carbonate solid, and

sodium carbonate gas). The shot-hole method could also lead to clouding of spring waters for up to several weeks. Oil leaks from vehicles operating in the field and parked at the campsite can also potentially pollute underlying groundwater.

Mitigation:

- Refueling areas must be underlain with spill-proof hardstanding or bund, with spill kits readily available and operatives trained in their use;
- All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures;
- All refuelling operations to be carefully overseen and managed;
- Pits for disposal of domestic and sanitary effluents should be sited with knowledge of the geological and soil characteristics of the area;
- Buffer zone distances between seismic lines and water sources will be established through extensive in-field ground vibration testing. Distances may vary between seismic source types, as per IAGC Guidelines;
- Spill kits to be carried with vibe truck service vehicle, refuelling bowser vehicles, drill crews. All staff to be briefed on use of these;
- When water is encountered during shot hole drilling, bentonite or a tapered concrete plug may be used to plug the hole up to 3m above the static water level or to a depth of 1m from the ground surface;
- Ensure that all vehicles and machinery operating in the field (and in the campsite) are properly maintained so as not to have any oil leaks that could contaminate the soils (section 4.3.7);
- Ensure that any in-field refuelling or maintenance is performed in a bunded area or while using a drip tray with a spill-kit available;
- Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks.

Residual impacts on water quality are not expected if the mitigations outlined above are effected.

7.3.6 Terrestrial Environment (Habitats, Flora and Fauna)

The region, though sparsely vegetated, has a number of varied habitats and some protected areas that are, as a result of their harsh climatic setting (high temperatures and low rainfall), sensitive to disturbance. These habitats do, however, exhibit a good capacity for regeneration, as some cut lines that were made during seismic surveys carried out in the early 1970s are no longer visible on the land surface. Domesticated animals are numerous in the area, while wildlife (and birdlife) is found primarily on the eastern side of the lake within the Sibiloi National Park.

With repeated vehicle passage and vibrator-pad compaction as would occur in this project, some damage would occur to the vegetation. The small-scale and spatial arrangement of the project operations is such that habitat is not likely to become fragmented or isolated from other areas of habitat. The vehicles and equipment, if previously used in other areas with different, exotic vegetation types, may introduce new weeds and pests into the area. The vibroseis vehicles may destroy bird nests found on the ground and in low growing shrubs and trees, and the disturbance may cause some birds to abandon their nests. Burrows that serve as refuge for reptiles, amphibians, and small mammals may be compacted by the vehicles or the vibrating plate. While the seismic activities may result in some wildlife moving out of the area, the low

percentage of land disturbed would affect only a small percentage of the population and their suitable habitat. The shot hole method would have little impact on the wildlife, except those individuals found within the immediate vicinity of the shot holes. Given the small percentage of land impacted (cut lines and access roads), the short duration of the project (six months maximum), its rolling-over nature (i.e. spending only a few hours at each survey locality), resulting in only localized and limited impact, any threats to endangered wildlife species are considered insignificant.

Mitigation:

- The mitigations related to soils (see above) apply;
- Trees with trunk diameter greater than 20cm should not be cut;
- Seismic survey activities to be undertaken during daylight hours only;
- Liaise with the Kenya Wildlife Service (KWS) to ensure that wildlife disturbance and danger to the seismic team is mitigated. Any planned lines that are considered to be a threat will be relocated;
- Hunting, fishing, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. All workers to be briefed regularly on this issue;
- The risk of introduction of weed and pests species to the region via contaminated vehicles and equipment will be mitigated by the wash-down of all vehicles and ancillary equipment at a designated location prior to the commencement of the survey.

The residual impact will be reduced vegetation cover along track lines; this will, however, regenerate in a few years. Given the small scale of the project, combined with implementation of the suggested mitigation measures, this impact is not considered significant.

7.3.7 Land Resources and National Parks

Pasture and browse are the major land resource in the area and supports the pastoral lifestyle of the local community, while fisheries are supported by the lake. The Sibiloi National Park and the Island Parks are tourism resources.

Mitigation:

- As for sections 7.3.1 (Physiography and Geology) and 7.3.7 (Terrestrial Environment) above.

7.3.8 Archaeological, Historical and Cultural Sites

The Koobi Fora (east of Lake Turkana) and the central to northern part of the western Lake Turkana region are important archaeological sites. Community cultural sites are dispersed within the region, but tend to have very small areal coverage e.g. meeting places, shrines and burial areas. Impacts to such sites can occur because of vehicles driving over the surface, compression from the vibroseis pad on the surface, vibrations resulting from the vibroseis testing or dynamite charges in shot holes, and the drilling of shot holes. Vibrating pads would only compress the soils up to a few inches, so archaeological material that is not very close to the soil surface will likely remain intact.

Mitigation:

- Consultations with the National Museums of Kenya (NMK) should take place in the design and execution of the seismic survey in archaeologically important areas;
- Close liaison should be maintained with stakeholders such as the Turkana Basin Institute (TBI) as they are custodians of some of the archaeological sites within the project area (section 4.3.15). Lines should be relocated if necessary after consultation with stakeholders;
- Use of shot points rather than vibroseis is recommended for such areas;
- Seismic survey lines will not be planned to go through known archaeological and cultural sites (section 4.4.4);
- Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites during the survey in order to prevent conflict with the community;
- Access routes and cut lines will be selected to provide sufficient offset to known archaeological sites to avoid surface disturbance: these offsets shall be determined in consultation with NMK and TBI archaeologists;
- All cultural and archaeological sites will be flagged for avoidance (sections 4.3.2; 4.4.4);
- Permitted archaeologists will monitor project operations in archaeological sites, and if archaeological materials are found during the operations, they will advise on how to proceed;
- All project field workers must be informed, before commencement of operations, that any disturbance to, defacement of, or removal of archaeological, historical, or sacred material will not be permitted;
- Any archaeological finds to be noted and reported to the TBI.

No residual impacts are expected if the mitigations outlined above are effected.

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7.3.9 Visual Aesthetics

It is anticipated that there will be some minor impacts on the aesthetics of the pristine environment. Dust generated by wind erosion is not expected to affect air visibility in the project area due to the limited duration and extent of the activities.

Mitigation:

- Use of modern line cutting technology, preferably *mulchers* for clearing of the geophysical survey transects will ensure that minimal vegetation is removed, hence ensuring that re-vegetation will occur in a much shorter period since the rootstock, and seeds will be left along the traverses and this will promote faster re-growth (section 4.4.6);
- Campsite design should take into consideration the aesthetics of the selected area.

7.3.10 Noise and Vibrations

The use of heavy road construction equipment, vibroseis acoustic energy sources, dynamite charging, and power augers for shallow drilling are potential sources of environmental pollution in the form of noise generation and vibrations during the onshore survey that may affect the survey crew, neighbouring communities and their livestock, and wildlife. The base camp site

can also be a source of noise pollution especially if generators are used for electricity generation.

Some noise sensitive areas (e.g. National Park, nesting sites along the shorelines, schools, hospitals and residences) are found in the project area. However, no significant impact is anticipated due to the localized and temporal nature of this project and its expected noise levels. The length of time the seismic crew spends in any one location is short, with up to 10 km per day of acquisition possible in good weather conditions. This will reduce the overall noise impacts on localised residential receptors to less than one day of actual disturbance.

Mitigation:

- To reduce the expected transient impacts on wildlife, noise levels will need to be minimized to the extent possible, correct strength of dynamite charging and vibroseis use applied to achieve the survey objectives, and human contact with wildlife should also be minimized in line with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution (Control) Regulations, and the Wildlife Conservation and Management Act;
- All seismic operations should be carried out only during daylight hours;
- Ensure that vibroseis and other vehicles have working silencers to muffle noise;
- Provide full personal protective gear to workers as appropriate (e.g. helmets and ear muffs/plugs) and as specified in the Occupational Safety and Health Act;
- Workers should be sensitized on hazards likely to be encountered in such a work environment, and trained accordingly;
- Buffer zones distances between receptors and seismic sources/vehicles will be established through extensive in-field ground vibration and noise testing. Distances may vary between seismic source types, as per IAGC Guidelines. Liaison will be maintained with the relevant Kenyan government authority in deciding these distances;
- Engage local leaders in sensitising the communities in the vicinity of the seismic operation areas about the project and its possible noise and vibration impacts;
- The communities should be informed in advance when a seismic survey operation is to be executed along a given seismic transect/location;
- Use generators with minimal noise production at camp sites and effect a noise mitigation policy for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations.

No residual impacts are expected if the mitigations outlined above are enforced.

7.3.11 Solid and Liquid Waste

As a result of the proposed project, it is expected that waste will be generated by the survey crew e.g. cans, wrappings, paper, plastics. Plastic waste is of particular concern especially if ingested by livestock, and for its environmental pollution effect. Waste oils and petroleum used in vehicles and exploration machinery may spill or leak on/into the ground, hence polluting the soil or water system within the project area. This may degrade water quality and affect livestock and domestic water users in the project area.

Mitigation:

- Waste materials (at the camp and in the field working areas) should be segregated into non-hazardous and hazardous waste, and consideration given to re-use, recycling, or disposal (section 4.4.1) as appropriate;
- A waste management plan documenting the waste strategy, storage (including facilities and locations), handling procedures and means of disposal should be developed and should include a clear waste-tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location in compliance with the Environmental Management and Coordination (Waste Management) Regulations;
- Hygienic sanitation and disposal of grey and blackwater will be covered in the waste management plan in order to protect the general health of the workers and the general public;
- Ensure that solid waste is removed from site for recycling/disposal only by an authorised waste handler, ideally a handler licensed under the Waste Management Regulation, 2006;
- Fuel and other non-aqueous liquid storage areas should be bunded;
- Servicing of equipment should be carried out in a designated garage area which has regularly maintained oil drainage traps and readily available spill kits. Workers in this area will be regularly briefed on spill prevention.

7.3.12 Social Characteristics

The local communities are conservative with respect to their culture. Due to the influx of people into the area, adherence to these cultures may be compromised. Owing to poverty levels in the area, school drop-out rates may also increase.

Mitigation:

- Employ Community Liaison Officers to keep communities informed prior to project mobilisation and on an ongoing, continual basis to ensure sensitization of the community and stakeholders *vis a vis* the project objectives, activities and scheduling, potential impacts;
- The communities should be informed well in advance of the start of the seismic survey operation and prior to execution along a specific seismic transect/location using appropriate wide-penetration communication media;
- Awareness campaigns can be undertaken to inform/educate both the local communities and project employees;
- During the seismic operations, disruption of livelihood activities in the area (section 4.3.6) should be avoided where possible, otherwise minimized.
- Provision to be made to compensate local property and landowners for any loss or damage caused by seismic operations. Compensation rates to be agreed with Government dept before operations commence.

7.3.13 Economic Characteristics

The infrastructure, especially roads within the project area is poor, hence some cut lines may be useful to the local communities as access roads after seismic survey completion. The proposed project will offer limited, short-term, unskilled and semi-skilled employment

opportunities to the locals. This may result in an influx of people from other areas, and could lead to recruitment-related conflicts if not properly handled.

Mitigation:

- Liaise with local community leaders during the recruitment process;
- Employment policies to be strategically managed to avoid inter-community conflict and similar problems caused by migrant labourers;
- Unskilled and semi-skilled manpower to be sourced locally as far as possible;
- Gender should be factored into the employment criteria;
- Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan.

The residual impacts in this instance would mostly be positive, including short-term employment opportunities, and infrastructure improvements if access roads are designed in such a manner that they would be useful to the communities post-project. Due to strong inter-tribal rivalries, great care will have to be taken to prevent conflict during hiring of local labour.

7.3.14 Occupational Health and Safety

During the seismic survey, the workers, visitors and the local community may be exposed to occupational and health hazards not normally encountered during day to day life or activity in the area. Accidents between vehicles or vehicles and humans or wildlife may occur. Workers could also be exposed to other risks in the field, such as landslips, rock falls, fires, and attacks from criminal elements.

On implementation of mitigations, no residual impacts are expected in this case.

Mitigation:

- All operations will be conducted in compliance with Tullow's EHS policy, international best practices and Kenya Government requirements (as set out in the Occupational Health and Safety Act and the Public Health Act; see also section 4.2.5 of this report);
- Appropriate and well-stocked first aid kits and fire fighting equipment should be available to all crew, and specific crew members should be trained on first aid administration and handling of fire fighting equipment (section 4.3.9);
- Job-specific personal protective equipment to be provided to the workers, training should be given, and their use made mandatory in designated areas (section 4.3.9);
- Environmental safety and health regulations and policies/plans must be adhered to (see sections 4.2.5 (Health Policy), 4.3.7 (Energy Act), 4.3.8 (Public Health Act), 4.3.12 (Local Government Act), 4.3.13 (Physical Planning Act), and 4.4 – NEMA Regulations);
- A Base Camp Clinic is to be provided, manned by suitably qualified field medical staff, liscensed as appropriate to operate in-country, equipped with equipment and medication as appropriate, including ambulance vehicle(s);
- Adequate warning or cautionary signage will be posted as required;
- All electrical equipment shall be properly installed earthed and regularly inspected and where practicable will comply with IEE 17th edition regulations;
- Only properly trained and authorised employees shall operate equipment or machinery;

- Tullow driving policy and all other project-specific driving policies and journey management plans to be strictly adhered to and enforced.

7.3.15 Security and Public Safety

Security is a major concern, especially for people living in Todonyang area, due to recurrent conflicts involving the Turkana fishermen and their Merille counterparts from Ethiopia. During the project course, security issues may escalate due to free movement of people. The increase in human activity, including vehicle and seismic exploration activity, could increase the potential for human-related conflicts, including ignition of wildfires.

Mitigation:

- Ensure that all workers can be identified by staff uniform and badges where applicable;
- Adequate security measures should be provided, e.g. perimeter fencing, safe havens and security manning at the campsites and whilst on line utilising AP's and KPR's;
- The company should liaise with the Provincial Administration, the Kenya Police, KWS, Kenya Police Reservists and other agencies to provide adequate security during the seismic survey operation;
- Barriers and guards will be installed as necessary to protect employees and visitors from physical hazards and criminal activity;
- Camp population will be forbidden from interacting with local populace;
- Journey management policy and monitoring to be enforced.

A positive residual impact is the possibility that the involvement of government agencies during the project operations may enhance long term security initiatives from the concerned parties, hence improving the security situation in the area.

Table 7.2: Existing environmental pressures and potential impacts of onshore (land) project operations on environmental and social factors in the project area prior to adoption of mitigation measures (see Chapter 3, section 3.2 for impact assessment criteria and rating).

Parameter assessed	Baseline or Project	Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance of Potential Impacts
Physiography and Geology	Baseline (Pre-project)	- Delta growth due to land use changes in the catchment - Reduced river flows - Increased sedimentation in lake	Medium	Regional	Permanent	Definite	Negative	High	
	Project Operations	- Cut lines leave long-lasting residual impacts (tracks, and/or scarring on surface landscape) - Vibrators/bulldozers and dynamite use near steep slopes may lead to minor landslips and rock topples -	Low	Site-specific	Long-term	Highly probable	Negative	High	Medium
Soils	Baseline (Pre-project)	- Livestock and wildlife grazing and soil compaction - Wind and water erosion	Medium	Regional	Long-term	Highly probable	Negative	High	
	Project Operations	- Compaction of soft sediments in water-logged areas along cut lines - Disturbance of soil along cut lines - Cut lines, may enhance gulleying and erosion (wind and water) - Rutting in loose soils - Contamination of soils	Medium	Site-specific	Long-term	Highly Probable	Negative	High	Medium

Air quality	Baseline (Pre-project)	- Dust generated by wind and enhanced by low vegetation cover - Offensive odours from point sources e.g. pit latrines and garbage dumps	Low Low	Regional Site-specific	Short-term Short-term	Definite Probable	Neutral Negative	High High	
	Project Operations	- Pollution from exhaust emissions - Fugitive dust generation from traffic - Offensive odours - Health risks	Low Low	Local Site-specific	Short-term Short-term	Definite Probable	Negative Negative	High High	Low Low
Surface and groundwater	Baseline (Pre-project)	- Freshwater shortage - Damming of rivers - Uneven distribution of resource - High demand for water resources	High	Regional	Permanent	Highly probable	Negative	Medium	
	Project Operations	- Conflict with neighbouring communities if water source is shared - Compaction of near-surface aquifers such as springs, reducing yield - Downward draining of groundwater through drill holes, reducing yield at springs	Negligible Medium	Site-specific to local Site-specific to local	Short-term Permanent	Probable Probable	Negative Negative	Medium High	Medium High
Water Quality	Baseline (Pre-project)	- High sediment loads in rivers - Point-source pollution of springs and wells	Low	Site-specific to local	Permanent	Probable	Negative	Medium	
	Project Operations	- Contamination of water supply source for the camp - Contamination of underlying aquifers	Low	Site-specific to local	Short-term	Probable	Negative	Medium	Medium

Terrestrial environment	Baseline (Pre-project)	- Land degradation from overgrazing - Desertification - Frequent fires - Few wildlife in unprotected areas	Low	Regional	Permanent	Probable	Negative	High	
	Project Operations	- Cutting of vegetation along cut lines - Disturbance of wildlife (physical presence and noise) - Introduced weeds and pests	Medium Low Low	Local Local Local	Medium-term Short-term Permanent	Probable Probable Improbable	Negative Negative Negative	Medium Medium High	Medium Medium High
Land resources and natural heritage sites	Baseline (Pre-project)	- Overgrazing	Medium	Regional/ Local	Long-term	Probable	Negative	Medium	
	Project Operations	- Cut lines affect pastoral resources - Disturbance of animals in National Parks	Negligible Low	Site-specific Local	Long-term Short-term	Improbable Probable	Neutral Negative	High Medium	High Medium
Archaeological, Historical and Cultural Sites	Baseline (Pre-project)	- Water erosion	Low	Local	Long-term	Probable	Negative	Medium	
	Project Operations	- Compaction by heavy vehicles and machinery may damage fossils/artifacts buried in shallow soils - Vibrations and drilling of shot holes may disturb/break up near-surface archaeological materials	Low	Site-specific	Permanent	Probable	Negative	Medium	High
Visual aesthetics	Baseline (Pre-project)	- Land degradation	Low	Local	Long-term	Probable	Negative	Medium	
	Project Operations	- Poor campsite design does not blend in with the environment - Cut line footprints and	Low Low	Local Site-	Short-term Long-term	Probable Probable	Negative Negative	High Medium	Low Medium

		vegetation cover removal lower aesthetic value of landscape - Landscape scarring on rocky surfaces		specific					
Noise and vibrations	Baseline (Pre-project)	- Noise from strong winds - Anthropogenic (but not excessive) noise localised in small towns and centres	Low	Local	Permanent	Definite	Neutral	High	
	Project Operations	- Disturbance to humans, animals and livestock - Disturbance to workers - Health risks	Low	Local	Short-term	Definite	Negative	High	Medium
Liquid and Solid Wastes	Baseline (Pre-project)	- Poor liquid and solid waste management in major centres, e.g. Lodwar	Low	Local	Short- to long-term	Probable	Negative	High	
	Project Operations	- Pollution of surface soils, waters and groundwaters - Offensive odours - Health risks	Low	Local	Short-term	Probable	Negative	Medium	Medium
Social Characteristics	Baseline (Pre-project)	- Low education levels - Low literacy levels - Few health facilities (inadequate, understaffed and under-equipped)	High	Regional	Long-term	Definite	Negative	High	
	Project Operations	- Possible increase in crime rate and prostitution - Possible increase in school drop out by individuals searching for jobs - Erosion of culture and social values as a result of intermingling with workers - May interfere with grazing lands and watering points - Spread of communicable diseases - Inter-community conflict - Conflict between community	Low	Local	Short-term	Probable	Negative	Medium	Medium

		and operation worker force							
Economic factors	Baseline (Pre-project)	- Few job opportunities - Poor access to markets - Slow economic growth rate	High	Regional	Long-term	Definite	Negative	High	Medium
	Project Operations	- Improved livelihood - Improved short-term business opportunities for the locals - CSR project benefits	Medium	Regional	Short-term Long-term	Probable	Positive	High	Medium
Occupational Health and Safety	Baseline (Pre-project)	- Low occupational health and safety issues	Low	Local	Short-term	Probable	Negative	High	
	Project Operations	- Injuries to workers, visitors and area residents arising from project operations - Fire hazard - Other health risks	Low	Site-specific	Short-term	Probable	Negative	High	Low
Security and public safety	Baseline (Pre-project)	- Frequent cattle rustling - Illegal guns - Resource conflicts -	High	Regional	Long-term	Highly probable	Negative	High	
	Project Operations	- Improvement in security due to security enhancement for project activities	High	Local	Short-term	Probable	Positive	Medium	High

7.4 ENVIRONMENTAL AND SOCIAL ASPECTS AND IMPACTS IDENTIFICATION FOR THE OFFSHORE (LAKE) SURVEY

The components of the seismic survey and survey-related activities that have been outlined in Chapter 2 and that could result in environmental and social impacts are indicated in Table 7.3 below.

Table 7.3: Offshore Survey Project Environmental and Social Aspects and Impacts.

	Parameters	Aspects	Potential Impacts
1.	• Air Quality	• Vessels and machinery • On-board sanitary systems • Poor waste storage and disposal	• Pollution from exhaust emissions • Offensive odours • Health risks
2.	• Water Quality	• Liquid effluent discharges from the vessels • Disposal of solid wastes from the vessels • Oil , fuel or chemical leaks from engines, machinery and storage areas	• Changes in water quality • Low level contamination/toxicity of water and benthic habitats
3.	• Aquatic Environment (Habitats Flora and Fauna)	• Vessels movement • Vessels anchoring and grounding, accidental loss of Ocean Bottom Cable hydrophone array (OBCs) and associated equipment • Liquid effluent discharges from the vessels • Disposal of solid wastes from the vessels • Oil, fuel or chemical leaks from engines, machinery and storage areas • Use of a non-sanitised vessel that has been operating in a different marine environment	• Collision with reptiles, water turtles and fish • Disturbance of aquatic animals and benthic habitats • Physical interference with crocodile and bird breeding sites • Pollution of habitats • Introduction of exotic aquatic species
4.	• Noise and Vibrations	• Air powered seismic sources • Vessel engines and other machinery	• Disturbance to fish, reptiles and zoobenthos • Disturbance to water birds • Changes to behavioural ecology of species (feeding, breeding, migration patterns). Species would include marine flora and fauna (including water birds). • Physical damage to aquatic flora and fauna
5.	• Solid and Liquid Wastes	• Liquid effluent discharges from the vessels • Disposal of solid wastes from the vessels • Oil or chemical leaks from	• Pollution affecting aquatic flora, fauna, water and sediment quality

		engines, machinery and storage areas	
6.	• Social Characteristics	• Physical presence of vessels • Presence of workforce	• Interference with other water users in the area because of exclusion zones • Risk of accidents with other water users • Breaking or entanglement with fishing nets
7.	• Economic Characteristics	• Physical presence of vessels • TKBV operations in the area	• Interference with shipping, boating and fishing in the area, diminishing economic returns • Employment opportunities for locals • Improvement of businesses and living standards • CSR project benefits • Social friction caused by sudden financial imbalances due to introduction of cash via local workforce into local populace • Long term economic benfits to local and national economy should the exploration programme be successful
8.	• Occupational Health and Safety	• The various workplace environments (see Chapter 2)	• Potential vessel to vessel accidents • Personal injury • Fire hazard
9.	• Security and Public Safety	• Workforce security needs	• Improvement in security due to security enhancement for project activities

7.5 IMPACTS ASSESSMENT AND MITIGATION FOR THE OFFSHORE (LAKE) SURVEY

7.5.1 Air Quality

The major emission sources from the proposed project are the seismic vessel and the support vessels. Operational atmospheric emissions may include exhaust fumes from diesel generators and compressors. Emissions will include carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), hydrocarbons, sulphur dioxide (SO_2), and particulate matter. These emissions are not anticipated to be significant. Offensive odours are also likely to originate from improper management of on-board solid and liquid wastes and sanitation facilities. However, it is noted that there are limited and localized emissions sources, and few receptors in the project area. Exceedance of ambient air quality criteria is not expected to occur, given the low-level concentrations of such emissions, the transient nature of the survey operations, and the generally strong and highly dispersive winds.

Mitigation:

- All vessel propulsion systems, exhaust systems, power generation equipment and incinerators shall be well and regularly maintained and operated efficiently (section 4.4.8);
- Minimizing vapour loss from fuel tanks, and idling of equipment when not in use;
- Use low-sulphur fuels where available;

- Project emissions will not exceed applicable air quality standards or guidelines such as the MARPOL Annex VI, Regulations for the Prevention of Air Pollution from Ships;
- Sanitary facilities should be kept clean and a routine established for this;
- Solid and liquid wastes should be properly managed in keeping with the guidelines and regulations for the specified vessel.

Due to the low-level and transient emissions and fugitive dust expected to be raised by the project operations, no residual impacts are envisaged.

7.5.2 Water Quality

Potential discharges from the seismic vessel and associated equipment that could impact on lake-water quality include: oil contaminated drainage; accidental release of OBC cable fluid, diesel, lubricant oil, oily sludge; sanitary effluent discharges; chlorinated water discharges; cooling water discharges; and solid wastes. Such discharges, if they occurred, would be on a small scale. Thus, impacts on water quality as a result of oil and chemical leaks, liquid effluent and solid wastes discharges are considered to be localised, short term, and of negligible significance with respect to the aquatic ecosystem.

Mitigation:

- Engineering machinery and components (e.g. engines, pumps, OBCs etc.) will be well-maintained and checked regularly for leaks;
- Use of bunded storage areas– spills and surface water will drain into a holding tank and treated according to MARPOL requirements;
- Oil spill management kits will be available on board, and emergency response training including drills will be conducted;
- Relevant authorities will be notified (according to the Energy Act) on detection of a spill. The location of the spill, prevailing winds, currents and sea state will be identified and recorded;
- All solid and liquid wastes shall be handled as outlined in section 7.5.5 below.

Residual, but localised or site-specific impacts may occur where an oil spill occurs in very shallow water and contaminates beach and lake sediments that contain high amount of clays which would adsorb the contaminant. These would, however, be dissipated by natural degradation processes over time.

7.5.3 Aquatic Environment (Habitats, Flora, and Fauna)

There are a number of potential impacts of seismic survey operations in the marine environment. Noise and vibration impacts on the aquatic environment are covered in section 7.5.4 below. This section addresses other potential impacts on the aquatic environment (see Table 7.3). The Valued Ecosystem Components (VEC – the elements of a project or activity's surroundings that are of importance) that were identified during the EIA fieldwork were reptiles, aquatic birds, fish (including eggs and lavae), invertebrates and zooplankton.

The survey may affect migratory routes, roosting, breeding and foraging sites of aquatic fauna, but the seismic lines can be deviated to avoid such areas, and anchoring or shoreline trampling avoided, based on the sensitivity map (Figure 5.16). The potential impacts of mobile vessels on aquatic fauna include physical contact (strikes). Birds may also be attracted to vessels as a

result of structural stimuli (Tasker et al., 1986), food concentrations (Wolfson et al., 1979; Tasker et al., 1986), and lights (Wallis, 1981). Other impacts may include disturbance/trampling of ground nests and nesting sites while accessing the lake. There are no adequate vessels in Lake Turkana that can be used for the work. The seismic survey vessel (and other vessels) would have to be imported from other areas, in which case they may introduce exotic aquatic species including pests (i.e. invasive species with competitive abilities and noxious traits capable of causing harm). Reducing the risk of entry and/or spread of potentially invasive species therefore represents by far the most effective and cost-efficient means of avoiding these threats.

Mitigation

(Collisions/Strikes):

- All seismic survey vessels will carry out visual monitoring and clearance of an exclusion zone around the array and in the immediate vicinity of the survey vessel (section 4.3.5);
- Emphasis should be placed on proper disposal of food waste to avoid attracting birds to the vessels;
- Surveys will be undertaken during daylight hours only.

(Disturbance of Benthic Habitats and Breeding/Nesting Sites):

- Seismic survey shall be undertaken during non-spawning/breeding seasons (in the areas and during the times that are specified and/or indicated in Figure 5.16 and Table 5.19 in Chapter 5, respectively) (see also sections 4.4.3, 4.4.5 to 4.4.7);
- Ocean Bottom Cable (OBC) hydrophone array shall be placed on the lake bed;
- The marine source will be an air-powered array;
- The source array will be most likely towed at a depth of ca. 2m below water level, this will in turn restrict the array from being used in waters shallower than 2m;
- A high resolution bathymetry survey is currently being undertaken by TKBV in Block 10BA. This data will ensure that the lake seismic survey will have the most up-to-date information on the lakebed.

(Pollution):

- Carry out vessel surface cleaning to remove biofouling prior to departure from areas with known or potential aquatic pests. Immersible equipment that has been used in other aquatic settings should also be cleaned (i.e. OBCs, air powered seismic sources, and accompanying cables/ropes/chains) before use in the lake (the Fisheries (General) Regulations; see also section 4.4.3);
- Coat vessel surfaces with an effective antifouling coating;
- Apply proper waste management on board (mitigations in section 7.5.5).

(Invasive Species):

- Carry out vessel surface cleaning to remove biofouling prior to departure from areas with known or potential aquatic pests as required under the Fisheries (General) Regulations.
- Immersible equipment that has been used in other aquatic settings should also be cleaned (i.e. OBCs, air powered seismic sources, and accompanying

cables/ropes/chains) before use in the lake as stipulated the Fisheries (General) Regulations).

The residual impact specified for water quality (section 7.5.2) would apply, as benthic and shoreline habitats could be contaminated. This may have impacts on the viability of zoobenthic populations at the particular contaminated site, but would not jeopardise the genetic pool nor food web structure significantly as such communities are widespread in the entire lake.

7.5.4 Noise and Vibrations

Use of vessels and air powered seismic sources will contribute to noise and vibration levels in the lake. The primary animals of concern in Lake Turkana are the crocodiles, fish, water birds, turtles, hippos and invertebrates. Reptiles are considered to be less sensitive to noise than aquatic mammals (Thomson et al., 2000). Fish may show startle response, change in swimming patterns, and change in vertical distribution (DFO, 2004). Several studies of direct physical damage by air-guns on fish eggs and larvae confirm that signal levels exceeding 230-240 dB p-p re 1µPa are necessary for harm to occur (Gausland, 2000), typically the pressure waves from the air guns can cause instant egg and larval mortility within a distance of about 1.5m, and mortal lesions within 3 to 6.5m (Mosbech et al., 2000), but the ecological effect of this mortality is marginal because the actual volume of water is very small, with a Norwegian study suggesting that larval mortality was 0.45% in a worst case scenario (Mosbech et al., 2000). In general, pressure waves have very little effect on marine invertebrates (Wardle, 2001), presumably due to the lack of air-containing chambers, such as a swim bladder, in these animals. The effect on freshwater turtles is currently unknown, but in marine environments, turtles have shown increased and/or erratic swimming patterns that have been interpreted as being indicative of an agitated state, and that avoidance of air powered seismic sources may occur at levels of approximately 175 dB rms re 1 µPa. (McCauley et al., 2000).

Mitigation:

- Avoid unnecessary acoustic energy (noise) generation through source, array, and receiver design optimization (section 4.4.7) ;
- To minimize vessel noise, use modern seismic survey vessels and associated equipment, ensure that all equipment including machinery are working well and are regularly serviced and maintained, and machinery that is not in use should not be left idling;
- A sequential build-up of warning pulses (soft start) should be made to deter and warn aquatic fauna immediately before commencement of seismic activity;
- Due to the fact that the breeding, spawning and migration seasons of the lake and lake-related fauna (fish, invertebrates, reptiles, water birds, hippos) are all different and are spread throughout the calendar year (see Table 5.20), avoidance of operations during such seasons is impractical, but particular care will be taken at all times to avoid disturbing the fauna;
- Contractor EHS observers will attend on the seismic source boat to observe and report any unusual wildlife activity during acquisition.
- Vulnerable ecological communities to be identified through close liaison with KWS, and appropriate mitigations agreed.

These effects of noise and vibrations are expected to be short-term, and are expected to vary between species and individuals, and be dependent on the properties of received sound. The

ecological significance of such effects is expected to be low, except where they influence reproductive activity (DFO, 2004), and it has been suggested that special consideration should be given to spawning because displacement of populations during spawning may affect recruitment to fish stocks (Mosbech, 2000).

7.5.5 Solid and Liquid Waste

The risks and impacts of garbage, food waste and plastics, sewage, sewage sludge and grey water discharges from ships has led to concerns over the vulnerability of marine ecosystems to such types of waste products. In addition to these are possible oil leaks and chemical spills. These may contaminate the lake water that the communities are dependent upon, with the potential of sewage-caused illnesses, water impacts such as increases in biological oxygen demand, chemical oxygen demand, and total organic carbon, reduced water and sediment quality, adversely impacted aquatic biota, increased turbidity, and raised nutrient levels.

Mitigation:

- No sewage discharge will be undertaken in the lake (sections 4.3.7, 4.4.5, 4.4.6, 4.4.9);
- All wastes generated will be managed (i.e., appropriately stored, handled and disposed of) in accordance with MARPOL 73/78. Under no circumstances will solid and hazardous wastes be disposed of in the lake. The wastes will be returned to shore and will be stored, labelled and disposed of in accordance with local authorities legislation (no hazardous waste will be disposed of to a facility that is not fully equipped to receive, store, treat and dispose the waste, and local authorities will be notified as to the type and quantity of waste to be disposed);
- The proponent must adhere to the: Water Act 2002; EMCA, 1999; Environmental Management and Coordination (Waste Management) Regulations, 2006; the Fisheries (General) Regulations and the industry best practices;
- Machinery spaces will be equipped with drip trays, curbs and gutters, and other devices to prevent spilled or leaked materials from entering the water. Such wastes will be collected in a closed system designed for that purpose and transferred onshore for disposal.
- Waste materials and equipment lost overboard will be recorded and recovered (where possible);
- Accurate and detailed waste manifests and safe disposal records shall be maintained.

The residual impact of liquid waste discharges in particular would be similar to that outlined under water quality (section 7.5.2), but would also make the water more unsafe to drink or bathe in as harmful microbiological organisms would multiply in sewage-enriched waters. The anticipated volumes of such wastes would, however, be quite low and rapidly dissipated and diluted by lake currents.

7.5.6 Social Characteristics

The proposed seismic survey area lies within offshore waters that support subsistence and to a lesser extent commercial fishing. The survey has the potential to interfere with fishing activities and damage fishing equipment (e.g. nets, lines, fixed gear) in the area. Damage to fishing equipment is a concern from both a safety viewpoint (i.e. potential risk to personnel on the fishing vessel and the survey vessels) and in terms of adverse reactions/complaints and subsequent compensation claims from fishermen whose equipment has been damaged (i.e.

loss of equipment and temporary loss of earnings/livelihood). Damage to the OBCs from fishing gear and resulting impact on aquatic fauna is also a major concern.

Mitigation:

- The local authorities will be advised of the planned survey including details of participating vessels, survey schedule and locations;
- TKBV CLOs will sensitise local fishing communities about the proposed activities and ensure that their concerns are addressed;
- A notice will be issued through the local administration informing fishermen of the proposed seismic survey activities;
- The scout and guard vessels will clear the area of fishing boats and their equipment, and prevent fishing vessels from crossing the seismic array; and
- A radar reflector and flashing lights will be provided on the source array tail buoy should it be required.

No residual impacts are anticipated.

7.5.7 Economic Characteristics

As indicated earlier, L. Turkana occupies the most part of the project area. Most of the locals, being fishermen, might be affected by the seismic operations, especially within the lake. It should be noted that fish catch rate near surveys can be affected by air powered seismic source use, but any reduction in catch rates is not expected to be long lasting as the reason for the reduced catches is probably because fish dive to the bottom or disperse when exposed to high-level sound (Grassland, 2000). Temporary migration of fish populations from spawning areas may be harmful because of the negative effect it would have on fish stocks (Mosbech, 2000). OBC equipment may also entangle nets and other types of fishing gear.

Mitigation:

- A support vessel will conduct reconnaissance scouting ahead of the survey vessel;
- Regular communication with fishing groups and provision of coordinates of survey area to fishermen will minimize potential impacts to commercial fishing activity;
- Seismic operations should be scheduled during least sensitive period for instance during low fishing season (September to November) (section 4.3.6);
- Liaise with local community leaders during the recruitment process;
- Unskilled and semi-skilled manpower to be sourced locally;
- Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan;
- Where damage occurs, for example, to fishing nets, or when project operations may lead to exclusion of fishing in a particular area, then compensation can be made for those income losses. A complaints and compensation mechanism should be developed by a body comprising of TKBV, Ministry of Energy, and Department of Fisheries officials, as well as community and relevant stakeholder organisation leaders (e.g. Beach Management Units).

The residual impact in this instance would be positive, relating to improvement of work skills that will be acquired by locals who will be employed in the project as semi- or skilled workers.

7.5.8 Occupational Health and Safety

During the seismic survey, the workers, visitors and the local community may be exposed to occupational and health hazards. The seismic survey crew will be exposed to strong wind conditions on the lake, and may face sudden storms when carrying out the marine seismic survey. Accidents between vessels and/or vessels and aquatic animals or grounding on unmapped projecting lakebed topography in shallow areas may occur. Other accidental events could include damage or loss of seismic gear, and entanglement of seismic gear with fishing gear.

Mitigation:

- Monitoring of wind speeds should be undertaken, and the marine-based seismic surveys should be called off should the winds and waves thereby generated begin to reach a pre-determined and established critical threshold that may put the life of the boat crews in danger;
- Watch will be maintained on the survey vessel for other craft (sections 4.3.5, 4.3.9).
- The scout and guard vessels shall be used to caution other boats, to protect deployed equipment, and to assist/support the seismic survey vessel during abnormal or emergency situations;
- All deployed equipment will be made highly visible to minimise accidents and to facilitate retrieval in case of loss;
- Survey operations shall be suspended in adverse weather conditions;
- The survey vessel will carry operational, navigation, bathymetry tracking, and warning lights.
- The OBC hydrophone cables will be tracked via GPS to monitor their location (assisting retrieval if one or more become severed).
- Well-stocked first aid kits and fire fighting equipment should be available to all crew, and selected crew members should be trained on first aid administration and handling of fire-fighting equipment as provided in the Occupational Health and Safety and Health Act.
- Appropriate personal protective equipment (e.g. Personal Flotation Devices (PFDs)) and fire-fighting apparatus shall be maintained and be easily accessible on the vessels. The crew shall be competent in the use of fire fighting equipment and well-drilled on emergency response procedures as required by the Occupational Health and Safety and Health Act;
- Provisions of environmental health and safety plan (EHS) will be adhered to by all.
- Adequate warning or caution signage, including ‘no smoking’ signs, will be posted as required;
- Only properly trained and authorised employees shall operate equipment or machinery.

No residual impacts are anticipated.

7.5.9 Security and Public Safety

Security is a major concern in the region, especially for people living in Todonyang area. This is due to recurrent conflicts involving the Turkana fishermen and their Merille counterparts from Ethiopia.

Mitigation:

- The company should liaise with the Provincial Administration, the Kenya Police, KWS, Kenya Police Reservists and other agencies to provide adequate security during the seismic survey operation.
- Ensure that all workers have staff uniform and badges;
- Adequate security measures should be provided, like perimeter fencing safe havens and security manning at the campsites and while en route to and from lake side;
- The proponent should ensure that their drivers adhere to speed limits both for boats and vehicles.
- Barriers and guards will be installed as necessary to protect employees and visitors from physical hazards and criminal activity.
- Camp population will be forbidden from interacting with local populace.
- Journey management policy and monitoring to be enforced as per Tullow Oil's Driving Policy.

The project operations can potentially result in long-term improvement of security and safety in and around the lake by enhancing collaboration and information-sharing across different agencies operating within it and along its shoreline.

Table 7.4: Existing environmental pressures and potential impacts of offshore (lake) project operations on environmental and social factors in the project area prior to adoption of mitigation measures (see Chapter 3, section 3.2 for impact assessment criteria and rating).

Parameter assessed	Baseline or Project	Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance of Potential Impacts
Air quality	Baseline (Pre-project)	- Dust generated by wind	Medium	Regional	Short-term	Definite	Neutral	High	
	Project Operations	- Pollution from exhaust emissions - Offensive odours - Health risks	Low	Site-specific	Short-term	Probable	Negative	High	Medium
Water quality	Baseline (Pre-project)	- Decreasing water quality and quantity (increased turbidity and salinity) - Contamination of water and benthic habitats	Medium	Regional	Long-term	Probable	Negative	High	
	Project Operations	- Changes in water quality - Low level contamination/ toxicity of water and benthic habitats	Medium	Site-specific	Short-term	Probable	Negative	High	Medium
Aquatic environment	Baseline (Pre-project)	- Disappearance of birds and crocodiles due to reduced water levels	Medium	Regional	Long-term to Permanent	Highly probable	Negative	High	
	Project Operations	- Collision with reptiles, water turtles and fish - Disturbance of aquatic animals and benthic habitats - Physical interference with crocodile and bird breeding sites - Pollution of habitats - Introduction of exotic aquatic species	Medium	Site - specific	Short-term	Probable	Negative	Medium	Medium to High
Noise and vibrations	Baseline (Pre-project)	- Natural strong winds - Anthropogenic (but not excessive, boat traffic)	Low	Local	Short-term	Probable	Negative	Low	

	Project Operations	- Disturbance to fish, reptiles and zoobenthos - Disturbance to water birds - Changes to behavioural ecology of species (feeding, breeding, migration patterns). Species would include marine flora and fauna (including water birds). - Physical damage to aquatic flora and fauna	Medium	Site-specific	Short-term	Highly Probable	Negative	Medium	Medium
Liquid and Solid Wastes	Baseline (Pre-project)	- Insignificant	Negligible	Site-specific	Short-term	Improbable	Neutral	High	Low
	Project Operations	- Pollution affecting aquatic flora, fauna, water and sediment quality -	Medium	Local	Short-term	Improbable	Negative	Medium	Medium
Social Characteristics	Baseline (Pre-project)	- Subsistence and to a lesser extent commercial fishing - Tourism in and around the islands - Sport fishing and research in some parts	Low	Local	Short-term	Probable	Positive	Medium	
	Project Operations	- Interference with other water users in the area because of exclusion zones - Risk of accidents with other water users - Breaking or entanglement with fishing nets -	Medium	Local	Short-term	Probable	Negative	Medium	Medium
Economic factors	Baseline (Pre-project)	- Few job opportunities - Poor access to markets - Slow economic growth rate	Medium	Regional	Medium-term	Probable	Negative	Medium	

	Project Operations	- Interference with shipping, boating and fishing in the area, diminishing economic returns - Employment opportunities for locals - Improvement of businesses and living standards - CSR project benefits	Low Low Low Low	Local Regional Local Local	Short-term Short-term Short-term Long-term	Probable Definite Definite Definite	Negative Positive Positive Positive	Medium High Medium High	Medium Medium Low Medium
Occupational Health and Safety	Baseline (Pre-project)	- Lake users exposed to strong windy conditions - A majority of boats lack proper safety gears	Medium	Local	Short-term	Probable	Negative	Medium	
	Project Operations	- Potential vessel to vessel accidents - Personal injury - Fire hazard	Low	Site-specific	Short-term	Probable	Negative	Medium	Medium
Security and public safety	Baseline (Pre-project)	- Occasional piracy close to Omo River delta - Illegal guns - Resource conflicts	Medium	Local	Short-term	Probable	Negative	Medium	
	Project Operations	- Provision/ deployment of security personnel - Prior warning and information transfer of the intend seismic survey schedule	Medium	Regional	Medium-term	Probable	Positive	High	

7.6 CUMULATIVE IMPACTS IN THE PROJECT AREA

Cumulative impacts are those impacts which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions.

The impact on soil resources can be accurately characterised and for the most part mitigated through the proposed line preparation activity using mulchers, which help to preserve their stability, and significantly raise the probability of regenerating the indigenous vegetation *in situ* from the existing seed base.

The cumulative impacts on the biodiversity of the area are considered insignificant. The temporary modification of approximately 913km of vegetation to permit the conduct of the seismic survey is considered a minor impact due to the commonality and widespread nature of the vegetation across the region. The vegetation is recognized as being sensitive to disturbance due to the harsh climatic setting and poor soils. The direct impact of the activity on threatened species of fauna is considered small: the wildlife species identified have large and protected ranges in the Sibiloi National Park, while few to none exist on the western side of the lake. Their ranges are significantly large so that the disturbance of actual or potential habitat will not introduce impacts deleterious to the localised populations of the species. Within the lake, survey impacts are also not likely to have any significant effect on identified threatened aquatic species such as the freshwater turtle, or on breeding and nesting grounds, as the proposed seismic lines will not pass close to the islands and their sensitive habitats.

Changes to lake level (lowered lake level) are likely to occur when the Gibe III dam in Ethiopia begins full-scale operations, and may be enhanced by natural hydrological variations related to changes in the climate system. This (damming of the Omo River in Ethiopia) can have moderate to severe effects on the delta, shoreline, littoral and open lake ecosystems and ecosystem services that would in turn be largely detrimental to the livelihoods of the locals. However, the seismic survey project components will not in any way interact with influent rivers nor will it entail direct use of the lake water, so any such future variations ought not to be erroneously linked to this seismic survey activity.

The scope for cumulative impacts on archaeological and cultural sites from the proposed activity are low, this again being due to the linear (rather than areal) nature of the programme, and also because such sites can be deviated once identified, and flagged so as not to be disturbed. The scale of fugitive particulate material generation and their impacts on the surrounding environment is generally negligible, particularly because the naturally strong winds have a much greater impact in this regard. Adequate mitigation measures are, however, available during the operations phase to limit the generation of dust in the localised area and where the activity creates greater than normal levels of traffic.

Positive cumulative benefits for the local business community are an expected result of the proposed activity with the planning and construction phases utilising a range of local professional service providers. Semi-skilled workers who may be employed in the project will likely acquire new and lifelong skills that may prove useful in other sectors of the Kenyan economy.

7.7 SIGNIFICANCE OF IMPACTS

The seismic survey will utilise state-of-the-art equipment and experienced personnel to carry out the work. They will also adhere to the international best practices regulations of OGP and IAGC and the applicable national legislation and regulations. As mentioned earlier, seismic survey operations are regarded, from an industry standpoint, as being of a small scale in terms of both extent and duration. In addition the majority of operations will be conducted a large distance away from any habitation, town or workplace so that the inhabitants will be largely unaffected. The short-term duration (less than 6 months) of seismic survey activity and of impacts will result in negligible cumulative impacts for most environmental and social factors, and no long-term cumulative impacts following cessation of the proposed seismic survey project.

CHAPTER 8:

ENVIRONMENTAL MANAGEMENT PLAN

8.1 INTRODUCTION

The environmental and social concerns in the EIA must be properly managed. The tool for achieving this is the incorporation of an Environmental Management Plan (EMP) into the EIA to ensure adherence and compliance with legislation, good environmental performance, and integration of environmental issues into the project planning and execution. The EMP provides the means of assessing the accuracy of the predicted project impacts and the monitoring of the effectiveness of the proposed mitigation measures contained in the EIA study report. The EMP should therefore indicate how the environmental concerns highlighted in the EIA would be managed. TKBV will monitor the implementation of key contractor parties and assess compliance with the provisions of the EMP through its contractual mechanisms and management.

TKBV is committed to provide resources essential to the implementation of the EMP. The EMP outlined below provides all the details of project activities, impacts, mitigation measures, time schedules, costs, responsibilities and commitments proposed to minimize environmental and social impacts of the project, and includes monitoring and evaluation for the implementation, operational and decommissioning phases of the project.

8.2 OBJECTIVES OF THE EMP

The objectives of the EMP are to:

- Address and develop legal frameworks and other requirements that must be adhered to;
- Promote environmental management and communicate the aims and goals of the project EMP to all stakeholders;
- Incorporate environmental management into project design and operating procedures;
- Ensure all workers, contractors, sub-contractors and others involved in the project meet all requirements with regard to environmental management;
- Address issues and concerns raised in the EIA stakeholders' consultation process;
- Serve as an action plan for environmental management;
- Provide a framework for implementing commitments of the project (i.e. mitigation measures identified in the EIA);
- Prepare and maintain records of project environmental performance (i.e. monitoring, audits and compliance tracking); and
- Prepare an environmental monitoring plan whose aim is to ensure that the negative environmental impacts identified in this EIA are effectively mitigated in design, construction, operational and decommissioning stages of the project; and the positive impacts are enhanced.

8.3 PROJECT DESCRIPTION

The project has been described in detail in Chapter 2. The main objective is to undertake a seismic survey in Block 10BA, which covers a part of the Lake Turkana basin area (including the lake) in order to identify and delineate potential oil and gas deposits therein. On land, the acoustic energy required will be generated mostly by vibroseis, and in some select (sensitive) areas, by dynamite charges, while on the lake, airguns which release pulses of compressed air, will be used.

As per the PSC requirements, 1534 km of 2D seismic data will be acquired over a projected time period of approximately six months, a Transition Zone crew (a land and marine crew) mobilising to the area around August / September of 2011, provided that a permit of approval for this EIA has been issued.

913km of line data will be acquired on land, and 621km in the lake. Line clearance along the pre-determined and pre-surveyed transects on land will be done by use of mulchers and light hand-cutting tools, and where access roads are required, by bulldozers. Support vehicles such as for personnel movement, carrying of data recording equipment, etc., will be available. For the lake survey, the boat specifications, operations and safety requirements shall conform to the International Association of Oil and Gas Producers (OGP) guidelines for watercraft and water in geophysical exploration, report 355. The workforce, who will reside in a fully equipped base camp, will be between 100 and 150 in number. The health and safety of the crew and the general public at large will be ensured by the company complying both with the relevant national legislation, its own in-house environmental health and safety (EHS) policies which embrace the international best practices for such activities, and this EMP. A close working relationship will be fostered with the local communities, and as far as is practicable, unskilled and semi-skilled workers shall be recruited locally.

8.4 APPLICABLE LEGISLATION AND REGULATIONS

The spectrum of legislation and regulations that apply to the seismic survey project has been detailed in Chapter 4. Some of the key legislation that relate to the activity are the:

- Environmental Management and Co-ordination Act, 1999 and associated regulations and guidelines;
- Petroleum (Exploration and Production) Act, Cap. 308;
- Energy Act, No. 12 of 2006;
- Explosives Act, Cap. 115;
- Wildlife (Conservation and Management) Act, Cap. 376;
- National Museums and Heritage Act, Cap. 216;
- Water Act, Cap. 372;
- Merchant Shipping Act, 2009;
- Fisheries Act, Cap. 378; and
- Occupational Safety and Health Act, No. 15 of 2007.

8.5 TULLOW POLICIES AND PROCEDURES

Tullow Oil plc has two key policies that relate to this activity, namely, the Environmental, Health and Safety Policy, and the Corporate Social Responsibility Policy. These policies aim to: preserve biodiversity and promote sustainable development by protecting people, minimising harm to the environment and reducing disruption to its neighbouring communities, and; conduct all business operations to best industry standards and to behave in a socially responsible manner (i.e. behave ethically and with integrity in the communities where it works, and to respect cultural, national and religious diversity). Further details on these policies are in Chapter 4, section 4.6).

8.6 ROLES, RESPONSIBILITIES AND TRAINING

TKBV will be responsible for the overall implementation, monitoring and quality assurance/quality control of this EMP. It will be responsible for ensuring that the policies, management plans and actions to be implemented to avoid, reduce, mitigate, or compensate for adverse environmental and social impacts are adhered to. TKBV shall develop a clear command chain framework for employee responsibilities, reporting and incident management, and shall ensure that all employees understand it.

TKBV may sub-contract certain aspects of the activities. In such cases, the contractor will be responsible for the implementation and monitoring of the EMP in their related work contract activity (and this condition should be built into the terms of reference for tendered work and the contract document), but the oversight on compliance will rest with TKBV. Each contractor will also be responsible for the occupational health and safety of the workers and others who may be carrying out both related and un-related activities within and around the work sites. With respect to its oversight role, TKBV will be responsible for regular environmental inspections of the work and camp sites in general. The contractors will also be responsible for implementing corrective actions that may be required by TKBV as a result of these inspections.

TKBV will train its employees in order to equip them to carry out their duties under the scope of the EMP. Contractors will likewise be required to do the same for their employees and in relation to the work component that they have been given to carry out (see the EMP below). The workers shall be regularly informed on, and assessed for, their understanding of the various policies and plans that relate to their work environment. TKBV will constitute a competent and effective workforce, taking into account the skills required for each work component, and giving priority to the locals for employment opportunities in the semi-skilled and unskilled work categories. Suitable training and skill transfer will be provided, where required.

Specific training requirements are mentioned under the relevant sections of the EMP below.

8.7 COMMUNICATION WITH STAKEHOLDERS AND GRIEVANCE MECHANISM

TKBV will develop and maintain a formal procedure for communication with various stakeholders to inform on the various stages of project activities, as well as to receive their views and concerns, if any. TKBV should maintain a written register of its interactions and

discussions with the various stakeholders so that issues that require to be followed up are clear and well-understood, and the outputs can be assessed.

TKBV will also establish a grievance mechanism to handle complaints from the stakeholders/residents of the area, as well as for its own and contracted workers. This mechanism will also include procedures for assessing any project-related damages to persons and properties and levels of compensation. Such a mechanism will be best established in consultation with officials from Government (Ministry of Energy, Ministry of Fisheries, Community Leaders, and Stakeholder Group Representatives).

8.8 AUDITING

It is a requirement by law that any project activity being undertaken be audited after every year. The seismic survey is, however, of a much shorter duration. Auditing will, therefore, be done upon completion of the project activities.

Besides the regulatory framework, TKBV will conduct regular internal EHS audits covering various aspects of the EMP during the course of the project operations. The audits shall be performed by qualified staff and communicated to TKBV's relevant departments.

8.9 THE ENVIRONMENTAL (AND SOCIAL) MANAGEMENT PLAN (EMP) FOR THE ONSHORE SEISMIC SURVEY

The EMP for the onshore survey addresses the following components that relate to the seismic survey:

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

The structure of the Environmental Management Plan adopted for each of the environmental and social components addressed in it (below) is as follows:

1. Potential Impacts and Mitigations – these outline the impacts and mitigations that have been identified and that are peculiar to the project area (see Chapter 7);
2. Identification of Desired Outcomes, Objective Indicators, and Monitoring – The Desired Outcomes reflect what the project proponent and stakeholders would like to see once

the operation has been completed. The Objective Indicators indicate how the Desired Outcomes can be measured, and their success determined (either qualitatively, quantitatively, or both). The Monitoring aspect is based on assessment of project operations *vis à vis* the Objective Indicators and the Desired Outcome;

3. Responsibilities and Management.

In each and every component of the EMP, the Tullow EHS and CSR policies that are outlined in Chapter 4 apply. Other additional relevant plans (whose frameworks are outlined in later sections of this EMP and that TKBV will need to adopt) are indicated under the applicable EMP component(s).

8.9.1 Physiography and Geology

The impact sources from the project operations will include the vibroseis and associated equipment, bulldozer and dynamite charges.

Potential Impacts	Mitigation
▪ Cut lines leave long-lasting residual impacts (tracks, and/or scarring on surface landscape) ▪ Vibrators/bulldozers and dynamite use near steep slopes may lead to minor landslips and rock topples	▪ Use existing access roads to the extent possible; ▪ Pre-survey possible access routes, and use the selected routes rather than accessing work sites through free-ranging driving across the open country ▪ Explosives (dynamite) should be used as source instead of vibroseis in areas with highly dissected and incised surfaces (sections 4.3.3 and 4.3.4); ▪ When laying cut lines, use will be made of existing roads and tracks to avoid creating unnecessary tracks and trampling of pasture; ▪ Minimise, to the extent possible, the use of bulldozers to open up cut lines and access roads to minimise landscape scarring; ▪ Avoid cut lines on slopes steeper than 40º to minimise risk of landslips and rock topples; ▪ Optimise source energy to achieve the survey objectives to minimise risk of landslips and rock topples; ▪ Buffer zones of 50m should be maintained from areas posing landslip and topple hazards.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Residual impacts of cut lines minimized to the extent possible	▪ 100% of seismic cut lines pre-surveyed on the ground ▪ Actions taken to minimise cut line impacts are recorded	▪ Continuous, daily: pre-survey and actual line cutting
▪ Landslips and rock topples do not occur	▪ No project-related landslips or rock topples recorded	▪ On site

Responsibility and Management:

The TKBV EHS Representative will be responsible for the day-to-day monitoring and management, and will report to the Tullow Oil Seismic Operations Supervisor and the TKBV EHS Manager on a daily and weekly basis, or immediately in case of an incident occurring. The following will be observed in the field: there will be no cooking on site and no fires; smoking will only be permitted in designated areas; no litter will be left on site; there will be no collecting of vegetation or firewood, and no hunting and trapping of wildlife; and vehicle speed will not exceed 40 km an hour, with all vehicles fitted with vehicle tracking and monitoring systems.

8.9.2 Soils

The impact sources from the project operations will include vibroseis and associated equipment, bulldozer, and transport vehicles. Other sources will be oil or chemical leaks from vehicles, machinery, garage and storage areas.

Potential Impacts	Mitigation
▪ Compaction of soft sediments in water-logged areas along cut lines ▪ Disturbance of soil along cut lines ▪ Cut lines, may enhance gulleying and erosion (wind and water) ▪ Rutting in loose soils ▪ Contamination of soils	▪ Machinery and equipment should use existing routes as much as is practicable to avoid compaction of the surface soil (section 4.4.5); ▪ Construct drainage channels on cut lines where natural drainage may be affected; ▪ Turkwel River should be crossed only at the existing road crossing; ▪ Luggas should be crossed at road crossings, where such crossings exist, or in areas where the bank heights are less than 1m – banks at the lugga crossings should be mechanically restored; ▪ Vehicles should steer away from natural drains and waterways wherever practicable, but a buffer zone of 20m should be maintained except at crossing points; ▪ Minimize vegetation and grassland clearance as much as possible when cutting the survey line transects (section 4.4.5); ▪ Seismic survey should aim to be carried out as far as possible during the dry seasons; ▪ Use only essential vehicles and low pressure/low impact tyres in areas with wet soils or that are susceptible to ponding or are prone to erosion; ▪ Ensure that all vehicles and machinery operating in the field and in the campsite are properly maintained so as not to have oil leaks that could contaminate the soils (section 4.3.7); ▪ Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available; ▪ All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures; ▪ Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks; and ▪ Installation and proper management of camp sanitation facilities.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Minimal, (if any) , compaction of soft sediments where applicable ▪ Minimal disturbance of soils along cut lines ▪ No contamination of soils	▪ Maintain inventory on length of wet/dry patches encountered along the survey routes ▪ Zero spillage of oils/chemicals. Incidents of spillage type and amount recorded and georeferenced	▪ Continuous during survey ▪ Continuous during survey, ▪ One time assessment and site selection ▪ All incidents to be reported immediately to the Seismic QC Representative

Responsibility and Management:

The TKBV EHS Representative will be responsible for the day-to-day monitoring and management, and will report to the Tullow Oil Seismic Operations Supervisor and the TKBV EHS Manager on a daily and weekly basis, or immediately in case of an incident occurring.

8.9.3 Air Quality

The impact sources from the project operations will include vehicles and machinery, sanitary systems and waste disposal points.

Potential Impacts	Mitigation
▪ Pollution from exhaust emissions; ▪ Fugitive dust-generation from traffic; ▪ Offensive odours; ▪ Health risks.	▪ Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation; ▪ Field vehicles, trucks and any other machinery should be switched off when not in use; ▪ Regular servicing of all trucks, service vehicles, and any other machinery powered using fossil fuels to ensure efficient combustion and minimisation of exhaust emissions (section 4.4.8); ▪ Use low sulphur fuels if available and where suitable; ▪ Employees working in dusty conditions must use appropriate PPE; ▪ If litter is to be burned, it should be done at a time of low wind movement, and preferably in areas shielded from wind by vegetation; ▪ Installation and proper management of camp sanitation facilities.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Minimal pollution from exhaust emissions ▪ Minimal dust generation from traffic ▪ No offensive odours ▪ No health risks	▪ Use of low sulphur versus other fuels wherever possible ▪ Adherence to equipment maintenance schedule ▪ Set speed limits are not exceeded (record exceedence incidents) ▪ No offensive odours recorded ▪ No violation of OHS requirements for dust impact mitigation (violations recorded).	▪ Malfunctioning equipment removed immediately from operations for repair ▪ Speed limit violations based on speed-tracking devices in vehicles, monitored at base camp ▪ Regular inspection of sanitary facilities and waste disposal points ▪ Regular checks on use of PPE

Responsibility and Management:

The TKBV EHS Representative will be responsible for the day-to-day monitoring and management of air quality issues in the field, and around the campsite. The EHS representative will liaise with the Seismic QC representative on site on any issues arising and will report to the Tullow Oil Seismic Operations Supervisor and the TKBV EHS Manager on a daily and weekly basis, and will immediately report on health risk incidents.

8.9.4 Surface and Groundwater Resources

The impact sources from the project operations will include water supply source for the camp, heavy vehicles and machinery, and drilling of shot holes.

Potential Impacts	Mitigation
▪ Conflict with neighbouring communities if water source is shared ▪ Compaction of near-surface aquifers such as springs, reducing yield ▪ Downward draining of groundwater through drill holes, reducing yield at springs	▪ A water supply borehole should be drilled to provide the water required for the project; this could be donated to the community on completion of the seismic survey; ▪ It is recommended that an efficient water-use policy be adopted by the project proponent at the camp site and other work areas (section 4.4.3); ▪ An efficient sanitation system should be put in place in the campsite(s) to handle effluents (section.4.3.8); ▪ Hazardous and toxic waste material should be managed according to international protocols and best practices and in complicance with Kenyan legislation, specifically the Environment Management and Coordination (Waste Management) Regulations; ▪ Buffer zone distances between seismic lines and water sources will be established through extensive in-field ground vibration testing. Distances may vary between seismic source types, as per IAGC Guidelines. ▪ When water is encountered during shot hole drilling, bentonite, or a tapered concrete (or other suitable material widely accepted in the industry), can be used to plug the hole up to 3m above the static water

	level or to a depth of 1m from the ground surface; ▪ Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available; ▪ Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No conflict over water use with neighbouring communities	▪ TKBV has its own water borehole or other independent water source	▪ Not applicable
▪ No compaction of near surface aquifers	▪ Identification of nearby springs and wells along cut lines during line survey exercise ▪ No violation of buffer zone limits around groundwater sources	▪ Continuous, during line survey ▪ Compliance with buffer zone requirements ▪ Continuous, during line survey
▪ No downward draining of groundwater through drill holes	▪ Identification of nearby springs and wells along cut lines during line survey exercise ▪ No violation of buffer zone limits around groundwater sources ▪ Inventory of drill hole plugging maintained	▪ Compliance with buffer zone requirements ▪ Per drill hole site

Responsibility and Management:

The TKBV EHS Representative will be responsible for the day-to-day monitoring and management of surface and groundwater resource issues in the field, and around the campsite. The EHS representative will liaise with the Seismic QC representative on any issues arising and will report to the Tullow Oil Seismic Operations Supervisor and the TKBV EHS Manager on a daily and weekly basis, and will immediately report on incidents of concern.

TKBV will seek authority from the local council to drill a water borehole. Once approval is obtained, site selection for the borehole will be done with inputs from a registered hydrogeologist. The hydrogeological report will be done in accordance with the legislation and regulations that relate to the Water Act 2002, and will be submitted to the Water Resources Management Authority (WRMA) sub-regional office in Nakuru. WRMA will then approve the report and issue a drilling permit.

8.9.5 Water Quality

The impact sources from the project operations will include: liquid effluent discharges from sanitation systems at the campsite; oil or chemical leaks from garage and storage areas, vehicles and machinery operating in the camp and field; and subsurface detonation of dynamite charges during the field survey.

Potential Impacts	Mitigation
▪ Contamination of water supply source for the camp ▪ Contamination of underlying aquifers	▪ Refueling areas must be underlain with spill-proof hardstanding or bund, with spill kits readily available and operatives trained in their use; ▪ All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures; ▪ All refuelling operations to be carefully overseen and managed; ▪ Pits for disposal of domestic and sanitary effluents should be sited with knowledge of the geological and soil characteristics of the area; ▪ Buffer zone distances between seismic lines and water sources will be established through extensive in-field ground vibration testing. Distances may vary between seismic source types, as per IAGC Guidelines; ▪ Spill kits to be carried with vibe truck service vehicle, refuelling bowser vehicles, drill crews. All staff to be briefed on use of these; ▪ When water is encountered during shot hole drilling, bentonite or a tapered concrete plug may be used to plug the hole up to 3m above the static water level or to a depth of 1m from the ground surface; ▪ Ensure that all vehicles and machinery operating in the field (and in the campsite) are properly maintained so as not to have any oil leaks that could contaminate the soils (section 4.3.7); ▪ Ensure that any in-field refuelling or maintenance is performed in a bunded area or while using a drip tray with a spill-kit available; ▪ Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No contamination of water supply source for the camp	▪ Camp water supply source is fit for human consumption ▪ Camp water supply source is protected ▪ Zero spillage of chemicals and hazardous material on soils that may lead to surface/ groundwater pollution ▪ Waste pits and landfills are professionally sited	▪ Physico-chemical and microbiological testing regularly. ▪ Casing and cementing of borehole and wellhead area ▪ Protocols for and conditions of oils and chemicals storage at the camp are adhered to ▪ Compliance with buffer zone requirements
▪ No contamination of underlying aquifers in the project area	▪ Buffer zones are observed	

Responsibility and Management:

The TKBV EHS Representative will be responsible for regular monitoring and management of surface and groundwater resource issues in the field, and around the campsite. The EHS representative will liaise with the Seismic QC Representative on any issues arising and will

report to the Tullow Oil Seismic Operations Supervisor and the TKBV EHS Manager on a daily and weekly basis, and will immediately report on incidents of concern.

8.9.6 Terrestrial Environment (Habitats, Flora, and Fauna)

The impact sources from the project operations will include: vibroseis and associated equipment, mulchers, bulldozer and transport vehicles, and physical presence of the workforce.

Potential Impacts	Mitigation
▪ Cutting of vegetation along cut lines ▪ Disturbance of wildlife (physical presence and noise) ▪ Introduced weeds and pests	▪ The mitigations related to soils (see above) apply; ▪ Trees with trunk diameter greater than 20cm should not be cut; ▪ Seismic survey activities to be undertaken during daylight hours only; ▪ Liaise with the Kenya Wildlife Service (KWS) to ensure that wildlife disturbance and danger to the seismic team is mitigated. Any planned lines that are considered to be a threat will be relocated; ▪ Hunting, fishing, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. All workers to be briefed regularly on this issue; ▪ The risk of introduction of weed and pests species to the region via contaminated vehicles and equipment will be mitigated by the wash-down of all vehicles and ancillary equipment at a designated location prior to the commencement of the survey.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Minimal cutting of vegetation along cut lines	▪ Length of line where no cutting is required versus length of line where mulcher is used	▪ Continuous, during line preparation
	▪ Number of wildlife encounters and actions taken recorded	▪ Continuous, during line preparation
▪ Minimal disturbance of wildlife	▪ All equipment (vehicles and vessels) are washed down and biofouling removed before being taken to the project area	▪ Daily
▪ No weeds or pests introduced into the area		▪ Inspection and certification of the cleaning action

Responsibility and Management:

Close liaison will be maintained with the Kenyan Wildlife Service who can , advise the Seismic QC Representative on a day-to-day basis. Access to areas with wildlife is protected and permissions will have to be sought to gain access. Wildlife shall have the right of way when

they are of such a size that they can be readily seen from vehicles. Hunting and feeding of wildlife shall be strictly prohibited. In wildlife areas, access roads will be used as much as possible. Employees should be made aware of the wildlife-sensitive locations.

8.9.7 Land Resources and National Parks

The impact sources from the project operations will include: vibroseis, mulchers and associated equipment, dynamite shots, vehicles, and presence of humans.

Potential Impacts	Mitigation
▪ Cut lines affect pastoral resources ▪ Disturbance of animals in National Parks	▪ As for sections 7.3.1 (Physiography and Geology) and 7.3.7 (Terrestrial Environment) above.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Animal encounters minimised ▪ Pastoralist activities are only minimally disrupted ▪ Other desired outcomes relate to the following sections: Soils (8.9.2), Terrestrial Environment (8.9.6)	▪ No animal encounters recorded ▪ No complaints from pastoralists ▪ Objective indicators for Soils and Terrestrial Environment are met	▪ Monitoring of animal presence along survey routes ▪ Information outflow to the affected communities on seismic line survey schedules and exclusion time periods ▪ Adhering to the use of existing routes and road network ▪ Enforcing policy against hunting and gathering through training and direct supervision where applicable

Responsibility and Management:

Supervisors should ensure that (i) unnecessary incursions into park areas are avoided and (ii) hunting animals and gathering of indigenous roots/berries or other edible plant material while undertaking the project should be prohibited. An effective liaison with the Kenya Wildlife Service field staff will be established, and will involve KWS personnel in the areas within the jurisdiction of the institution, but can be extended outside this scope. The Seismic QC Representative will be in charge this. All workers will be regularly briefed on this issue.

8.9.8 Archaeological, Historical and Cultural Sites

The impact sources from the project operations will include: vibroseis and associated equipment, vehicles and dynamite shots.

Potential Impacts	Mitigation
▪ Compaction by heavy vehicles and machinery may damage fossils/artifacts buried in shallow soils ▪ Vibrations and drilling of shot holes may disturb/break up near-surface archaeological materials	▪ Consultations with the National Museums of Kenya (NMK) should take place in the design and execution of the seismic survey in archaeologically important areas; ▪ Close liaison should be maintened with stakeholders such as the Turkana Basin Institute (TBI) as they are custodians of some of the archaeological sites within the project area (section 4.3.15). Lines should be relocated if necessary after consultation with stakeholders; ▪ Use of shot points rather than vibroseis is recommended for such areas; ▪ Seismic survey lines will not be planned to go through known archaeological and cultural sites (section 4.4.4); ▪ Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites during the survey in order to prevent conflict with the community; ▪ Access routes and cut lines will be selected to provide sufficient offset to known archaeological sites to avoid surface disturbance: these offsets shall be determined in consultation with NMK and TBI archaeologists; ▪ All cultural and archaeological sites will be flagged for avoidance (sections 4.3.2; 4.4.4); ▪ Permitted archaeologists will monitor project operations in archaeological sites, and if archaeological materials are found during the operations, they will advise on how to proceed; ▪ All project field workers must be informed, before commencement of operations, that any disturbance to, defacement of, or removal of archaeological, historical, or sacred material will not be permitted. ▪ Any archaeological finds to be noted and reported to the TBI.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Negligible interference, if any, with the archaeological, historical and cultural sites ▪ Desired Outcomes for Soils (section 8.9.2) apply	▪ No violations of buffer zone restrictions ▪ The sites are flagged for avoidance ▪ Archaeologist from NMK on site with the field team when carrying out work in archaeological areas, starting from the line survey phase. ▪ Objective indicators for section 8.9.2 are met	▪ Buffer zones are adhered to ▪ Flagging is done and cleared once the work is completed ▪ Archaeological sites are not interfered with

Responsibility and Management:

The Seismic QC Representative shall liaise with a qualified archaeologist in the identification and flagging of archaeologically sensitive areas, and with community leaders on identification and flagging of culturally sensitive sites. Such persons with good knowledge of the sites may need to accompany the seismic team to identify the various sites. The Seismic QC Representative shall be responsible for ensuring that such sites are not disturbed, and that all the workers are aware of the locations of the site. If archaeological artifacts or features are discovered during the line surveys, then they shall be left undisturbed, and the relevant authorities notified to provide further guidance on the matter. An internal awareness education and training programme will be conducted to provide personnel and contractors with knowledge and an understanding of the importance of archaeological and cultural resources.

8.9.9 Visual Aesthetics

The impact sources from the project operations will include campsite design and cut lines.

Potential Impacts	Mitigation
▪ Poor campsite design does not blend in with the environment ▪ Cut line footprints and vegetation cover removal lower aesthetic value of landscape	▪ Use of modern line cutting technology, preferably *mulchers* for clearing of the geophysical survey transects will ensure that minimal vegetation is removed, hence ensuring that re-vegetation will occur in a much shorter period since the rootstock, and seeds will be left along the traverses and this will promote faster re-growth (section 4.4.6); ▪ Campsite design should take into consideration the aesthetics of the selected area.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Campsite blends well with environment ▪ Visual aesthetics maintained by minimising cut line footprints and vegetation removal	▪ Camp design is aesthetic and good housekeeping practices are maintained ▪ Residual impacts of cut lines minimized in extent (sections 8.9.1, 8.9.2 and 8.9.6 apply)	▪ Camp constructed according to design ▪ Physiography and Geology, Soils and Vegetation sections apply (sections 8.9.1, 8.9.2 and 8.9.6)

Responsibility and Management:

Maintenance of visual aesthetics will be the responsibility of the Seismic QC Representative The OHS policy regarding use of PPE should be adhered to, to ensure safety of workers.

8.9.10 Noise and Vibrations

The impact sources from the project operations will include: vibroseis and associated equipment, dynamite charges, and associated equipment and vehicles traversing the area.

Potential Impacts	Mitigation
▪ Disturbance to humans, animals and livestock ▪ Disturbance to workers ▪ Health risks	▪ To reduce the expected transient impacts on wildlife, noise levels will need to be minimized to the extent possible, correct strength of dynamite charging and vibroseis use applied to achieve the survey objectives, and human contact with wildlife should also be minimized in line with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution (Control) Regulations, and the Wildlife Conservation and Management Act; ▪ All seismic operations should be carried out only during daylight hours; ▪ Ensure that vibroseis and other vehicles have working silencers to muffle noise; ▪ Provide full personal protective gear to workers as appropriate (e.g. helmets and ear muffs/plugs) and as specified in the Occupational Safety and Health Act; ▪ Workers should be sensitized on hazards likely to be encountered in such a work environment, and trained accordingly; ▪ Buffer zones distances between receptors and seismic sources/vehicles will be established through extensive in-field ground vibration and noise testing. Distances may vary between seismic source types, as per IAGC Guidelines. Liaison will be maintained with the relevant Kenyan government authority in deciding these distances; ▪ Engage local leaders in sensitising the communities in the vicinity of the seismic operation areas about the project and its possible noise and vibration impacts; ▪ The communities should be informed in advance when a seismic survey operation is to be executed along a given seismic transect/location; ▪ Use generators with minimal noise production at camp sites and effect a noise mitigation policy for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Ambient noise and vibration levels maintained	▪ Seismic data acquisition design plans optimised for reduction of noise and vibrations from vibroseis and dynamite charges ▪ Equipment installed to monitor noise (e.g. dosimeter) ▪ Regularly serviced and efficient vehicle engines ▪ "Quiet" machinery e.g. generators, purchased	▪ Review of design parameters, as needed ▪ Monitor ground and noise vibration during parameter testing phase ▪ Monitor installed equipment ▪ Servicing work and schedules ▪ Requirement embedded in tendering of equipment documents, inspect as needed

Responsibility and Management:

The TKBV EHS Representative will be responsible for ensuring the monitoring and mitigation of noise and vibrations. During camp construction, noisy activities should be undertaken during normal working hours. The OHS policy regarding use of PPE should be adhered to by the workers. Trucking operations should be avoided at night.

8.9.11 Solid and Liquid Wastes

The impact sources from the project operations will include: campsite and workplaces in the field.

Potential Impacts	Mitigation
▪ Pollution of surface soils, water and groundwater ▪ Offensive odours ▪ Health risks	▪ Waste materials (at the camp and in the field working areas) should be segregated into non-hazardous and hazardous waste, and consideration given to re-use, recycling, or disposal (section 4.4.1) as appropriate; ▪ A waste management plan documenting the waste strategy, storage (including facilities and locations), handling procedures and means of disposal should be developed and should include a clear waste-tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location in compliance with the Environmental Management and Coordination (Waste Management) Regulations; ▪ Hygienic sanitation and disposal of grey and blackwater will be covered in the waste management plan in order to protect the general health of the workers and the general public; ▪ Ensure that solid waste is removed from site for recycling/disposal only by an authorised waste handler, ideally a handler licensed under the Waste Management Regulation, 2006; ▪ Fuel and other non-aqueous liquid storage areas should be bunded; ▪ Servicing of equipment should be carried out in a designated garage area which has regularly maintained oil drainage traps and readily available spill kits. Workers in this area will be regularly briefed on spill prevention.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No pollution of surface soils, water and groundwater ▪ No offensive odours ▪ No health risks	▪ No leakages of oils, chemicals or sewage and other domestic effluents reported ▪ Sanitary systems are working and no breakdowns reported ▪ Hazardous wastes (e.g. medical and chemical wastes) are properly disposed of ▪ Appropriate use of personal protective equipment when and where mandatory	▪ Storage rooms are secure and accessed only by authorised personnel, daily ▪ Work areas are secure and accessed only by authorised personnel, daily ▪ Material storage containers checked for leaks daily ▪ Daily visual checks on sanitary systems ▪ Adherence to OHS policy and use of PPEs

Responsibility and Management:

Seismic QC representative will be responsible for management of solid and liquid waste at the camp sites and field working areas. Systems for treating solid and liquid wastes generated in

the course of rolling out the project should be properly selected, installed, managed and decommissioned according to national legislation, regulations, and international best practices in order to minimise or eliminate their potential environmental impacts. A Hazardous Materials Management Plan (HMMP) will be developed for the project (see section 8.11.3) Safety of the workers and the surrounding communities will be taken into account for all stages of materials handling during all project phases. The EHS officer shall consult with the local authorities in Lodwar to determine where and how the different types of wastes that will be generated during the project can be disposed of.

8.9.12 Social Characteristics

The impact sources from the project operations will include; workforce influx and activities along the seismic survey lines.

Potential Impacts	Mitigation
▪ Possible increase in crime rate and prostitution ▪ Possible increase in school drop-out by individuals searching for jobs ▪ Erosion of culture and social values as a result of intermingling with workers ▪ May interfere with grazing lands and watering points	▪ Employ Community Liaison Officers to keep communities informed prior to project mobilisation and on an ongoing, continual basis to ensure sensitization of the community and stakeholders *vis a vis* the project objectives, activities and scheduling, potential impacts; ▪ The communities should be informed well in advance of the start of the seismic survey operation and prior to execution along a specific seismic transect/location using appropriate wide-penetration communication media; ▪ Awareness campaigns can be undertaken to inform/educate both the local communities and project employees; ▪ During the seismic operations, disruption of livelihood activities in the area (section 4.3.6) should be avoided where possible, otherwise minimized. ▪ Provision to be made to compensate local property and landowners for any loss or damage caused by seismic operations. Compensation rates to be agreed with Government dept before operations commence.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Decrease in crime rates and no school drop-outs ▪ Preservation of cultural and social values ▪ Protection of grazing lands and watering points	▪ No violations of Tullow CSR policy ▪ No complaints from the locals on cultural or social values concerns relating to the workers ▪ Relates to Soils (8.9.2) and Surface and Groundwater Resources (8.9.4) sections	▪ Awareness of Tullow CSR policies by workforce ▪ Grievance mechanism in place and implemented ▪ Related monitoring aspects are being undertaken

Responsibility and Management:

The TKBV Community Liaison Team should ensure community involvement in establishment of recruitment and tender committees to check on recruitment procedures, gender balance and potential conflict areas. One officer should be selected to coordinate the implementation of the grievance mechanism.

8.9.13 Economic Characteristics

The impact sources from the project operations will include: employment opportunities, tenders, and supplies.

Potential Impacts	Mitigation
▪ Improved livelihood ▪ Improved short-term business opportunities for the locals ▪ CSR project benefits	▪ Liaise with local community leaders during the recruitment process; ▪ Employment policies to be strategically managed to avoid inter-community conflict and similar problems caused by migrant labourers; ▪ Unskilled and semi-skilled manpower to be sourced locally as far as possible; ▪ Gender should be factored into the employment criteria; ▪ Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Improved economy and living standards	▪ Number of locals recruited ▪ Number and type of CSR projects that TKBV commits to ▪ Establishment of recruitment and tender committees	▪ As needed

Responsibility and Management:

The TKBV Community Liaison Team should ensure community involvement in establishment of recruitment and tender committees to check on recruitment procedures, gender balance and potential conflict areas. One officer should be selected to coordinate the implementation of the grievance mechanism, which would be set up and managed by TKBV. TKBV would also determine fair levels of compensation (if the need arises) in consultation with relevant Government agencies (e.g. Ministry of Energy, KWS, and Ministry of Fisheries).

8.9.14 Occupational Health and Safety

The impact sources from the project operations will include the campsite and fieldwork environments.

Potential Impacts	Mitigation
▪ Injuries to workers, visitors and area residents arising from project operations ▪ Fire hazard ▪ Other health risks	▪ All operations will be conducted in compliance with Tullow's EHS policy, international best practices and Kenya Government requirements (as set out in the Occupational Health and Safety Act and the Public Health Act; see also section 4.2.5 of this report); ▪ Appropriate and well-stocked first aid kits and fire fighting equipment should be available to all crew, and specific crew members should be trained on first aid administration and handling of fire fighting equipment (section 4.3.9); ▪ Job-specific personal protective equipment to be provided to the workers, training should be given, and their use made mandatory in designated areas (section 4.3.9); ▪ Environmental safety and health regulations and policies/plans must be adhered to (see sections 4.2.5 (Health Policy), 4.3.7 (Energy Act), 4.3.8 (Public Health Act), 4.3.12 (Local Government Act), 4.3.13 (Physical Planning Act), and 4.4 – NEMA Regulations); ▪ A Base Camp Clinic is to be provided, manned by suitably qualified field medical staff, liscensed as appropriate to operate in-country, equipped with equipment and medication as appropriate, including ambulance vehicle(s); ▪ Adequate warning or cautionary signage will be posted as required; ▪ All electrical equipment shall be properly installed earthed and regularly inspected and where practicable will comply with IEE 17th edition regulations; ▪ Only properly trained and authorised employees shall operate equipment or machinery; ▪ Tullow driving policy and all other project-specific driving policies and journey management plans to be strictly adhered to and enforced.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Prevent workers and/or visitors from possible injuries/harm and health-related risks	▪ 100% use of personal protective equipment (PPE) when and where required ▪ Caution signage placed visibly in required places ▪ Training and drills on health and safety issues in the workplace, including fire-fighting	▪ Continuous monitoring and recording of incidences under each work component section

Responsibility and Management:

The TKBV EHS Representative should ensure all the protocols relating to environmental health and safety, and occupational health and safety policies are adhered to. Frequent training programs on first aid fire-drills and other related health issues should be a prerequisite. The field team will be self-contained and will carry its own water to the work sites.

8.9.15 Security and Public Safety

The impact sources from the project operations will be related to the workforce security needs.

Potential Impacts	Mitigation
▪ Improvement in security due to security enhancement for project activities	▪ Ensure that all workers can be identified by staff uniform and badges where applicable; ▪ Adequate security measures should be provided, e.g. perimeter fencing, safe havens and security manning at the campsites and whilst on line utilising AP's and KPR's; ▪ The company should liaise with the Provincial Administration, the Kenya Police, KWS, Kenya Police Reservists and other agencies to provide adequate security during the seismic survey operation; ▪ Barriers and guards will be installed as necessary to protect employees and visitors from physical hazards and criminal activity; ▪ Camp population will be forbidden from interacting with local populace; ▪ Journey management policy and monitoring to be enforced.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No security-related incidents ▪ Adequate security for the workforce	▪ Number of security-related incidents recorded	▪ Continuous monitoring and recording of incidences

Responsibility and Management:

The involvement of government agencies during the project operations may enhance long-term security initiatives from the concerned parties, hence improving the security situation in the area. Security issues should be the overall responsibility of the Country Manager.

8.10 THE ENVIRONMENTAL (AND SOCIAL) MANAGEMENT PLAN (EMP) FOR THE OFFSHORE (LAKE) SEISMIC SURVEY

The EMP for the offshore (lake) survey addresses the following components that relate to the seismic survey:

- Air Quality
- Water Quality
- Aquatic Environment (Habitats Flora and Fauna)
- Noise and Vibrations
- Solid and Liquid Wastes
- Social Characteristics
- Economic Characteristics
- Occupational Health and Safety
- Security and Public Safety

8.10.1 Air Quality

The impact sources from the project operations will include: vessels and machinery, on-board sanitary systems, poor waste storage and disposal.

Potential Impacts	Mitigation
▪ Pollution from exhaust emissions ▪ Offensive odours ▪ Health risks	▪ All vessel propulsion systems, exhaust systems, power generation equipment and incinerators shall be well and regularly maintained and operated efficiently (section 4.4.8); ▪ Minimizing vapour loss from fuel tanks, and idling of equipment when not in use; ▪ Use low-sulphur fuels where available; ▪ Project emissions will not exceed applicable air quality standards or guidelines such as the MARPOL Annex VI, Regulations for the Prevention of Air Pollution from Ships; ▪ Sanitary facilities should be kept clean and a routine established for this; ▪ Solid and liquid wastes should be properly managed in keeping with the guidelines and regulations for the specified vessel.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No pollution from exhaust emissions ▪ No offensive odours ▪ No health risks	▪ Number of equipment with low emissions ▪ Use of low sulphur versus other fuels ▪ Adherence to equipment maintenance schedule ▪ Proper waste-handling apparatus and facilities installed and procedures established prior to commencement of work ▪ No offensive odours recorded	▪ Malfunctioning equipment removed immediately from operations for repair ▪ Compliance with use of low sulphur fuel if available (fuel supply tenders) ▪ Monitor installed equipment and facilities ▪ Daily inspection of sanitary facilities and waste disposal points ▪ Regularly clean waste disposal facilities

Responsibility and Management:

The TKBV EHS Representative shall be responsible for ensuring that air quality is maintained at work and living sites, and that EHS policies regarding handling of wastes and their disposal are adhered to.

8.10.2 Water Quality

The impact sources from the project operations will include: liquid effluent discharges from the vessels, disposal of solid wastes from the vessels, oil or chemical leaks from engines, machinery and storage areas.

Potential Impacts	Mitigation
▪ Changes in water quality ▪ Low level contamination/toxicity of water and benthic habitats	▪ Engineering machinery and components (e.g. engines, pumps, streamers etc.) will be well-maintained and checked regularly for leaks; ▪ Use of bunded storage areas– spills and surface water will drain into a holding tank and treated according to MARPOL requirements; ▪ Oil spill management kits will be available on board, and emergency response training including drills will be conducted; ▪ Relevant authorities will be notified (according to the Energy Act) on detection of a spill. The location of the spill, prevailing winds, currents and sea state will be identified and recorded; ▪ All solid and liquid wastes shall be handled as outlined in section 7.5.5 below.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Water quality remains unaltered	▪ No change in water quality before and after operations	▪ Collect water for quality checks at baseline sampling stations after end of operations
▪ No contamination/toxicity of water and benthic habitats	▪ No leakage recorded from equipment and materials storage areas on the vessel ▪ No discharges to the lake ▪ No throwing of solid wastes overboard ▪ Proper liquid and solid waste/chemicals handling apparatus and facilities installed and procedures established prior to commencement of work	▪ Check equipment and material stores daily for possible leakages – daily checks ▪ Oil/chemicals storage areas are secure – daily checks ▪ Monitor proper handling, storage and disposal of all waste on daily basis ▪ Daily monitor adherence to waste-handling and disposal protocols

Responsibility and Management:

The TKBV EHS Representative shall be responsible for ensuring that water quality is maintained at work and living sites, and that EHS policies regarding handling of wastes and their disposal are adhered to.

8.10.3 Aquatic Environment (Habitats Flora, and Fauna)

The impact sources from the project operations will include: vessels movement, vessels anchoring and grounding, accidental loss of streamers and associated equipment, liquid effluent discharges from the vessels, disposal of solid wastes from the vessels, oil or chemical leaks from engines, machinery and storage areas, use of a non-sanitised vessel that has been operating in a different marine environment.

Potential Impacts	Mitigation
▪ Collision with reptiles, water turtles and fish ▪ Disturbance of aquatic animals and benthic habitats ▪ Physical interference with crocodile and bird-breeding sites ▪ Pollution of habitats ▪ Introduction of exotic aquatic species	▪ ***(Collisions/Strikes):*** 1. All seismic survey vessels will carry out visual monitoring and clearance of an exclusion zone around the array and in the immediate vicinity of the survey vessel (section 4.3.5); 2. Emphasis should be placed on proper disposal of food waste to avoid attracting birds to the vessels; 3. Surveys will be undertaken during daylight hours only. ▪ ***(Disturbance of Benthic Habitats and Breeding/Nesting Sites):*** • Due to the fact that the breeding, spawning and migration seasons of the lake and lake-related fauna (fish, invertebrates, reptiles, water birds, hippos) are all different and are spread throughout the calendar year (see Table 5.20), avoidance of operations during such seasons is impractical, but particular care will be taken at all times to avoid disturbing the fauna; • Ocean Bottom Cable hydrophone array (OBC) shall be placed on the lake bed; • The marine source will be an air-powered array; • The source array will be most likely towed at a depth of ca. 2m below water level, this will in turn restrict the array from being used in waters shallower than 2m; • A high resolution bathymetry survey is currently being undertaken by TKBV in Block 10BA. This data will ensure that the lake seismic survey will have the most up-to-date information on the lakebed. ▪ ***(Pollution):*** 1. Carry out vessel surface cleaning to remove biofouling prior to departure from areas with known or potential aquatic pests. Immersible equipment that has been used in other aquatic settings should also be cleaned (i.e. OBCs, air powered seismic sources, and accompanying cables/ropes/chains) before use in the lake (the Fisheries (General) Regulations; see also section 4.4.3); 2. Coat vessel surfaces with an effective antifouling coating; 3. Apply proper waste management on board (mitigations in section 7.5.5). ▪ ***(Invasive Species):*** 1. Carry out vessel surface cleaning to remove biofouling prior to departure from areas with known or potential aquatic pests as required under the Fisheries (General) Regulations. 2. Immersible equipment that has been used in other aquatic settings should also be cleaned (i.e. OBCs, air powered seismic sources, and accompanying cables/ropes/chains) before use in the lake as stipulated the Fisheries (General) Regulations).

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No collision with reptiles, water turtles or fish ▪ No disturbance of aquatic animals and benthic habitats ▪ No interference with breeding sites ▪ No pollution of habitats ▪ No exotic aquatic species introduced	▪ A designated expert observer is employed by the contractor ▪ Noise and vibration levels optimised (section 8.10.4) ▪ Equipment handled as indicated in mitigations above ▪ No breeding sites are interfered with ▪ Vessels and equipment are cleaned prior to commencement of operations as indicated in mitigations above	▪ Observer carries out the work ▪ Monitoring as indicated in section 8.10.4 applies ▪ Inspections during work, continuous monitoring ▪ Monitoring to ensure that such sites are avoided ▪ Inspection to certify that vessels and equipment are properly cleaned

Responsibility and Management:

The TKBV EHS Rep. shall be responsible for ensuring that the aquatic environment is not or only minimally disturbed. He/she shall be responsible for ensuring that all the mitigation measures specified above are implemented. Any incidents will be immediately reported by the EHS Representative to the Tullow Oil Seismic Operations Supervisor, the TKBV EHS Manager and the Tullow Oil Operations Manager in Nairobi.

8.10.4 Noise and Vibrations

Noise and vibration sources are airguns, vessel engines and other machinery.

Potential Impacts	Mitigation
▪ Disturbance to fish, reptiles, turtles and zoobenthos ▪ Disturbance to water birds ▪ Changes to behavioural ecology of species (feeding, breeding, migration patterns). Species would include marine flora and fauna (including water birds). ▪ Physical damage to aquatic flora and fauna	▪ Avoid unnecessary acoustic energy (noise) generation through source, array, and receiver design optimization (section 4.4.7) ; ▪ To minimize vessel noise, use modern seismic survey vessels and associated equipment, ensure that all equipment including machinery are working well and are regularly serviced and maintained, and machinery that is not in use should not be left idling; ▪ A sequential build-up of warning pulses (soft start) should be made to deter and warn aquatic fauna immediately before commencement of seismic activity; ▪ Due to the fact that the breeding, spawning and migration seasons of the lake and lake-related fauna (fish, invertebrates, reptiles, water birds, hippos) are all different and are spread throughout the calendar year (see Table 5.20), avoidance of operations during such seasons is impractical, but particular care will be taken at all times to avoid disturbing the fauna; ▪ EHS observers will attend on the seismic source boat to observe and report any unusual wildlife activity during acquisition. ▪ Vulnerable ecological communities to be identified through close liaison with KWS, and appropriate mitigations agreed.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No disturbance to fish, reptiles, turtles and zoobenthos ▪ No changes to behavioural ecology of aquatic species ▪ No physical damage to aquatic flora and fauna ▪ No disturbance to water birds	▪ Seismic data acquisition design plans optimised for reduction of noise and vibrations from air guns ▪ Towed equipment does not drag on the lake-bed ▪ Regularly serviced vessels/equipment ▪ “Quiet” machinery/ equipment, purchased	▪ Review of design parameters, as needed ▪ Monitor performance of installed equipment, continuous during work ▪ Requirement embedded in tendering of equipment documents, inspect as needed

Responsibility and Management:

The EHS Representative will be responsible for ensuring the mitigation of noise and vibrations. The EHS Representative shall also ensure that occupational health and safety protocols are strictly implemented on board the vessels. Any incidents involving the seismic operation and the natural environment will be recorded and reported.

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8.10.5 Solid and Liquid Wastes

The impact sources from the project operations will include: liquid effluent discharges and disposal of solid wastes from the vessels; and oil or chemical leaks from engines, machinery and storage areas on the vessels.

Potential Impacts	Mitigation
▪ Pollution affecting aquatic flora, fauna, water and sediment quality	▪ No sewage discharge will be undertaken in the lake (sections 4.3.7, 4.4.5, 4.4.6, 4.4.9); ▪ All wastes generated will be managed (i.e., appropriately stored, handled and disposed of) in accordance with MARPOL 73/78. Under no circumstances will solid and hazardous wastes be disposed of in the lake. The wastes will be returned to shore and will be stored, labelled and disposed of in accordance with local authorities legislation (no hazardous waste will be disposed of to a facility that is not fully equipped to receive, store, treat and dispose the waste, and local authorities will be notified as to the type and quantity of waste to be disposed); ▪ The proponent must adhere to the: Water Act 2002; EMCA, 1999; Environmental Management and Coordination (Waste Management) Regulations, 2006; the Fisheries (General) Regulations and the industry best practices; ▪ Machinery spaces will be equipped with drip trays, curbs and gutters, and other devices to prevent spilled or leaked materials from entering the water. Such wastes will be collected in a closed system designed for that purpose and transferred onshore for disposal. ▪ Waste materials and equipment lost overboard will be recorded and recovered (where possible); ▪ Accurate and detailed waste manifests and safe disposal records shall be maintained.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No pollution occurs	▪ No leakages and discharge into the lake of oils, chemicals or sewage and any other effluents reported ▪ Sanitary systems are working and no breakdowns reported ▪ Hazardous wastes (e.g. medical, oils and chemical wastes) are properly handled and disposed of ▪ Appropriate use of personal protective equipment when handling wastes	▪ Equipment and facilities are checked daily ▪ Wastes are stored properly and disposed of on land at approved facilities ▪ Material storage containers checked for leaks daily ▪ Daily checks on sanitary systems ▪ Adherence to OHS policy and use of PPEs

Responsibility and Management:

The EHS officer will be responsible for solid and liquid waste management. On-board systems for treating solid and liquid wastes generated in the course of rolling out the project should be properly selected, installed, and managed according to national legislation, regulations, and international best practices in order to minimise or eliminate their potential environmental impacts.

8.10.6 Social Characteristics

The impact sources from the project operations will include the physical presence of vessels and the associated equipment, as well as the presence of the workforce.

Potential Impacts	Mitigation
▪ Interference with other water users in the area because of exclusion zones ▪ Risk of accidents with other water users ▪ Breaking or entanglement with fishing nets	▪ The local authorities will be advised of the planned survey including details of participating vessels, survey schedule and locations; ▪ TKBV CLOs will sensitise local fishing communities about the proposed activities and ensure that their concerns are addressed; ▪ A notice will be issued through the local administration informing fishermen of the proposed seismic survey activities; ▪ The scout and guard vessels will clear the area of fishing boats and their equipment, and prevent fishing vessels from crossing the seismic array; and ▪ A radar reflector and flashing lights will be provided on the streamer tail buoy.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Minimal interference with other water users ▪ No accidents with other water users ▪ No damage to properties of lake users, e.g. fishing nets	▪ No complaints from the locals on interference with their activities ▪ No accidents recorded ▪ No damage to properties recorded	▪ Monitoring of the mitigations outlined above ▪ Awareness of Tullow CSR policies by workforce ▪ Grievance mechanism in place and implemented

Responsibility and Management:

The TKBV Community Liaison Officers will be responsible for handling social issues and , grievance issues.

8.10.7 Economic Characteristics

The impact sources from the project operations relate to the physical presence of vessels and TKBV's operations in the area.

Potential Impacts	Mitigation
▪ Interference with shipping, boating and fishing in the area, diminishing economic returns ▪ Employment opportunities for locals ▪ Improvement of businesses and living standards ▪ CSR project benefits	▪ A support vessel will conduct reconnaissance scouting ahead of the survey vessel; ▪ Regular communication with fishing groups and provision of coordinates of survey area to fishermen will minimize potential impacts to commercial fishing activity; ▪ Seismic operations should be scheduled during least sensitive period for instance during low fishing season (September to November) (section 4.3.6); ▪ Liaise with local community leaders during the recruitment process; ▪ Unskilled and semi-skilled manpower to be sourced locally; ▪ Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan; ▪ Where damage occurs, for example, to fishing nets, or when project operations may lead to exclusion of fishing in a particular area, then compensation can be made for those income losses.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ Minimal interference with shipping, boating and fishing activities in the lake ▪ Improved economy and living standards due to employment opportunities and CSR benefits arising from implementation of the project	▪ No interference recorded ▪ Number of locals recruited ▪ Number and type of CSR projects that TKBV commits to ▪ Establishment of recruitment and tender committees	▪ Daily ▪ As needed

Responsibility and Management:

The project manager will be responsible for recruitment issues, taking into account the balance of geographical location (within the project area) and gender balance. Grievances can be handled by an officer to whom the task shall be assigned.

8.10.8 Occupational Health and Safety

Occupational health and safety issues will need to be considered in all work and living environments.

Potential Impacts	Mitigation
▪ Potential vessel to vessel accidents ▪ Personal injury ▪ Fire hazard	▪ Monitoring of wind speeds should be undertaken, and the marine-based seismic surveys should be called off should the winds and waves thereby generated begin to reach a pre-determined and established critical threshold that may put the life of the boat crews in danger; ▪ Watch will be maintained on the survey vessel for other craft (sections 4.3.5, 4.3.9). ▪ The scout and guard vessels shall be used to caution other boats, to protect deployed equipment, and to assist/support the seismic survey vessel during abnormal or emergency situations; ▪ All deployed equipment will be made highly visible to minimise accidents and to facilitate retrieval in case of loss; ▪ Survey operations shall be suspended in adverse weather conditions; ▪ The survey vessel will carry operational, navigation, bathymetry tracking, and warning lights. ▪ The OBC hydrophone cables will be tracked via GPS to monitor their location (assisting retrieval if one or more become severed). ▪ Well-stocked first aid kits and fire fighting equipment should be available to all crew, and selected crew members should be trained on first aid administration and handling of fire-fighting equipment as provided in the Occupational Health and Safety and Health Act. ▪ Appropriate personal protective equipment (e.g. Personal Flotation Devices (PFDs)) and fire-fighting apparatus shall be maintained and be easily accessible on the vessels. The crew shall be competent in the use of fire fighting equipment and well-drilled on emergency response procedures as required by the Occupational Health and Safety and Health Act; ▪ Provisions of environmental health and safety plan (EHS) will be adhered to by all. ▪ Adequate warning or caution signage, including ‘no smoking’ signs, will be posted as required; ▪ Only properly trained and authorised employees shall operate equipment or machinery.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No accidents, injuries, fires or other occupational and health related risks occurring	▪ 100% use of personal protective equipment (PPE) when and where required ▪ Caution signage placed visibly in required places ▪ Training and drills on health and safety issues in the workplace, including fire-fighting ▪ Qualified, certified and trained personnel man the vessels and equipment	▪ Continuous monitoring and recording of incidences under each work component section

Responsibility and Management:

The TKBV EHS Representative should ensure all the Tullow Oil protocols relating to environmental health and safety, and occupational health and safety policies are adhered to. Frequent safety audits, training programs on first aid, fire-drills and other related health issues should be conducted.

8.10.9 Security and Public Safety

The impact sources from the project operations will be related to the workforce security needs.

Potential Impacts	Mitigation
▪ Improvement in security due to security enhancement for project activities	▪ The company should liaise with the Provincial Administration, the Kenya Police, KWS, Kenya Police Reservists and other agencies to provide adequate security during the seismic survey operation. ▪ Ensure that all workers have staff uniform and badges; ▪ Adequate security measures should be provided, like perimeter fencing safe havens and security manning at the campsites and while en route to and from lake side; ▪ The proponent should ensure that their drivers adhere to speed limits both for boats and vehicles. ▪ Barriers and guards will be installed as necessary to protect employees and visitors from physical hazards and criminal activity. ▪ Camp population will be forbidden from interacting with local populace. ▪ Journey management policy and monitoring to be enforced as per Tullow Oil's Driving Policy.

Desired Outcomes, Objective Indicators and Monitoring		
Desired Outcomes	**Objective Indicators**	**Monitoring**
▪ No security-related incidents ▪ Adequate security for the workforce	▪ Number of security-related incidents recorded	▪ Continuous monitoring and recording of incidences

Responsibility and Management:

The involvement of government agencies during the project operations may enhance long term security initiatives from the concerned parties, hence improving the security situation in the area. Security issues should be the overall responsibility of the Country Manager.

8.11 OTHER GENERAL REQUIREMENTS AND TRAINING ISSUES

8.11.1 Occupational Health and Safety Plan

TKBV will develop an Occupational Health and Safety Plan (OHSP), based on Tullow's EHS and CSR policies, prior to commencement of the project operations. The OHSP will uphold TKBV's commitment to a safe environment for employees, contractors and visitors. The plan will also address all applicable legal requirements relating to health and safety. The OHSP will set out the framework under which health and safety on the project site, and to and from the site, will be managed. The roles and responsibilities of the company, manager, supervisors and workers will be set out under this plan.

A health and safety training programme will also be implemented at the site. The objectives of this training programme will be to:

- provide appropriate orientation and support to all employees, contractors and visitors on site so that they can act in an appropriately safe manner;
- provide ongoing training to workers;
- Inform at-risk workers to help attain a positive and safe work environment.

8.11.2 Vehicle Traffic Plan

The following guidelines will apply to vehicular traffic:

- Tullow Oil Driving Policy
- All drivers will be properly licensed and trained according to specific vehicle type and operating conditions;
- Vehicle use will be determined by local ground conditions and access requirements;
- All local traffic laws and speed limits will be obeyed;
- Traffic on the rights-of-way will follow the posted speed limits, which might vary depending on site-specific conditions;
- All vehicular traffic will be confined to approved rights-of-way, workspace and access roads or trails; and
- Site-specific features of concern (e.g., archaeological sites, sensitive wildlife habitat) will be flagged, or otherwise designated, so that subsequent traffic can avoid these areas.

8.11.3 Hazardous Materials Management Plan

A Hazardous Materials Management Plan (HMMP) will be developed for the project that will identify potentially hazardous materials to be used and provide a system for monitoring them. Transportation, storage, use and ultimate disposal will be considered. Safety of the workers and the surrounding communities will be taken into account for all stages of materials handling during all project phases. The Camp Boss, with direction from the crew Party Chief, shall consult with the local authorities in Lodwar to determine where and how the different types of wastes that will be generated during the project can be disposed of.

Hazardous materials and wastes require special handling and training procedures. All employees will be provided with basic training so that, at a minimum, they can: identify hazardous materials; know how to obtain appropriate information on special handling procedures required; know what precautions and protective equipment are required; know how to label and package hazardous materials and wastes; know where and how hazardous wastes

are to be stored; and know how wastes are to be disposed of. Employees who are tasked with receiving, off-loading and storing potentially hazardous materials or involved in the storage and shipment off-site of hazardous wastes should receive hazardous materials handling training.

8.11.4 Spills Prevention and Response Plan

Before construction of the project commences, a Spill Prevention and Response Plan (SPRP) will be developed for use by TKBV and contracted personnel in the event of a deleterious material spill. The objective of the spill response measures will be to ensure that where accidental spills occur, all available resources are used appropriately to minimize the extent and severity of effect on the environment. All spills occurring on the project site will be responded to in a way that will uphold the following priorities: protection of human life and health; protection of the environment; protection of property; and minimized disruption to operational activities. At all times, applicable regulations will be used to guide response and cleanup activities.

At locations where the potential for spillage of hazardous material is highest, such as at fuelling points, spill control and containment means will be incorporated into the infrastructure during construction. The storage of materials will be tied in with the HMMP.

Spill response kits appropriate to the types and volumes of materials that will be used during the project operations will be specified, including the types of equipment that will handle or transport contaminant materials (including fuel). Spill response kits will be located at appropriate material handling and storage locations. The contents of the kits will be based on the potential risk associated with the material, volume of material, and environmental sensitivity of the area. General kit contents could include: oil absorbent pas; absorbent socks; granular absorbents; and protective equipment such as gloves, goggles and protective suits. All kits will be stored in a visible location, and in appropriate weather-resistant containers. Regular inspections of the kits will be performed to ensure that kits are complete and all materials remain functional.

All TKBV employees and contractors will undergo, as part of their orientation to the site, a training programme on spill-prevention and hazard-identification, as well as spill-response, containment and reporting procedures. Other aspects of the training will include education on the:

- SPRP
- Applicable legislation
- Potentially affected environmental receptors (e.g. soil, surface and groundwater)
- Field application of appropriate spill-response techniques.

8.11.5 Emergency Response Plan

A more general plan that will deal with emergencies such as those related to accidents and personal injury, medical evacuations, fires, and escalating insecurity shall be put in place before the commencement of project operations. Issues to be addressed would include the capacity for response and management, and the support agencies that can be called in to assist (e.g. Kenya Police, Hospital staff, KWS, etc).

8.11.6 Environmental Awareness Plan

On appointment, all contracting companies and employees will receive a copy of the EMP and will be trained in the relevant categories of the EMP that are outlined in sections 8.9 and 8.10 above. In addition, a detailed environmental awareness plan will be developed prior to commencement of the seismic survey activities. The plan will address the following items:

- Basic workforce environmental awareness;
- Sensitivity of the site
- Personnel environmental training needs; and
- Resources available for use in personnel environmental awareness training

Ongoing monitoring and auditing will also assist in continually improving the environmental awareness of the project team. TKBV will also target the community leaders and government administrators for awareness-building on the project components. These leaders and administrators would, thereafter, be able to explain the project components, the environmental issues, and mitigation measures that are being undertaken, to the community at large.

8.12 COST OF THE EMP AND TIMEFRAME FOR THE ACTIVITY

It is estimated that the entire project will cost USD 16.9 million (equivalent of Ksh. 1,436,500,000). The costs of implementing the EMP will largely be borne through salaried employees who will be tasked to carry out the various EMP monitoring and evaluation activities, therefore the EMP will not incur significant additional costs, over and above those already budgeted for in the project. The project is expected to begin in August/September 2011, and will run for a period of up to six months.

CHAPTER 9:

CONCLUSIONS AND RECOMMENDATIONS

9.1 SUMMARY OF THE PROJECT COMPONENTS

Tullow Oil is an International Oil and Gas exploration company with interests in many parts of the African continent including Kenya, Uganda and Ghana. A Production Sharing Contract (PSC) was signed with the Government of Kenya on 17th September 2008 and an Exclusive Prospecting Right (EPR) for Block 10BA was obtained. The block partnership now intends to undertake an onshore and offshore seismic survey for the purpose of evaluating the hydrocarbon prospects safely and without adversely impacting on the environment, in order to determine the hydrocarbon potential of the designated prospect area.

The proposed seismic survey will use environmentally friendly state-of-the-art technology that is suitable for the terrain, and will comply with the Environmental Management Plan detailed herein, as well as all relevant national legislative requirements and industry international best practices. There are possible impacts from the proposed seismic operation that have been identified: mitigation measures have been provided and must be implemented to protect the biophysical and socio-economic environments.

The community members and leaders who attended the various public meetings and participated in the questionnaire survey welcomed the proposed project, but appealed for adherence to environmental safeguards and labour legislation. TKBV is committed to continually engaging all local stakeholders throughout the duration of the project, as well as to being sensitive to local culture and customs, and would want to be seen as a valued part of the communities in the areas where they will carry out the work. The mitigation measures that have been put forward in this report, and the environment management plan that has been developed, will ensure that the project is technically, environmentally, economically and socially sound and acceptable.

9.2 RECOMMENDATIONS

From an environmental point of view, it can be concluded that the project is viable and will not adversely affect the environment if the EMP outlined in this document is strictly adhered to. Some of the key recommendations are summarized here below:

- Limit the energy generated by vibroseis, dynamite charging and airguns to the minimum level required to achieve the survey objectives;
- In highly eroded and gullied areas, explosives (dynamite) should be used instead of vibroseis;
- In the lake, the airgun should be discharged at a minimum distance of 2m from the lake bottom;
- Trees that have a greater trunk diameter than 20cm should be avoided or circumnavigated, and minimise vegetation and grassland clearance as much as practicable;
- Existing routes should be used as much as is practical to access survey areas;

- Limit traffic speeds and restrict movement of vehicles as is reasonable to minimize dust generation, and ensure that all equipment is regularly serviced and well maintained to reduce pollution from exhaust emissions;
- Employees should be provided with and use appropriate personal protective equipment at all times;
- The company should consider drilling its own water supply borehole for the camp to avoid water resource conflicts with the communities;
- Seismic survey activities to be undertaken during daylight hours only;
- Involve the KWS, the Fisheries Department, Beach Management Units, and other stakeholders, in order to ensure that terrestrial and aquatic fauna and flora are not unduly disturbed, and that any risks posed by wildlife to the seismic team is eliminated;
- Work closely with the National Musuems of Kenya and the Turkana Basin Institute, and the local communities, to ensure that archaeological and cultural sites are not disturbed;
- Consultations with the local people on matters that may concern them is encouraged;
- Provisions should be made for mechanical sanitary systems at the campsites;
- All waste material from field operations should be brought back to the base camp for proper disposal;
- The exploration team should work closely with the local elders to help them in identifying any sensitive sites in order to prevent conflict with the community;
- The proponent should involve the local community in every stage of the project execution;
- Adequate security measures (Kenya Police/Administration Police) should be put in place by the proponent, and the local Kenya Police reservists should also be considered; and
- Unskilled labour force is to be sourced locally and in consultations with the various resident communities.

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APPENDICES:

APPENDIX 1: PROVISIONAL 2011 SEISMIC PROGRAMME LINE COORDINATES

PROVISIONAL 2011 SEISMIC PROGRAM BLOCK 10BA - SUBJECT TO REVISION (NB: Coordinates are in TTM, not UTM)				
Line Name	X	Y	Type	Line Length
KE10BA-11-01	748283	337140	onshore	31.1
KE10BA-11-01	775702	351732	onshore	
KE10BA-11-02	751953	368102	onshore	45.4
KE10BA-11-02	776973	330167	onshore	
KE10BA-11-03	810995	327754	onshore	41.5
KE10BA-11-03	850353	340949	onshore	
KE10BA-11-04	774686	323817	onshore	47.2
KE10BA-11-04	819250	339298	onshore	
KE10BA-11-05	749934	324833	onshore	77.1
KE10BA-11-05	823187	348938	onshore	
KE10BA-11-06	793215	357942	onshore	38.7
KE10BA-11-06	824953	357307	onshore	
KE10BA-11-07	789405	372534	onshore	33.1
KE10BA-11-07	817726	328897	onshore	
KE10BA-11-08	816456	362006	onshore	17.8
KE10BA-11-08	830922	367721	onshore	
KE10BA-11-09	813408	371010	onshore	13.2
KE10BA-11-09	825461	376344	onshore	
KE10BA-11-10	811376	379265	onshore	16.5
KE10BA-11-10	826858	384968	onshore	
KE10BA-11-11a	823810	356685	onshore	41.5
KE10BA-11-11a	811552.3	396351	onshore	
KE10BA-11-11b	812527	389308	onshore	64.8
KE10BA-11-11b	812384.5	454064	onshore	
KE10BA-11-11c	808909	442786	onshore	37.3
KE10BA-11-11c	823932	476884	onshore	
KE10BA-11-11d	820943	466215	onshore	45.7
KE10BA-11-11d	818742	511841	onshore	
KE10BA-11-12	807566	506012	onshore	19.3
KE10BA-11-12	826858	506012	onshore	
KE10BA-11-13	814678	486466	offshore	60.6

KE10BA-11-13	875232	486466	offshore	
KE10BA-11-14	813662	472395	offshore	61.8
KE10BA-11-14	875486	472395	offshore	
KE10BA-11-15	813789	459707	offshore	74.5
KE10BA-11-15	888313	459580	offshore	
KE10BA-11-16	807947	444226	offshore	135.5
KE10BA-11-16	885392	555353	offshore	
KE10BA-11-17	806296	430269	offshore	78.6
KE10BA-11-17	884884	430269	offshore	
KE10BA-11-18	811503	412882	offshore	72.2
KE10BA-11-18	883741	412628	offshore	
KE10BA-11-19	809344	392842	offshore	58.8
KE10BA-11-19	868120	392969	offshore	
KE10BA-11-20	829525	499154	offshore	109.4
KE10BA-11-20	825842	485958	offshore	
KE10BA-11-20	826223	390302	offshore	
KE10BA-11-21	835240	494467	offshore	131.0
KE10BA-11-21	842225	363657	offshore	
KE10BA-11-22	845781	491800	offshore	100.9
KE10BA-11-22	853782	391191	offshore	
KE10BA-11-23	862151	491419	offshore	79.7
KE10BA-11-23	867104	411866	offshore	

TOTAL 10BA PROGRAM
2011 **Kilometres** **1533.1**

APPENDIX 2: PUBLIC CONSULTATIONS – MINUTES OF MEETINGS

MEETING HELD AT THE BARAZA GROUND IN KALOKOL LOCATION, KALOKOL DIVISION IN TURKANA CENTRAL DISTRICT ON MONDAY 7TH MARCH, 2011

Attendance:

1. Mr. Daniel Namojong - Assistant Chief, Kalokol Sub-location
2. Mr. Phillip Lochok - Former councillor, Kalokol Ward
3. Community elders and members
4. The EIA team

The meeting commenced with a prayer at 10:05 a.m with an assurance that the area security is good. The Assistant Chief, Kalokol location, Mr. Daniel Namojong welcomed and thanked the members present. Introduction of the EIA team was done and was shortly followed by a brief explanation of how seismic survey will be conducted in the area by Tullow Oil Kenya B.V. Some of the socio-economic benefits of the proposed project were highlighted, like employment and many more. The community raised the following views concerning the proposed project.

- They requested the proponent to employ the youth for both skilled and unskilled labour.
- They welcomed the proposed project and asked how cut lines will be made in the area.
- They want the community to be educated and awareness created before any project operations commence in the area.
- They do not anticipate for negative impacts until the operation commences in the area
- They expressed fear of displacement of community during the project operations.
- They reported that they have lost interest in proposed projects in the area because they are never implemented.
- They want the community to benefit and the proponent to support needy students by offering bursaries and academic scholarships.
- They requested the proponent to provide water to the community.
- They want labour to be sourced from Kalokol Location only and it should be equal, transparent and gender sensitive.
- They wanted to know if the affected community will be compensated and later suggested that they should be compensated.
- They asked whether the community will use water from boreholes that the proponent will drill in their camps.
- They requested the proponent to recognize and support community self-help groups like women and youth groups in Kalokol Location.
- They said that the E.I.A team took the right procedure by consulting the community.
- They want the proponent to exploit oil and build a refinery in the district.
- They said that recruitment should be done according to the people's qualifications.
- A member encouraged others to accept the proposed project because it will benefit the community.

Responses to the views raised were made by emphasizing that the community members will be responsible for identifying corporate social responsibilities that they would like the proponent to implement. They were assured that the project will not have negative impacts to the environment and the community health. The Assistant Chief made his closing remarks by encouraging the community to cooperate with the proponent during the project operations in the

area. He assured them that the views presented will be taken into consideration. Lastly, he said that the proposed project had their blessing. The meeting came to an end with a prayer at 12:05 p.m.

MEETING WITH THE CLERK, COUNTY COUNCIL OF TURKANA, HELD AT THE CLERK'S OFFICE IN LODWAR DIVISION, TURKANA CENTRAL DISTRICT, ON TUESDAY 8TH MARCH, 2011

Attendance:

1. Clerk, County Council of Turkana - Mr. Christopher Onanda
2. Tullow oil Kenya B.V Representative - Mr. David Egialan
3. E.I.A Team - .Nicholas Aketch, Evelyne Sindani and James Ndunda

The meeting started at 9:05 a.m. The clerk welcomed the E.I.A team, shortly followed by the introduction of the team. The clerk was briefed on the background of the proposed project in Blocks 13T, 10BA and 12A, which covers some areas in the larger Turkana district like Turkana Central, South, North and Loima Districts which are under the County Council of Turkana.

Mr. Nicholas explained to the clerk the E.I.A teams' mission in the districts mentioned above. He emphasized that the proposed project was in its first stage, which requires an EIA to be done for the seismic survey, and that communities' views concerning the proposed project were important for the exercise. He also informed him that the report will be prepared and submitted to NEMA, and before the proponent is given a licence to operate in the area, the County Council of Turkana comments concerning the proposed project will be required by NEMA.

The clerk reported that they have not been involved in any development project in the county. He pointed out that Africa Oil BGP operating in Loperot failed to follow the right procedure as it did not inform the County Council of Turkana on the operations they undertook. He also said that the Council was not aware of what the EIA teams were doing in the district. He added that the major issue to be addressed concerns the pastoralism lifestyle of the Turkana community.

He recommended that prior communication should be made to the County Council before any activity is undertaken by the proponents proposing development projects in the County. He said that all stakeholders must be involved in all the proposed development projects in the County, and added that the Council welcomes all development projects in the County Council of Turkana.

He later called the Councillor of Kalokol Ward, Mrs. Leah, and informed her of the activities that the E.I.A teams were undertaking in Kalokol. He informed the councillor that the teams were collecting geo-ecological data of the areas to be covered and communities' views concerning the proposed seismic survey project in Block 13T, 12A and 10BA.

Lastly, he thanked the E.I.A team for informing the councillor and the clerk on the proposed project. The meeting ended at 10:25 a.m.

MEETING HELD AT THE BARAZA GROUND IN KANG'ATOTHA LOCATION, KALOKOL DIVISION IN TURKANA CENTRAL DISTRICT, ON TUESDAY 8TH MARCH, 2011.

Attendance:

1. Chief, Kang'atotha Location -.Mr. Mackenzie Emathe
2. Councillor, Kang'atotha Ward - Mr. Joseph Akuron
3. Community elders and members

The meeting started with a prayer at 3:05 p.m. The Chief, Kang'atotha Location, welcomed all the members present. He informed the E.I.A team that the location has three sub-, namely: Eliye, Naoros and Lomopus. Introduction of the EIA team was done,followed by a brief background of the proposed project. The community members raised the following views.

- They welcomed the proposed project in the area and wanted to know the specific site where seismic survey will be conducted.
- They wanted to know what will happen if the cut lines affect their settlements, grazing lands, fish and fishing activities in Lake Turkana.
- They believe oil prospects will be found in Kang'atotha location and requested the proponent to involve the community by holding separate meetings with the youth, women, elders and the leaders.
- They expect to benefit from the project when its operation commences in the area.
- They requested the proponent not to cut mature trees during project operations.
- They suggested that elders should be educated on the proposed project activities.
- They said that they will not allow foreigners to exploit resources in the area without the community's consent.
- They expressed fear of displacement due to tpast experience in the district in the early 1980s when the company that conducted oil survey destroyed their settlements and grazing lands.
- They wanted to be enlightened on both positive and negative impacts associated with oil exploration.

Responses were made by informing them that the specific site where oil prospects will be found is not yet known and the aim of the meeting was to collect the community's opinions concerning the proposed seismic survey project. Assurance was made that mature trees will not be cut and that although shrubs might be cut in order for cut lines to be made, recommendations will be made to mitigate the anticipated negative impacts.

They were told that only a small area will be used by the project operations and that oil exploration in L. Turkana will not affect fish and fishing activities. An example of oil exploitation in L. Albert in Uganda was given. Lastly, they were assured that the views presented will be taken into consideration.

Closing remarks were made by the chief who encouraged the community to be receptive to the proposed project. In addition, he told them that a series of meetings with the community will be held before the project operations commence in the area. The meeting ended with a prayer at 5:03 p.m.

MEETING HELD WITH THE MEMBERS OF THE BEACH MANAGEMENT UNIT (BMU) AT THE BMU OFFICE IN KALOKOL DIVISION, TURKANA CENTRAL DISTRICT, ON WEDNESDAY 9TH MARCH, 2011

Attendance:

1. BMU members and EIA team members

The meeting started at 3:40 p.m. and the chairman of BMU briefed the EIA team on the objectives of the organization which generally involve the management of Lake Turkana in terms of regulation of fishing activities, waste management and many more. He informed the team that the beach is divided into three BMUs which work under the Ministry of Fisheries, and all the fishermen fishing in the zones are members of BMU.

A brief background of the proposed project and the objective of the meeting which was to collect their views were addressed. The BMU members then raised the following views concerning the proposed project.

- They said that they heavily rely on L. Turkana for fishing and other activities; they therefore anticipate that the proposed project will affect the breeding grounds of fish in L. Turkana and asked what the proponent will do in case those effects occur.
- They wanted to know if the community will benefit and requested that the BMU organization should benefit from the proposed project.
- They requested the proponent to employ the youth and to create awareness and educate BMU members on all the project's activities through holding of meetings.
- They welcome the proposed project because they believe it will enhance development.
- They said that they want the company staff to respect their girls and women.
- They expressed fear of loss of fish in the lake during seismic survey.
- They wanted to know if the locals will be restricted from accessing the project area and gave an example that KWS has restricted them from accessing some areas in L. Turkana.
- They said that there is always war in many countries that exploit oil, like Nigeria, and asked whether the proposed project will cause war in the district.
- They wanted to know the plans that the proponent has for the needy students.
- They were worried about loss of grazing land and requested the proponent not to cut mature trees which provide pasture for the livestock.
- They requested the proponent to construct offices for the Beach Management Unit organization.
- They want the community to be informed of the results of the seismic survey which will be conducted in the area.
- They requested the proponent to provide fishing gear and also construct schools, hospitals and toilets, and provide water for the residents of Kalokol.

Responses to the views raised were addressed by Mr. James and he informed them that only a small piece of land will be occupied by the proposed project and not the whole location or division as they thought. He assured them that the breeding grounds for fish will not be affected. He also assured them that before the project commences in the area, meetings with the community members will be held as a way of informing and educating the community on the project's activities. The meeting came to an end at 5:00 p.m. with an assurance by the E.I.A. team that their views will be taken into consideration and that their interests will be protected by relevant laws and policies like EMCA 1999.

MEETING HELD AT THE BARAZA GROUND IN KATABOI LOCATION IN KATABOI DIVISION, TURKANA NORTH DISTRICT, ON FRIDAY 11TH MARCH, 2011.

Attendance:

1. Assistant Chief, Kataboi Sub-location - Mr. Francis Naseki
2. Community elders and members
3. EIA team

The meeting started at 10:14 a.m and was chaired by the Assistant Chief, Mr. Francis Naseki. He welcomed the members present then introduced the EIA team. Mr. Nicholas gave a brief background of the proposed project. The Assistant Chief emphasized further the project background and the objective of the meeting which was to collect the community's views concerning the proposed project. He then encouraged the community members to present their views.

- The women wanted to know if they will be involved in the project operations through employment.
- They expressed fear of war from other countries during oil exploitation in the area.
- They expressed fear of earthquakes during project operations.
- They wanted to know how recruitment will be done and how much they will be paid.
- They wanted to know if livestock will be adversely affected by the seismic activities.
- They asked whether they will be compensated when oil will be exploited in Kataboi and whether the settlements will be destroyed during the project operations.
- They asked whether L.Turkana will be polluted, thereby adversely affecting the fish, and whether the air in the area will also be polluted.
- They wanted to know if the EIA team camping in Lowareng'ak had employed the locals.
- They were concerned about the seismic activities and asked whether the seismic cables will injure children and livestock.
- They demanded respect for the girls and women by the company's staff.
- They wanted to know what the proponent will do in case of accidents caused to the livestock and people by the vehicles and machines and suggested compensation in that event.
- They want the proponent to work together with the former employees of Kenya Oil Company that operated in the area in the early 1980s.
- They requested the proponent to employ the youth and other community members.
- They welcome the proposed project in Kataboi division.

Mr. Nicholas responded to the views raised by assuring them that the community will benefit through employment. He also assured them that there will be no earthquakes and war. He told them that payment for jobs might vary according to job specifications. He emphasized that the proposed project will involve seismic survey in the area only after the EIA report has been prepared and a licence granted by NEMA and/or other relevant authorities.

The Assistant Chief made his closing remarks by thanking the E.I.A team and the community members for attending the meeting. The meeting ended at 11:30 a.m. with a prayer and an assurance by the E.I.A. team that the community's views will be taken into consideration.

MEETING HELD AT THE BARAZA GROUND IN NACHUKUI SUB-LOCATION, NG'ISIGER LOCATION IN LOKITAUNG DIVISION, TURKANA NORTH DISTRICT, ON FRIDAY 11TH MARCH, 2011.

Attendance:

1. Assistant Chief, Nachukui Sub-location - Mrs. Esther Apetet Mana
2. Tullow Kenya B.V representative - Mr. Joseph Loibach
3. E.I.A team and community members

The meeting started at 1:02 p.m with a word of prayer. The Assistant Chief, Nachukui Sub-location, Mrs. Esther Apetet, welcomed and thanked the members. Mr. Joseph, a representative of Tullow Kenya B.V, introduced the E.I.A team. Mr. James then took the floor and gave a brief background of the proposed project and the aim of the meeting. They were enlightened on how seismic survey will be conducted in the area. The community raised the following views concerning the proposed project.

- They welcomed the proposed project in the area and reported that drought has had adverse impact on the livestock in the area.
- They want the company's staff to respect fishermen and requested that project operations are not permitted to affect fishing activities in the lake.
- They want the proponent to create awareness and educate fishermen on the seismic survey operations which will be conducted in L.Turkana.
- They want employment opportunities to be given to the locals and especially the unskilled labour.
- They reported harassment of locals in the past when Kenya Oil Company was operating in the area in the 1980s. They want the community to be informed of the project operations in the area.
- They want all wastes to be managed in an environmentally friendly manner.
- They further said that hazardous waste should not be dumped in L. Turkana because they heavily rely on the lake for fishing activities.
- They were grateful for the meeting that the E.I.A team had with the community members.
- They suggested that all the community members from different areas of the division should be considered for employment which should be equal and transparent.
- They asked whether individuals and the community will be compensated in case of destruction of the structures and settlements.
- They asked whether the community will benefit from the proposed project.

Mr. James responded to the views raised by emphasizing that the proposed project operations will involve seismic survey and that the community will benefit through employment and other development activities that might arise in the course of the project operations. He assured the community members that all their views will be taken into consideration. Closing remarks were made by the Assistant Chief who thanked the members for attending the meeting. The meeting adjourned at 2:05 p.m.

MEETING HELD AT THE BARAZA GROUND ON SATURDAY 12TH MARCH, 2011, IN LOWARENG'AK SUB-LOCATION, NG'ISIGER LOCATION, IN LOKITAUNG DIVISION, TURKANA NORTH DISTRICT.

Attendance:

1. Assistant Chief, Kanamkuny Sub-location - Mr. Joseph Atach
2. Assistant Chief, Lowareng'ak Sub-location - Mr. Pius Chuchu
3. Community elders and members
4. EIA team

The meeting commenced with a prayer at 9:00 a.m. and was chaired by the Assistant Chief, Lowareng'ak Sub-location Mr. Pius Chuchu. He welcomed and thanked all the members who attended. He informed the members that the meeting would be brief because they were waiting for relief food which was to be distributed by Oxfam. He informed the EIA team that the meeting comprised of community members from Kanamkuny and Lowareng'ak Sub-locations. He also encouraged them to present their views concerning the proposed project. The E.I.A. team was introduced and the members were addressed on how seismic survey will be conducted in the area. The community views concerning the proposed project were as follows;

- They were grateful for the meeting that was held by the EIA team.
- They said that employment should be equal, transparent and gender sensitive and should be given to the locals, especially the unskilled labour.
- They want the proponent to provide water, construct schools and hospitals and also offer academic scholarships to the needy students in the area.
- They welcomed the proposed project in the area and said that they will be receptive if the proposed project will benefit the community.
- They complained that whenever projects operate in the area, the labour is sourced from other regions in the country and not the local community.
- They wanted to know when the project will commence its operations in the area.
- They expressed fear of loss of fish in Lake Turkana and requested the proponent to provide fishing nets, boats and other fishing equipment for the fishermen.
- They said that the project operations should not destroy settlements.
- They demanded respect for the girls and women by the company's staff and requested the proponent not to interfere with the cultural sites in the area.
- They requested the proponent not to interfere with the fishing activities in the lake and that the drilling poles should be located in an open area visible to the locals.
- They expressed fear of war and requested the government to improve security in the areas during the project operations.
- They anticipated adverse negative impacts in the lake. They therefore do not want seismic survey to be conducted in L. Turkana.

Responses were made by informing them that a series of meetings will be held with the community as a way of creating awareness. They were assured that there will be peace in the country in case oil will be exploited in the area. Emphasis was made that seismic survey will not affect fish and fishing activities in L. Turkana and that recruitment will be equal and transparent to all community members. Closing remarks were made by the Assistant Chief who encouraged them to cooperate with the proponent during the project operations in the area. Lastly, he assured the community that the views raised will be taken into consideration. The meeting adjourned with a prayer at 10:30 a.m.

MEETING HELD IN LOKITAUNG LOCATION, LOKITAUNG DIVISION IN TURKANA NORTH DISTRICT ON SATURDAY 12TH MARCH, 2011 AT THE BARAZA GROUND.

Attendance:

I. Chief - Mr. Paul Lobolia Lochul
II. Nominated Councillor - .Mrs. Mary Stella Ekunoit
III. Community opinion leaders and members
IV. EIA team

The meeting was chaired by the chief, Lokitaung Location, Mr. Paul Lobolia, and it commenced at 1:50 p.m. He welcomed and thanked all the members. The EIA team was introduced, followed by a brief explanation of how seismic survey will be conducted in the area. The community presented the following views.

- They welcomed the proposed project in the area and thanked the EIA team for holding the meeting with the community members.
- They requested the employment of the youth when the project operation commences in the area, especially the unskilled labour.
- They reported that whenever projects are implemented in the area, they always source labour out of the district. Therefore, they want the locals to be employed.
- They reported that when seismic activities were conducted in Kaleng in the past by Kenya Oil Company, it led to destruction of trees which livestock rely on for pasture.
- They wanted to know what the proponent will do in case the project activities destroy the grazing lands and structures.
- They believe that oil will be found in Lokitaung and requested the proponent to construct roads in the area.
- They asked whether the community will be informed of the project operations.
- Their major concern was on livestock and they were afraid that livestock health will be affected during project operations because of deforestation.
- They reported that the area has good security and suggested that the proponent should establish the camps in Lokitaung town.
- They reported that the community was not aware when Kenya Oil Company that operated in Kaleng decommissioned their project.

Responses were made by informing them that the proposed project will benefit the community through employment, and recruitment will be equal and transparent to the locals. They were informed that the project activities will not interfere with the environment, especially the mature trees which provide pasture to the livestock. The councillor made her closing remarks by saying that they welcome the proposed project in the area. She reported that whenever projects are implemented in the area, the youth in the division do not always benefit through employment. She therefore suggested that employment opportunities should be equal for all the community members, and especially the youth.

The youth leader said that the proposed project will benefit the youth and other community members. He also emphasized that the major problem in the area is unemployment of the youth and requested the proponent to employ all the youth in the community. The chief thanked all the members for their patience and the EIA team for holding the meeting with the community members. Lastly, he said that the project had the community's blessing. The meeting adjourned at 3:20 p.m. with a word of prayer.

MEETING HELD IN TODONYANG LOCATION, LAPUR DIVISION IN TURKANA NORTH DISTRICT ON SUNDAY 13TH MARCH, 2011.

Attendance:

1. Mr. Simon Choko - Commander of KPR, Todonyang Location
2. Mr. Joseph Loibach - Tullow Oil Kenya B.V representative
3. EIA team and Community members

The meeting started at 10:10 a.m. The EIA team was introduced, followed by a brief background of the proposed project and the aim of the meeting. The community was informed that the grazing lands will not be affected by the project operations. They were also enlightened on how seismic survey will be conducted in the area. The community then was given an opportunity to present their views concerning the proposed project in Todonyang.

- The community reported that the major issue in the area is of insecurity. They said that the Merile community from Ethiopia usually attacks the community members and raid livestock.
- They also reported that the attack from the neighbouring community of Ethiopia has greatly affected fishing and other activities in Lake Turkana.
- They welcome the proposed project in the area because they believe that it will solve their major problem of insecurity, and enhance development.
- They want the proposed project to benefit the community members.
- They were excited about the meeting that was held with the community members.
- They also reported that Todonyang is an area with few community members, most of whom are not employed. They therefore requested the proponent to employ the community members during the project operation.

The issues raised were responded to by the team which assured them that their views would be taken into consideration and that the proposed project would benefit the whole community through employment. In addition, the project operations might improve security in the area. The meeting adjourned at 10:39 a.m. with a word of prayer.

STAKEHOLDERS MEETING HELD AT KMTC IN LODWAR DIVISION, TURKANA CENTRAL DISTRICT ON MONDAY 14TH MARCH, 2011.

Stakeholders' attendance list

S/NO.	NAMES	DESIGNATION/ ORGANIZATION	CONTACT
1	Wycliffe Obiayo	District Forest Officer	0714242289
2	Michael .K. Changkwony	Research Technologist I	0722488887
3	James .E. Echwa	District Works Officer	0728642485
4	Margaret Lomosingo	Chief, Lodwar Location	0710445973
5	John .E. Lokir	VCO- Katilu Division	0711440025
6	Christopher Ajele	District Livestock Production Officer	0729207266
7	Zacharia Kemei	District Youth Officer	0721155024
8	Barnaba Kiplimo	Regional Manager –KVDA	0723245973
9	David Egialan	Tullow Oil Kenya B.V representative	0727595200
10	Joseph Loibach	Tullow Oil Kenya B.V representative	0728722381
11	James Ndunda	EIA team-Earthview Geoconsultants	0724350783
12	Evelyne Sindani	EIA team- Earthview Geoconsultants	0727251894
13	Nicholas Aketch	EIA team- Earthview Geoconsultants	0723324758

The meeting was chaired by Mr. David and it started with a word of prayer at 11:50 a.m. He welcomed all the stakeholders then Mr. Nicholas gave a brief background of the proposed project and the objectives of the meeting. He informed them that Tullow Oil Kenya B.V is proposing to undertake a seismic survey project in Blocks 13T, 10BA and 12A which cover four districts in Turkana County. He said that the main aim of the meeting was to collect their views concerning the proposed project. They were informed of EMCA 1999 which requires the project's proponent to consult the community before the project commences in the area. He said that the EIA report will be prepared and will be available for comments at CCT and the DEO's office before it is approved by NEMA.

He informed them that the EIA team had held community meetings in various areas covered in the Block. He also gave a brief report of the meetings that were held in Block 13T and 10BA and the planned meetings in Block 12A. He encouraged the stakeholders to present their views on the proposed project.

- They asked whether the proposed project will initiate other development activities in the community.
- They asked whether old cut lines in some areas where oil survey was conducted will be used by the proponent.
- They asked whether the EIA team sensitized the communities in the blocks that they had already covered and in case of any negative impacts, how will the community be compensated?
- They asked whether labour will be sourced locally or from other regions.
- They wanted to know what will be done in case the cut lines destroy the riverine vegetations, mature trees and watering points.
- They wanted to know if the GPS coordinates are determined from the office or at the sites where seismic survey will be conducted.
- They wanted to know the mitigation measures of the emission of dust and smoke from the vehicles and machines.

- They reported that Turkana County has many experts who can be recruited.
- They wanted to know the communities' responses towards the proposed project in the area and the challenges that the EIA teams have faced in the area visited.
- They welcomed the proposed project in Turkana County and requested that the proponent leave the cut lines to the community to use as access roads.
- They wanted to know other activities that the proposed project will undertake.
- They asked whether the machines will produce dust which will cause airborne diseases and suggested that mitigation measures be implemented.
- They said that most of the community members living in the remote areas of the district might not be receptive to the proposed project.
- They wanted to know how strong the seismic waves will be and whether they will affect the environment.
- They asked whether the proponent will put in place measures to mitigate deforestation during the project's operation.

Responses to the issues raised were made by Mr. James who informed them that the proposed project will only involve seismic survey. He also said that new cut lines will be made because the seismic survey will be conducted in different areas in the block. He reported that community meetings were conducted in Blocks 13T and 10BA and that their views were taken into consideration. He added that a series of meetings will be held to sensitize the communities and stakeholders in the areas.

He said that recruitment will be equal and transparent and labour will be sourced locally, especially the unskilled labour. He reported that specific sites like grazing lands, watering points, riverine vegetation, cultural sites and graves will not be destroyed by the project activities. He said that some of the GPS coordinates will be determined on the sites. The machines and vehicles will be operated in an environmentally friendly manner and mitigation measures will be put in place to mitigate anticipated negative impacts. Lastly, they were assured that the views presented will be taken into consideration and that their interest will be protected by the relevant laws and policies governing the proposed project.

Closing remarks were made by informing them that a copy of the EIA report will be available at the DEO's and CCT offices. He also said that the challenges faced by the EIA teams and environmental concerns will be presented in the report.

The stakeholders made their closing remarks by saying that the proposed project will enhance development in Turkana County and the communities will benefit. They suggested that the communities should be considered during employment in order to improve their living standards. Lastly, they said that the proposed project had their blessings. The meeting adjourned at 1:30 p.m. with a prayer.

MEETING HELD AT THE BARAZA GROUND IN LOIYANGALANI DIVISION, LOIYANGALANI DISTRICT ON THURSDAY 14TH APRIL, 2011.

Attendance:

1. Mr. Vincent Lomachar - DO Loiyangalani
2. Mr. Mark Ekale - Councillor, Loiyangalani ward
3. Mr. Christopher Lekapana - Chief, Loiyangalani Location
4. Community elders and members
5. The E.IA. team

The meeting was opened with a prayer at 10:33 a.m. The chief, Loiyangalani Location, Mr. Christopher Lekapana, welcomed and thanked the members present. The EIA team was introduced, then a brief background was given of the proposed seismic survey in the area. Some of the benefits that the community will get during the project operations,such as employment, were highlighted. They were encouraged to present their views concerning the proposed project in the area.

- They welcome the proposed project and want the community to benefit.
- They requested equality, transparency and clarity during the recruitment process.
- They reported that the area has a rich fossils history and requested that they not be destroyed
- They want the proponent to create awareness and educate the community on various project operations to be undertaken.
- They urged the proponent not to affect fish-breeding grounds and fishing activities in Lake Turkana and suggested that seismic survey should not be conducted during the breeding seasons.
- They want the proponent to manage all wastes at the camps in an environmentally friendly manner and it should not cause any environmental pollution.
- They expressed fear of ground-shake and were concerned with the occupational health and safety of employees during the project operations.
- They reported that the community did not benefit from the wind-power project in the area.
- They asked whether the community will be compensated in case the project operations affect the environment, community health and livestock.
- They asked whether measures will be put in place to avoid cutting down of mature trees.
- They wanted to know the specific sites in Loiyangalani where cut lines will be made.
- They emphasized that L. Turkana should not be affected because some Elmolo community live in the lake.
- They urged the proponent to involve the community at all phases of the project and that both skilled and unskilled labour be sourced locally.
- They said that population will increase and feared the spread of HIV/AIDS in the area.
- They asked whether other communities within the block will benefit in case oil prospects are found in a few areas covered in the block.
- They reported that the community sometimes faces insecurity as a result of cattle rustling from the neighboring communities and wanted the proponent to improve security.

Responses to the views raised were addressed by the E.I.A. team which informed them that the proposed project will not cause any adverse negative impacts to the environment, community or the livestock. A series of meetings will be held with the community members and

stakeholders before the project operations commence in the area. They were assured that Lake Turkana will be protected and the fishing activities will not be interfered with by the project operations in the lake. In addition, employment will be equal, transparent and gender sensitive. Lastly, the views raised will be taken into consideration.

Closing remarks were made by the councillor and he urged the EIA team to hold other meetings with the community in the area. He also encouraged them to participate by attending meetings which will be held by their leaders. Lastly, he assured them that all the stakeholders will be involved in the proposed project. The meeting adjourned at 12:55 p.m. with a word of prayer.

MEETING HELD IN KOMOTE VILLAGE IN ELMOLOBAY SUB-LOCATION, LOIYANGALANI LOCATION IN LOIYANGALANI DIVISION, LOIYANGALANI DISTRICT AT THE BARAZA GROUND ON THURSDAY 14TH APRIL, 2011.

Attendance:

1. Mr. Mark Barini - Assistant Chief, Elmolobay Sub-location
2. Mr. Christopher Lakapana - Chief, Loiyangalani location
3. Mr.Mark Ekale - Councillor, Loiyangalani ward
4. Community members
5. The E.I.A. team

The meeting started at 3:00 p.m. with a word of prayer. An explanation of how the proposed seismic survey will be conducted in the area and the benefits of the proposed project were addressed by the team. The community then raised the following views concerning the proposed project.

- They said that they have never heard of an oil exploration project in the area and they therefore welcome the proposed project.
- They expressed fear of displacement and wanted to know how the government and the proponent will handle issues of communal land.
- They wanted to know how the community will benefit from the proposed project.
- They asked whether the cut lines which will be made will be left for the community to use as access roads.
- They expressed fear of loss of fish in L. Turkana and they do not want fish and fishing activities to be affected by the project operations in the lake.
- They wanted to know the size of land which will be utilized by the project.
- They wanted to know the corporate social responsibilities that the proponent will implement within the community.
- They asked whether labour will be sourced locally and if the youth will be considered during the recruitment process.
- They asked whether an oil refinery will be established in the area when oil prospects will be found.
- They wanted to know when the proposed project will commence its operations in the area.
- They said that population will increase and feared the spread of HIV/AIDS. They therefore,suggested that the proponent should create awareness and educate the community on HIV/AIDS management when the project operations commence.
- They reported that Lorian Island has cultural values to the Elmolo community and urged the proponent not to destroy their cultural sites.
- They asked whether the affected communities will be compensated.

The E.I.A. team responded by assuring the community that the views raised will be taken into consideration and their interests will be protected by the relevant laws and policies concerned with the proposed project.

The Assistant Chief made closing remarks by thanking all the EIA team for holding the meeting with the community and urged the community to cooperate during the project operations. The meeting ended with a prayer at 4:15 p.m.

MEETING HELD IN MOITE SUB-LOCATION IN LOIYANGALANI LOCATION, LOIYANGALANI DIVISION IN LOIYANGALANI DISTRICT ON FRIDAY 15TH APRIL 2011

Attendance:

1. Mr. Napulo .N. Lokok - .Assistant Chief, Moite Sub-location
2. Community members
3. The E.I.A. team

The meeting commenced at 1:22 p.m. with a word of prayer. The EIA team was introduced, then followed a brief explanation of how the seismic survey will be conducted in the area. Some of the project's benefits like employment were highlighted. The Assistant Chief encouraged the community to present their views concerning the proposed project.

- They welcome all development projects and especially the proposed project in the area.
- They want the youth to be employed and emphasized that labour should be sourced locally.
- They said that the EIA team took the right step by informing the community of the proposed project in the area.
- They want the community to benefit from the project.
- They do not want fish and fishing activities to be affected during the project operations.
- They said that the proposed project will improve the community's living standards.

Responses to the views raised were addressed by the E.I.A. team which informed the community that the proposed project will benefit the community and will not cause any negative impacts to the environment, lake, community and the livestock. They were assured that a series of consultative meetings will be held with the stakeholders and the community members. Their interests will be taken into consideration and protected by the relevant laws and policies concerned with the proposed project.

The Assistant Chief made his closing remarks by thanking the community and assured them that a series of meetings will be held with the community before the project operations commence in the area. The proposed project had their blessings. The meeting adjourned with a prayer at 2:43 p.m.

MEETING HELD AT ILLERET PRIMARY SCHOOL IN ILLERET LOCATION IN NORTH HORR DIVISION, NORTH HORR DISTRICT, ON SUNDAY 17TH APRIL, 2011.

Attendance:

1. Mr. Michael Moroto - Chief, Illeret location
2. Mrs. Jeniffer Lonyaman - Councillor, Illeret ward
3. Community members
4. The E.I.A. team

The meeting was opened at 2:35 p.m. The chief, Illeret Location, Mr. Michael Moroto and the councillor Mrs. Jeniffer Lonyaman, thanked the members present who mostly comprised of the community youth. The EIA team was introduced, then followed Sa brief background of the proposed seismic survey in the area. The members were enlightened on how the seismic survey will be conducted. Some of the project benefits like employment were highlighted to the members. The community then raised the following views concerning the proposed project.

- They asked whether oil prospects have been found in the area.
- They asked whether the affected community will be compensated and suggested that they should be compensated.
- They asked whether there will be use of hazardous materials during the project operations.
- They wanted to know the corporate social responsibilities which the proponent will implement in the area.
- They asked whether the proponent will involve the community in the proposed project operations.
- They urged the EIA team to hold meetings with the community elders before the project operations commence in the area.
- They requested the proponent to provide potable water to the community.
- They said that oil exploitation is associated with cancer and were afraid that the community will suffer from cancer during project operations in the area.
- They wanted to know whether the livestock grazing patterns will be affected.
- They wanted to know the number and specific sites where the cut lines will be made in the area.
- They wanted to know when the next meeting with the community will be held, and also when the project operations will commence in the area.

In response to the issues raised, the EIA team informed them that the project will not cause any negative impacts to the community and/or displacement. They were assured that the community will be involved in all the project operations in the area through meetings which will be held. The issues of corporate social responsibilities will be discussed at a later stage. In addition, labour will be sourced locally, especially the unskilled labour, and the project will commence once the proponent has been given a licence by the relevant authorities like NEMA. Lastly, the views raised will be taken into consideration. The meeting ended at 3:36 p.m.

APPENDIX 3: SOIL RESULTS ANALYSIS AND COPIES OF LABORATORY RESULTS.

APPENDIX 4: CERTIFICATES OF THE CONSULTANTS

APPENDIX 5: TKBV PIN NUMBER AND VAT CERTIFICATES

Application Reference No. PR/8734

Registration No: 0009539

For official use

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Project Report/Environmental Impact Assessment Study Report received from ....TULLOW..KENYA..B.V.. (Name of individual/firm) ....P.O. BOX 63298-00169, NAIROBI (Address) submitted to the National Environment Management Authority in accordance with the Environmental Impact Assessment & Audit Regulations regarding ....PROPOSED OIL AND GAS SEISMIC SURVEY ..PROJECT.... (title of project) whose objective is to carry on ....OIL AND GAS EXPLORATION .... (briefly describe purpose) located at .....BLOCK...10BA..TURKANA..CENTRAL,...TURKANA..NORTH,...LOYANGALANI..AND..... NORTH..HORR..DISTRICT..... (locality and district) has been reviewed and a licence is hereby issued for implementation of the project, subject to attached conditions.

Dated this.....28TH.....day.....SEPT..... of 20..11..

Signature.....

(SEAL)

Director General

The National Environment Management Authority

CONDITIONS OF LICENCE

1. This licence is valid for a period of ....**24 MONTHS**.... (time within which the project should commence) from the date hereof.
2. The Director–General shall be notified of any transfer/variation/surrender of this licence.

P. T. O.

1. General Conditions

1.1. This approval is for oil and gas seismic survey in Block 10BA:Turkana Central, Turkana North, Loyangalani and North Horr Districts by Tullow Kenya B.V.

1.2. The license shall be valid for 24 months from the date of issue

1.3. The proponent shall provide the final project accounts (final project costs) on completion of construction phase. This should be done prior to project commissioning/operation/occupation

1.4. Without prejudice to the other conditions of this license, the proponent shall implement and maintain an environmental management system, organizational structure and allocate resources that are sufficient to achieve compliance with the requirements and conditions of this license.

1.5. The Authority shall take appropriate action against the proponent in the event of breach of any of the conditions stated herein or any contravention to the Environmental Management and Co-ordination Act, 1999 and regulations thereunder.

1.6. This licence shall not be taken as statutory defence against charges of pollution in respect of any manner of pollution not specified herein.

1.7. The proponent shall ensure that records on conditions of licenses/approval and project monitoring and evaluation shall be kept on the project site for inspection by NEMA's Environmental inspectors.

1.8. The proponent shall submit an Environmental Audit Report in the first year of occupation/operation/commissioning to confirm the efficacy and adequacy of the Environmental Management Plan.

1.9. The proponent shall comply with NEMA's improvement orders throughout the project cycle

2. Exploration Conditions

2.1. The proponent shall work in close collaboration with the local leaders to avoid any form of conflict.

2.2. The proponent shall put up a project signboard as per the Ministry of Works Standards indicating the NEMA license number among other information.

2.3. The proponent shall work in close collaboration with the Kenya Wildlife Service to ensure protection of the World Heritage Centre.

2.4. The proponent shall obtain a construction permit for the petrol station from Energy Regulatory Commission (ERC) as required under the Energy Act 2006.

2.5. The proponent shall ensure that all excavated material and debris is collected, re-used and where need be disposed off as per the Environmental Management and Coordination (Waste Management) Regulations 2006.

2.6. The proponent shall ensure strict adherence to the provisions of Environmental Management and Coordination (Noise and Excessive Vibrations Pollution Control) Regulations 2009.

2.7. The proponent shall ensure strict adherence to the Occupational Safety and Health Act (OSHA), 2007.

2.8. The proponent shall ensure that construction workers are provided with adequate personal protection equipment (PPE), sanitary facilities as well as adequate training.

2.9. The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.

2.10. The proponent shall ensure that the development adheres to zoning specifications issued for development of such a project within the jurisdiction of County Council of Turkana with emphasis on approved land use for the area.

3. Operational Conditions

3.1. The proponent shall ensure Corporate Socio Responsibility by hiring and utilizing local resources as much as possible.

3.2. The proponent shall ensure that all medical and hazardous waste is well contained and properly disposed in adherence to Environmental Management and Coordination (Waste Management) Regulations of 2006.

3.3. The proponent shall ensure that adequate and appropriate emergency response plans are designed and implemented during the survey.

3.4. The proponent shall ensure that all waste water is disposed as per the standards set out in the Environmental Management and Coordination (Water Quality) Regulations 2006.

3.5. The proponent shall ensure that rain water harvesting facilities are provided to supplement surface and ground water.

3.6. The proponent shall ensure that all drainage facilities are fitted with adequate functional Oil Water Separators and silt traps.

3.7. The proponent shall ensure that appropriate and functional efficient Air Pollution Control mechanisms are installed in the facility to control all air emissions.

3.8. The proponent shall ensure that all equipment used are well maintained in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations 2009.

3.9. The proponent shall ensure that all solid waste is handled in accordance with the Environmental Management and Coordination (Waste Management) Regulations 2006.

3.10. The proponent shall ensure that all workers are well protected trained as per the OSHA, 2007

3.11. The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of Ministry of Public Health and Sanitation, Directorate of Occupational Health and Safety Services, County Council of Turkana, Kenya Wildlife Service, Ministry of Energy, Department of Mines and Geology and other relevant Authorities.

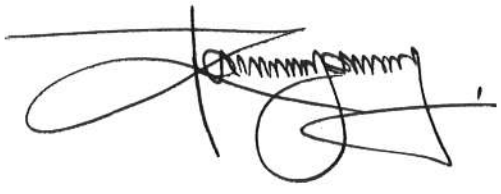
3.12. The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as waste management, noise and vibration control, occupational health and safety are designed, constructed and employed simultaneously with the proposed project.

4. Notification Conditions

4.1. The proponent shall seek written approval from the Authority for any operational changes under this licence

4.2. The proponent shall ensure that the Authority is notified of any malfunction of any system within 12 hrs on the NEMA hotline 020 6006041 and mitigation measures put in place

4.3. The proponent shall keep records of all pollution incidences & notify the Authority within 24 hrs.



4.4. The proponent shall notify the Authority of its intent to decommission three months in advance in writing.

5. Decommissioning Conditions

5.1. The proponent shall ensure that a decommissioning plan is submitted to the Authority for approval at least two (2) weeks prior to decommissioning

5.2. The proponent shall ensure that all pollutants and polluted material is contained and adequate mitigation measures provided during the phase.