ENVIRONMENTAL IMPACT ASSESSMENT
PROJECT REPORT

FOR

PROPOSED EXPLORATORY OIL AND NATURAL GAS WELL DRILLING PROGRAMME IN BLOCK 10BB: TURKANA SOUTH AND TURKANA CENTRAL

BLOCK 10BB SEISMIC EIA

TURKANA DRILLING CONSORTIUM (K) LTD

Prepared by

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EXECUTIVE SUMMARY

Turkana Drilling Consortium (K) Limited (TDCK) was established in Kenya in 2007 for the purpose of carrying out detailed seismic exploration surveys for oil and gas prospecting in Kenya. As per the Mining Act Cap 309, the company identified block 10BB which is partly located in Turkana south and Turkana central districts in northern Kenya and obtained exclusive prospecting rights (EPR) for oil and gas exploration in this block. The company further signed a production sharing contract (PSC) with the Government of The Republic of Kenya on 25th October 2007 and has subsequently been granted a prospecting license for oil and gas exploration in block 10BB. On the basis of the foregoing, the Company is proposing to carry out 2D and 3D seismic exploration surveys in parts of the assigned block so as to assess its potential for oil and gas reserves and to locate traps where such reserves may be occurring.

Block 10BB, as demarcated by National Oil Corporation of Kenya (NOCK) for the purpose of oil and gas exploration, and herein referred to as the project area or study area is partly located in Turkana south and partly in Turkana central districts in northern Kenya. The project area covers Lokichar/Loperat Mesozoic sedimentary basin which is bound by NNW trending lineaments associated with mobile belts at depth. Such NNW trending lineaments include Nyangea-Athi- Ikutha and Muglad-Anza-Lamu shear zones and these are responsible for the North to NNW trending Lokichar/Loperat Mesozoic sedimentary basin. The lineaments have resulted from a weakened and stretched lithosphere in northern Kenya. The project area is generally comprised of expansive plains categorised into piedmont plains, sedimentary plains, lacustrine plains and floodplains, with elevations ranging between 437-768 metres above sea level. It is also characterized by occurrence of uplands, foot slopes and hills with elevations occasionally reaching between 900- 1200 m. The hills are largely dependent on the phase of volcanism responsible for their emplacement, and subsequent tectonic movements which have tilted the layered volcanic successions.

The ecosystem in this area is extremely fragile with up to 90% of the landmass being arid while the remaining 10% can be classified as semi-arid. The area is sparsely populated and settlements (locally referred to as manyattas) are scattered within the project area. In addition, the vegetation is characteristic of arid and semi-arid conditions and is dominantly comprised of short grass, shrubs and scattered acacia trees.

Turkana Drilling Consortium (K) Limited since acquiring EPR and being granted an exploration license for block 10BB is currently finalizing its evaluation of all the existing data mainly gravity, magnetic and seismic data acquired from previous geophysical surveys in the project area. In addition, the company is currently negotiating for 2D and 3D seismic exploration surveys for the acquisition of new seismic data within the block. The new seismic data acquired will be processed, evaluated and integrated with all the existing information from previous geophysical surveys. This new information will enable the locations of prospective oil and gas reserves and lay the foundation for an exploratory drilling program commencing 2009.

In the course of the seismic exploration surveys, the proponent will set up base camps at Kangirisae and Loperot areas. However, the most suitable site for a base camp will be determined by the results of borehole site survey undertaken concurrently with this EIA project.

Turkana Drilling Consortium (K) Limited will utilize seismic exploration contractors to carry out the seismic exploration surveys. The seismic exploration surveys will be conducted using modern seismic energy sources as well as geophone receivers and recording devices. Vibroseis source vehicles which are designed to generate seismic energy into the ground without causing damage to the local environment will be used to generate the required seismic energy. Each of these vehicles is fitted with large pad which is lowered onto the ground at each shot point location. Complicated hydraulics on the vehicle will emit vibrations through the pad which move down through the earth as seismic waves and are reflected by each layer of subsurface rock encountered. Each shot point will be accurately located and positioned by using GPS survey equipment and marked using bio-degradable pegs on the ground. The pegs will later be removed after the survey. The pegs are carried on a back pack and this will minimize damage which may be caused by vehicles moving around the survey area.

The reflected seismic waves will be received by strings of geophone receivers attached to recording boxes and connected to a central recording truck by cables. The geophone receivers will be precisely positioned and located along predetermined and designed truck lines, most of which are already existing. The layout of the seismic survey equipment (Vibroseis source vehicles, geophone receivers, recording boxes and cables) is such that it is laid out in a grid around the survey area and sits on the ground surface. Once the seismic survey is completed and the equipment is removed, neither any damage to the terrain nor environmental degradation is envisaged. The electronics within the seismic survey equipment is powered by very low voltage DC current and this presents no threat to wildlife or people.

All the seismic survey data is centrally recorded, collated and stored in magnetic tapes in the recording boxes in a truck. During the course of a seismic survey, this truck moves around the area from time to time but generally occupies a fixed position in the middle of the survey area where the field crew is working. Support vehicles are however used to carry personnel and equipment around the survey area. The whole seismic survey is strictly governed by safety procedures to ensure that no bad incidents or accidents happen to the local population, livestock or wildlife.

The minimum requirement for shooting Seismic under the Production Sharing Contract (PSC) agreed with the Government of the Republic of Kenya is for 200 sq km of 3D seismic survey coverage, and 200 km of 2D seismic lines. However, the proposed survey is likely to extend up to 250 sq km for 3D and 300 km for 2D seismic surveys. The additional area and line kilometres for the seismic survey exploration will enhance the chances of accurately positioning the first exploration well, reducing the drilling phase and hence reducing further environmental impacts and degradation.

The main aim of the proposed project is to prospect for commercially viable oil and gas reserves in Block 10BB. The success of this project will lead to exploratory drilling of oil wells in the project area and if this is proven to be commercially viable, it will definitely have a significant positive impact in Kenya's energy sector. Further, it will boost the national economy and commercial production of oil, and shall lead to an improvement of the socio-economic well being of the Northern frontier districts and the country in general.

The proposed project is justified by a number of factors. The global demand for oil and the escalating oil prices are at an all time high. Turkana south district is experiencing high oil prospecting interest especially due to the fact that there could be possible mature hydrocarbon deposits within the area that could produce commercially viable oil and gas. This state of affairs calls for investment in seismic exploration activities and support facilities like infrastructure and social amenities. The proposed project will therefore go along way in ensuring that the potential of this part of Kenya is fully realized.

The project will lead to economic empowerment not only to the project proponent but also of a host of other people who will both directly and indirectly benefit from jobs and business opportunities within the project area. The only way to realize Vision 2030 that has been aptly propounded by the government of the republic of Kenya is to make deliberate investments like the one proposed. The project envisages having a significant positive effect on the lives of many people in terms of revenue generation to the central government through permits and taxes as well as growth in the GDP. More importantly, the design of the project is well thought out and state of the art technology in seismic exploration survey will be used and international standards in environmental conservation will be adopted in order to minimize environmental degradation. Appropriate Suggested Mitigation measures are detailed in this project report.

On the basis of the foregoing and considering the positive social-economic benefit of the proposed project, the proponent sought the services of Earthview Geoconsultants Limited to carry out an environmental impact assessment (EIA) of the proposed project. The EIA was subsequently undertaken between June 24, 2008 and July 3, 2008. The framework and methodology adopted during the present EIA included but not limited to:

(i) Scaling and Scoping,
(ii) Review of Regulatory Framework and Institutions,
(iii) Comprehensive Environmental Assessment, Impact Identification as well as Suggested Mitigation measures, and finally
(iv) Recommendations of appropriate Environmental Management Plan.

The environmental parameters assessed during the present EIA include: Physiography, geology and geological setting, soils and soil characteristics, climatology and air, surface and ground water potential and quality, flora and fauna, land resources, visual aesthetics, noise, solid wastes and effluents, socio-economics and health and safety issues.

The policy and legislative framework upon which the EIA survey for the proposed project was based on includes: Energy Policy (Sessional Paper No.4 of 2004), Environment and Development Policy, National Policy on Water Resources Management and Development (Sessional Paper No.1 of 1999), Mining Policy, Health Policy, and the Economic Recovery for Wealth and Employment Creation Strategy. The institution charged with overseeing the implementation of the Environmental Management Coordination Act (EMCA) 1999 is the National Environment Management Authority. Acts that do have a bearing on the rules and regulations that touch on oil and gas exploration include: Energy Act, 2006, Mining Act, Cap 309, Explosives Act, Cap. 115 Revised 1989, Public Health Act, Cap 242, Water Act 2002, Factories Act, Cap 515, Local Government Act, Cap 265, Local Government Act, Cap 265, and Penal Code, Cap 63.

This environmental impact assessment report has identified various potential impacts, both positive and negative, of the proposed project and Suggested Mitigation measures have been recommended. On the basis of the environmental impact assessment, an Environmental Management Plan has been drawn up for all aspects of the survey. The modes for implementation of recommendations arising from this assessment are outlined in detail within this document and reference should be made to them in their respective sections. Some of the key recommendations include:

- The Consortium should hold an area leaders meeting to inform and sensitize them on the survey plans prior to commencing the work. This idea was expressed by most of the leaders that we spoke to.
- While the team that will be carrying out the seismic work will be contracted by Turkana Drilling, Turkana Drilling will impress upon the contractor to hire local personnel to the extent possible.
- Ensure that community health and socio-cultural traditions are protected and that worker's occupational health and safety standards are maintained through capacity building, proper training, providing protective clothing and managing their residential camps according to the required health standards.
- Liaise with the local administration, the local authority and all other stakeholders throughout the process and prior to any seismic activities in, or close to, important cultural sites.
- Consider the use of existing utility and transport corridors for access roads to the extent possible. The right-of way should be kept to a minimum.
- The seismic survey should be conducted during the dry season if possible, in relatively vegetated and cultivated areas to minimize damage to plants and crops. Cutting of trees should be avoided as is reasonable and more generally, minimise areas that will be cleared. Attempt to minimize the use of heavy equipment such as bulldozers, especially on steep slopes, water and wetland crossings, and ecologically sensitive areas.
- Care should be taken when conducting Seismic operations within 30 m of any watercourse, and within 300m of any well, borehole, building or settlement depending on the amount of vibratory energy to be applied to the ground. Gallery forests should be avoided as is reasonable.

- Seismic line clearing should as is reasonable deviate around established vegetation and sensitive soils, steep gradients, and pass through areas of easiest access on river crossings.
- Proper management of both solid and liquid waste to avoid soil and groundwater contamination.

The project shall employ state of the art technology that is economically viable, environmental friendly and socially acceptable. However, the Company should adhere to the proposed Suggested Mitigation measures in this report as is reasonable to ensure that it protects the local communities' cultures and heritages and the environment's integrity.

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CHAPTER 1:

INTRODUCTION

1.1 Introduction

This EIA has been prepared by Earthview Geoconsultants for the Turkana Drilling Consortium Kenya Limited who is the proponent of a seismic survey project for oil and gas exploration in block 10BB. The EIA report provides a critical examination of issues considered important in fulfilling the requirements of a clean, sustained and healthy environment in a project being undertaken in Turkana South and part of Turkana Central districts. This report is primarily aimed at establishing the impacts of the proposed project on the environment, social, cultural and economic set up of the area inorder to fulfil the National Environment management Authority (Kenya) requirements as spelt out in the Environment Management and Coordination Act (EMCA) of 1999.

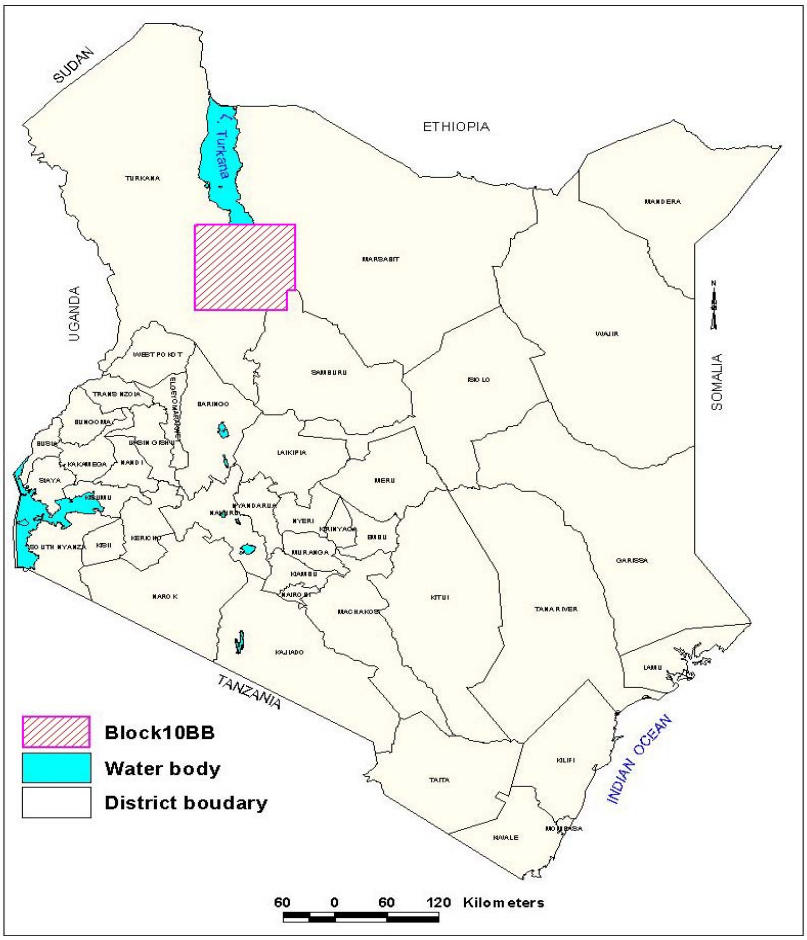


Figure 1.1: Location of the study area

1.2 Developer Identification

This Environmental Impact Assessment (EIA) is carried out for Turkana Drilling Consortium Kenya Limited (Pin No. P051218605Y), with respect to the proposed seismic survey for locating potential oil deposits.

1.2.1 Addresses

Offices In Kenya:	Contact:
4th Floor, The Citadel, Muthithi Road Nairobi, Kenya	Mr. Wayne Douglas Coulthard Country Manager Turkana Drilling Consortium (K) Ltd P.O.Box 47582-00100 Nairobi Kenya

1.2.2 Activities of Turkana Drilling Consortium: An Overview

Turkana Drilling Consortium is a private oil and gas company with a focus on Africa. The Consortium's first asset is Block 10 BB located in North Western Kenya. Turkana Drilling Consortium is currently finalizing its evaluation of all of the existing data from the previous operations in this block. The company desires to acquire new 2D and 3D seismic information over the block. Following the seismic acquisition, the information will be processed and evaluated along with the pre-existing data. With this information, oil well locations will be selected for exploration drilling program in 2009.

1.3 Brief Site Description

The project area straddles Turkana South and Turkana Central districts, and is referred to as Block 10BB as per petroleum prospecting blocks outlined by the National Oil Corporation of Kenya (NOCK). The initial exploration under review will be limited to a large part of Turkana South district that covers the entire Lokichar and Lokori Divisions and part of Keiyo division in Turkana Central (Figure 1). The district has a very fragile ecosystem with up to 90% of the landmass being arid while the remaining 10% can be classified as semi-arid. It is sparsely populated with several dry river beds including the River Kerio bed that traverses the vast area.

The current seismic survey will be limited to that part of Turkana south district that covers the entire Lokichar and Lokori divisions and part of Kerio Division in Turkna Central (Figure 1.2)

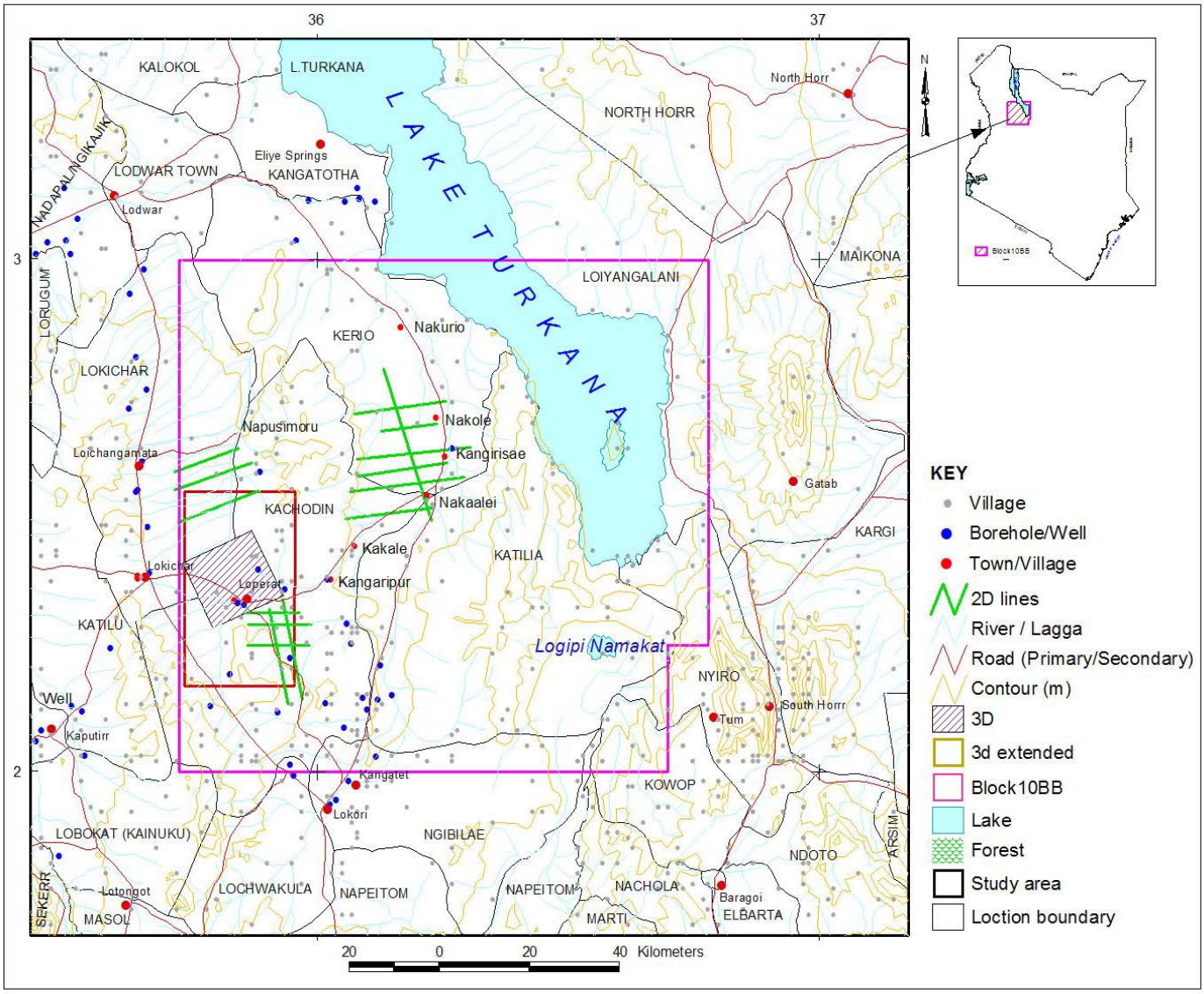


Figure 1.2: Location of project area

1.4 Project Background, Development Rationale and Objectives

1.4.1 Project Background

The Consortium's main aim and objective over the next three years will be to explore in detail the assigned area (Block 10BB in North Western Kenya) with the aim of locating and eventually producing petroleum from potential oil traps. Turkana Drilling Consortium is committed to ensuring that the seismic survey work conducted in the assigned area will have a minimal impact on the environment.

Table 1.1: Project cost

Phase 1, 2D seismic Acquisition 2008		**Phase 2, 2D Seismic Acquisition 2009**	
Major Activity	**Cost USD**	**Major Activity**	**Cost USD**
Mobilisation	$ 400,000.00		
Demobilisation	$ 100,000.00		
Seismic Acquisition includes Testing, Seismic Shooting (250 km)	$ 5,000,000.00	Seismic acquisition includes testing, seismic shooting	$ 2,000,000.00
Processing	$ 500,000.00	300K processing	$ 200,000.00
TOTAL	**$ 6,000,000.00**	**TOTAL**	**$ 2,200,000.00**

Projected costs relating to 2D seismic works 2008/9: $8,200,000.00

1.4.2 Project Rationale

Due to the numerous environmental issues and challenges such as degradation resulting from poorly implemented development programs, the Kenya government harmonised the country's environmental laws under the Environmental Management and Coordination Act (EMCA) 1999, for the purposes of coordinating environmental management. EMCA 1999 makes EIA mandatory for all the projects specified in the Second Schedule of the Act.

The purpose of this project is to prospect for commercially viable oil deposits in Block 10BB. Subsequent success of this activity may lead to drilling of oil wells. This if successful will have a significant positive impact in Kenya's energy sector, boost the national economy and commercial production of, and shall lead to an improvement of the socio-economic well being of the Northern frontier districts and the country in general.

The initial study by Shell Oil Company had some encouraging findings. For instance in the Loperot-1 well of Lokichar basin the main reservoir interval described by Lambers (1993) found oil in multiple horizons. There are oil shows in thin sandstones above the main lacustrine source rock interval and within the secondary reservoir interval and just above the secondary lacustrine source rock. In the Eliye Springs-1 well was drilled north of Block 10BB in the north part of the Kerio Basin. This well encountered thin, immature lacustrine source rocks. Potential reservoir rocks of fluvial/lacustrine origin measured 18-30% porosity. No hydrocarbon shows were reported (Lambers, 1993).

1.4.3 Project Justification

The proposed project is justified by a number of factors; Global demand for oil and oil prices are at an all time high. Turkana area is experiencing high oil prospecting interest especially due to the fact that there could be possible mature hydrocarbon deposits within the area that could produce commercially viable oil wells. This state of affairs calls for investment in seismic

exploration activities. The proposed project will therefore go along way in ensuring that the potential of this part of Kenya is fully realized.

The project will lead to economic empowerment not only of the project proponent but also of a host of other people who will both directly and indirectly benefit from jobs and business opportunities within the project area. The only way to realize Vision 2030 that has been aptly propounded by the government is to make deliberate investments like the one proposed. The project envisages having a significant change to the lives of many people, and in terms of revenue generation to the central government through permits and taxes.

More importantly, the design of the project is well thought out and state of the art technology in seismic survey will be used and international standards in environmental preservation will be adopted in order to minimize environmental degradation. Appropriate suggested mitigation measures are detailed in this project report.

1.4.4 Objectives

The specific objectives of the proposed project include, but are not limited to, the following:

a) To explore the prospects of potentially commercially viable oil and gas deposits in the project area.

b) To identify, evaluate, and propose suggested mitigation measures for potential environmental impacts of the proposed project on the various bio-physical and socio-economic structures of the area.

c) To assess and analyze the environmental costs and benefits associated with the proposed project.

d) To outline, environmental management plans and monitoring mechanisms during the project.

1.4.5 Development Partners

Turkana Drilling Consortium (K) Ltd is solely owned by private investors in the company and hence do not have any partners.

1.5 Terms of Reference (TOR)

The following Terms of Reference (TOR) apply to the project

- To hold appropriate consultations with the project proponent to establish the procedures, define requirements, responsibilities and a time frame for the proposed project.
- Carry out a systematic environmental assessment at the proposed project site and the surrounding area following the NEMA regulations and best international practice for an activity of this nature.

- Produce an Environmental Impact Assessment report that contain among other issues potential negative and positive impacts and recommendation of appropriate suggested mitigation measures to minimize or prevent adverse impacts of the proposed project.

- This will include providing 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.

- Develop an Environmental Management and Monitoring Plan for the proposed project.

CHAPTER 2:

PROJECT DESCRIPTION AND METHODS

2.1 Project Description

Turkana Drilling Consortium Limited is a company involved in petroleum exploration. The current exploration programme is to be conducted in the Lokichar and south Kerio basins in the southern section of block 10BB. The company, having won the exploration licence for the area, has already done a review of the previously obtained gravity / magnetic survey that detected and determined the large-scale features of the sub-surface geology. The company is also reassessing data from explorations done by Shell Oil Company in the early 1990s in the same area.

The exploration will initially cover the area within south Kerio (Kangirisae and Nakalalei in Kerio division) and also cover Kalapata and Lochingamata locations in Lokichar division. Seismic line tracks (4.5 – 5.5 metres wide) will be cleared along pre-specified transects, each traversing a range of 12 to 35 kilometres. This will entail earthworks that will slightly modify the environmental settings. This exercise uses highly sophisticated technology and the area map showing lead lines have been developed. The project will also entail the creation of two base camps at Kangirisae and Loperot areas.

2.2 Collection of Baseline Data

2.2.1 Overview of Methods

In general the framework used was as follows:

1. Scaling and Scoping (determination of geographical and other boundaries; preliminary assessment)
2. Review of existing Regulatory Framework and Institutional arrangement.
3. Detailed Assessment
4. Impact Identification and development of suggested mitigation Measures
5. Development of an Environmental Management Plan including costs estimates and responsibility assignment

The field study (scoping and detailed assessment) was carried out from 24th June to 4th July 2008. For all the sampling points, GPS co-ordinate readings were taken and recorded (Figure 2.1)

A desk study was conducted to review the available reports, design plans and maps in order to compile relevant biophysical and socio-economic information on the study area. The biophysical information was then compiled on environmental aspects such as topography, climate, hydrology, drainage, soils, geology/hydrogeology, vegetation and wildlife. The socio-economic environment study covered information on issues such as population, land use, land tenure, the social dimensions of well being and income levels, water supply, sanitation levels, policing among other pertinent issues. Field visits were conducted in the study area in order to collect site specific information on the biophysical and socio economic environment and to cross check the accuracy of the secondary data compiled during the desktop study. An extensive field visit was made to all areas including the proposed base camps.

2.2.2 Challenges in the Field

The challenges faced during the field trip were as follows;

- **Language barrier** – most of the residents are semi-literate or completely illiterate thus communication was through a translator.

- **Security concerns** – this being a cattle rustling prone area insecurity was a major issue and made our schedule to be restricted to day time.

- **Stakeholders and the community limited capacity** – they are unfamiliar with the petroleum exploration process and their knowledge about the E.I.A process and the substantive issues involved limited too.

- The field facilities (such as the living tents, the working tent, working tables, chairs and power supply) were in appropriate and not conducive.

- The road network in the area is not good. Accessibility to some parts of the study area is difficult

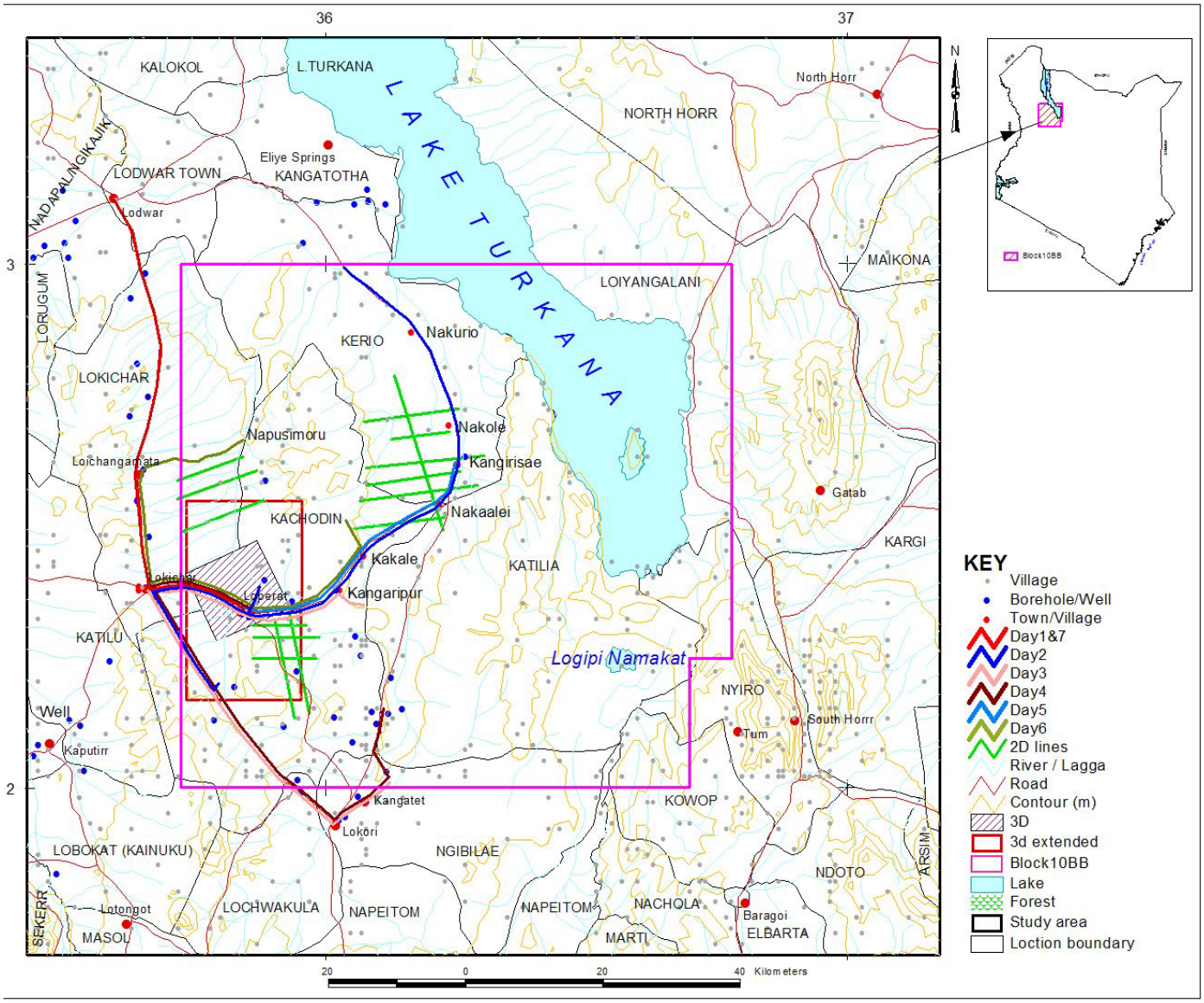


Figure 2.1: Route map for the field survey

2.2.3 Physiography and Geology

A literature review and field verification of the regional physiography and geology of the area was undertaken and the potential of related hazards (subsidence, landslides, earthquakes, etc.) were assessed in relation to the proposed project activities.

2.2.4 Soils

Primary soil data was obtained using the exploratory soil and agro-climatic zone map and report of Kenya (Sombroek *et al* 1982). Since the scale of the report was 1:1,000,000, it was found necessary to carry out a reconnaissance survey of the area at a scale of 1:50,000 through the use of existing topographical maps, satellite imagery and base maps denoting the proposed

project site (supplied by Turkana Drilling Consortium). Field data was collected through visual observation of soil auger points, and mini-pits where necessary to describe the soil mapping units. Soil texture, colour and structure were described to aid in soil classification. Surface physical characteristics were described to determine wind and soil-water erosion hazards, ponding and water logging potential. Surface stoniness and rockiness was also considered where agricultural enterprise was potentially viable. A GPS was used to geo-reference the sampling points. Soil samples were collected for fertility analysis where agricultural activities were noted. Office work included soil map compilation and correlation to assign soil boundaries and harmonize the soil legend.

2.2.5 Winds and Precipitation

This data was obtained from desktop studies and for winds was supplemented by visual observation in the field.

2.2.6 Air

The area is remote, rural and very sparsely populated. Determination of the ambient air quality in this rural setting was assessed qualitatively as it is essentially pristine and conforms to expected natural background levels for such areas.

2.2.7 Water

In order to assess the water quality, a thorough literature review was conducted covering the existing boreholes for physio-chemical analysis. In addition, water samples were collected from boreholes and shallow wells for physio- chemical analysis. GPS positions of all sampling locations were recorded. Vertical electrical sounding using a Terrameter was also conducted in the proposed project campsites, to determine possible locations of potable groundwater aquifers.

2.2.8 Terrestrial Environment: Flora and Fauna

The assessment was based on literature review as well as observations taken in the field. Considerations included whether the area has experienced any known loss of habitat or biodiversity decline, and whether the proposed operations related to exploration for oil and gas would have any adverse effect on the ecosystems flora and fauna. The approach was to navigate by car to an area of interest guided by GPS points provided to us by the proponent of the study. Stops were made in vegetation transitional zones, areas with unique vegetation settings, animal encounters, settlements and watering points thought to be of interest. Once on the ground a general classification of the area was done using the *Pratt et al* criteria (1966). After key vegetation types were recorded and where possible local names were recorded and uses of the tree or shrub was recorded. Species of mammals, birds, reptiles, amphibians, and arthropods present at the time of observation were noted down.

2.2.9 Aquatic Environment: Flora and Fauna

The assessment was based on literature review as well as observations taken in the field. Considerations included whether the area has experienced any known loss of habitat or biodiversity decline, and whether the proposed operations related to exploration for oil and gas would have any adverse effect on the ecosystems flora and fauna. The approach was to

navigate by car to an area of interest guided by GPS points provided to us by the proponent of the study. Stops were made in areas where aquatic habitats were encountered within the block. Once on the ground, the vegetation, mammals, birds, reptiles, amphibians, and arthropods species present at the habitat were recorded.

2.2.10 Land Resources and Natural Heritage Sites

This assessment was based on literature review as well as field observations. The following issues were considered; available renewable or non renewable resources; land degradation and associated risks and contamination; whether land uses at and in the project area could be sustained; whether the operation of the project would have the potential to cause significant land and land use changes; and whether sustainable use of the project sites (base camps) can be achieved beyond the project life. Also considered is the sustainable use of the proposed seismic tracks and road networks after the project decommissioning. We also assessed whether there exist archaeological and historic (including cultural) sites in the area that would be affected by the exploration.

2.2.11 Visual Aesthetics

This assessment was based on observations taken in the field. We considered the following issues in relation to the proposed camps and seismic survey transect lines: obstruction of view and sunlight in the area; building structures and conformity to local planning authority ; whether the built up environment would be an eyesore to the community; and whether the camps, access roads and survey transect lines would significantly affect the landscape.

2.2.12 Noise and Vibrations

The noise levels of the proposed sites, the camping sites and the surrounding areas were measured using a dosimeter.

2.2.13 Solid Wastes, Waste Oils and Effluents

Potential solid and liquid wastes that would be generated at the proposed camp sites and during the actual seismic survey were assessed and suggested mitigation measures proposed. The current methods of waste management in the project area were also noted.

2.2.14 Socio-Economics

The methodology used include review of available literature, meetings and consultation with local stakeholders and government officials, interviews and public consultation with the local residents, questionnaire surveys, site visits to the project area and the surrounding area and the application of professional knowledge and experience.

Consultations with interested and affected parties (IAPs) were conducted with the following aims:

- To sensitize and inform the local people and leaders about the proposed project and its objectives
- To identify the diverse socio-cultural and economic conditions found in the project area
- To seek views, concerns and opinions of people in the area concerning the project

- To establish if the local residents foresee any positive or negative environmental effects from the project and if so, how they would wish the perceived impacts to be addressed.

The following forums and/or tools were used:
- Public meetings (Barazas) with local residents and chiefs
- Interview with key stakeholders including government officials (DC's etc)
- Meetings with community leaders, NGO leaders and religious leaders
- Formal questionnaire survey at household level

A household questionnaire was used in 40 families for quantitative survey while personal interviews with leaders and other stakeholders were conducted for the qualitative survey. The following variables were analysed and their significance determined: land ownership, education standards, economic activities, access to water and access to health facilities.

2.2.15 Health and Public Safety

Primary data for this study was collected using questionnaire surveys, key informant interviews, and observations.

2.3 Data Analysis and Significance Determination

The water samples were taken to the Nairobi based Central Water Testing Laboratoies of the the Ministry of Environment and Natural Resources for analysis. Soil samples were taken to Kenya Agricultural Research Institute for soil survey tests.

Score 0=no known impact	
Score -1= Slight negative impact	Score + 1= Slight positive impact
Score -2= Moderate negative impact	Score + 2= Moderate positive impact
Score-3= Strong negative impact	Score + 3 = Strong positive impact

The impacts are further classified as: actual or potential; direct or indirect; short-term or long-term. Risk levels are classified as low, medium and high.

CHAPTER 3:

BASELINE ENVIRONMENTAL PARAMETERS OF THE STUDY SITE

This chapter provides details based on the desktop studies and field survey results based on the methods applied as outlined in chapter 2, section 2.2.

3.1 The Study Area

3.1.1 Geographical Aspects and Boundaries

The project area lies in Turkana South and part of Turkana Central districts that is part of Block 10BB as per the sub division developed by the National Oil Corporation of Kenya (NOCK). NOCK has identified potential petroleum exploration regions in Kenya and demarcated them into blocks. Block 10BB covers a larger part of Turkana South district and part of Turkana Central. The initial exploration under review will be limited to the south part of Kerio Basin and to Lokichar Basin in Kerio and Lokichar divisions respectively (Figure 1.2). The district has a very fragile ecosystem with up to 90% of the landmass being arid while the remaining 10% can be classified as semi-arid. The study area is currently not built up and is a natural landmass with sparse vegetation and concentrated temporary human settlement. Several seasonal rivers including the Kerio traverse the vast area.

Plate 3.1: Typical terrain of the study area. (Note the semi-arid nature)

3.1.2 Administrative Set-up

Turkana South district that has been carved out from the former large Turkana district now split into Turkana North, Turkana Central, and Turkana South Districts The latter is bordered to the north by Turkana Central District, to the east by Marsabit District, to the south-east by Samburu District, to the west by Pokot District, and to the south by Baringo District. Turkana South currently has five administrative divisions namely; Lokichar, Kainuk, Katilia, Lokori and Lomelo. The district's local authority operations are still under the larger Turkana County council. However, according to local leaders plans are underway to constitute Turkana south County Council. Lokichar town is the district headquarters, Kerio division part of which lies in Block 10BB is in Turkana Central District, whose administrative headquarters is Lodwar town.

3.1.3 Infrastructure

The project area just like most parts of the district has gravel or/ and earth roads, that are in a state of disrepair. Loperot village where the company intends to have their base camp can be approached through the main Lodwar-Lokichar road, which is bitumen standard but now in a sorry state of disrepair. The minor earth roads and tracks within the project area transverse luggas that are at times impassable. Earth roads linking: Loperot and Kangirisae (north east from Loperot); Loperot-Lochangamata-Napusimoru; Lokichar and Lokori, and Katilia are, however, in a state of disrepair and a lot needs to be done to make them motorable. There is however a functional and maintained airstrip near Lokori shopping centre.

Plate 3.2: Vehicles stuck along the truck lines. The tracks are undefined, frequently used by animals and seldom by vehicles.

3.1.4 Communication

Telecommunication system in the project area is unreliable. There is no telephone service for the inhabitants in a large part of the district and mobile telephony is only available within a radius of 10 kilometres from Lokichar Township. There is need for mobile telephone providers in the country to take advantage of the potential that exists in the area and extend their connectivity in this region. Telecommunication through mobile telephony is possible in the project area only through satellite connectivity. This is, however very expensive and way beyond the ability of the area residents. The

District administration and police use radio systems to which the local inhabitants do not have access to.

3.1.5 Governmental, Non-Governmental Organisations, and Aid/Relief Efforts

The project area is classified as ASAL region and has several non-governmental organizations (NGO's) and government agencies, with different mandates, operating from bases in Lokichar and Lodwar. The overall objective of most of these NGOs is to assist the communities minimize the adverse impacts of climatic shocks. This is done through capacity building, relief efforts and empowerment programmes. One of the key governmental agencies in the area is the Arid Lands Resources Management Programme (ALRMP) that coordinates ASAL development initiatives at district level. Their focal points are the drought management officers, who are members of the District Steering Group (DSG) in-charge of coordinating inter-sectoral ASAL initiatives. The DSG is a sub-committee of the District Development Committee. Some of the key NGOs in the project area and their mandates are discussed below:

1. World Vision Kenya

World Vision Kenya is one of the most successful NGOs in the area and has had a positive impact on the livelihood of the people as attested by them during our field visit. Among the key mandates of the organization include:

- Provision of water resources through development and maintenance of water pans, dams and boreholes. The organization has also tried to make the borehole more efficient by motorizing them using solar and wind energy.
- Relief provision and food security programmes
- Provision of subsistence loans for small scale business
- Irrigation agriculture programmes especially along the river banks and use of water dams for instance at the Morlem irrigation scheme project
- Livestock restocking – this programme is meant to cushion pastoralists from the impacts of climate shocks. It is currently at the conceptualization stage.
- Capacity building through training and empowerment programmes for both the young and adults
- Provision of logistical support to government to curb the impact of PPR (*Peste de petits a viral disease)* in livestock

2. Merlin

This is a health-based organization that works closely with health providers in the district. The organisation works closely with the Reformed Church of East Africa health centre based at Lokichar in terms of staff support programmes. Other key mandates in the project area include:

- Provision of health care programmes to the communities
- Monitoring malnutrition levels in children and providing intervention to poor nutrition especially to children.

3. Riam Riam

This is a local organization that is concerned with security issues in the district and in particular the proliferation of small arms in the area. The organization works very closely with communities in a bid to stem the negative impacts of firearms in the wrong hands. The

organisation also sensitises neighbouring communities on the need to maintain peaceful coexistence and to shun cattle rustling.

4. Reformed Church of East Africa

The Reformed Church of East Africa is one of the religious based organizations that have had a positive impact on the livelihood in the project area through numerous social initiatives. The church has been instrumental in spreading Christian faith in the area, through construction of churches in most of the trading centres. Besides Christian nourishment, the church is engaged in the following initiatives in the area:

- Health care programmes – the church has constructed and sponsored several health centres in the area. The church has also been running one of the key health centres at the Lokichar Township.
- Provision of water – the church has developed several water supply points. The main ones being water boreholes and water pans for domestic and livestock use.
- The church provides food relief to the local communities as part of food security initiatives in the area
- Education programmes – the church runs early childhood programmes and also provides nutritional care to children in the schools

3.2 Physiography and Geology

3.2.1 Physiography

The investigated area, block 10BB as demarcated by National Oil Corporation of Kenya, and herein referred to as the study area, occurs partly in Turkana south and partly in Turkana central districts, and covers Lokichar/Loperot Mesozoic sedimentary basin. The study area is generally comprised of expansive plains categorised into piedmont plains, sedimentary plains, lacustrine plains and floodplains, with elevations ranging between 437-768 masl. The floodplains occur along rivers Turkwell and Kerio. The lacustrine plains border the southern part of Lake Turkana, whereas the piedmont plains occur towards the south of the study area.

The study area is also characterized by uplands, foot slopes and hills such as Auwerwer, Hadukhungele, Lokhoriokho and Nakuangale, with elevations occasionally reaching between 900-1200 masl. The hills are largely dependent on the phase of volcanism responsible for their emplacement, and subsequent tectonic movements which tilted the layered volcanic successions (Joubert, 1966; Dodson, 1966; Walsh and Dodson, 1969).

3.2.2 Geology

Block 10BB, herein referred to as the study area, occurs in Turkana south and covers Lokichar/Loperot Mesozoic sedimentary basin. The study area is generally comprised of expansive plains with elevations ranging between 437-768 masl. The area is also characterized by hills such as Auwerwer, Hadukhungele, Lokhoriokho and Nakuangale Lake Turkana is the main surface water source. Other sources of surface water are seasonal rivers flowing during and shortly after the rains. Water pans and earth dams are significantly absent in the study area. River Omo is the main and permanent river draining into Lake Turkana and this enters the lake from the north and contributes more than 90% of the total water influx. The second largest river, Turkwel River, is now being dammed for hydroelectric power generation at Turkwel

Gorge 150 km west of the lake. The waters of this river are however murky due to high content of silt/alluvial clays and therefore not likely suitable for domestic and/or industrial uses.

Most of the other rivers in block 10BB are dry for most of the year and water flows sporadically after heavy rains. The flows are often torrential and flooding outside the shallow stream/river channels is a common phenomenon. River is Kerio other big but seasonal river that reaches the lake bed. The dry river beds that are covered with sand and are seasonal are generally referred to as *luggas*. Also noted in the study area is a bottomland within an upland landform, at Lokwamising, with a high water table yielding water through spring outlets. This area is used as a grazing ground by the local community and the water is used for human and livestock consumption.

Generally, Turkana region is characterized by a water divide which trends in a N-S direction more or less along the middle of the region. The luggas to the west of this water divide flow towards the vast Lotikipi plain in Turkana north whereas those to the east of the water divide flow towards Lake Turkana in a NNE direction. Turkana south district and the investigated area falls under the latter regime of the water divide and all the streams/rivers flow towards L. Turkana.

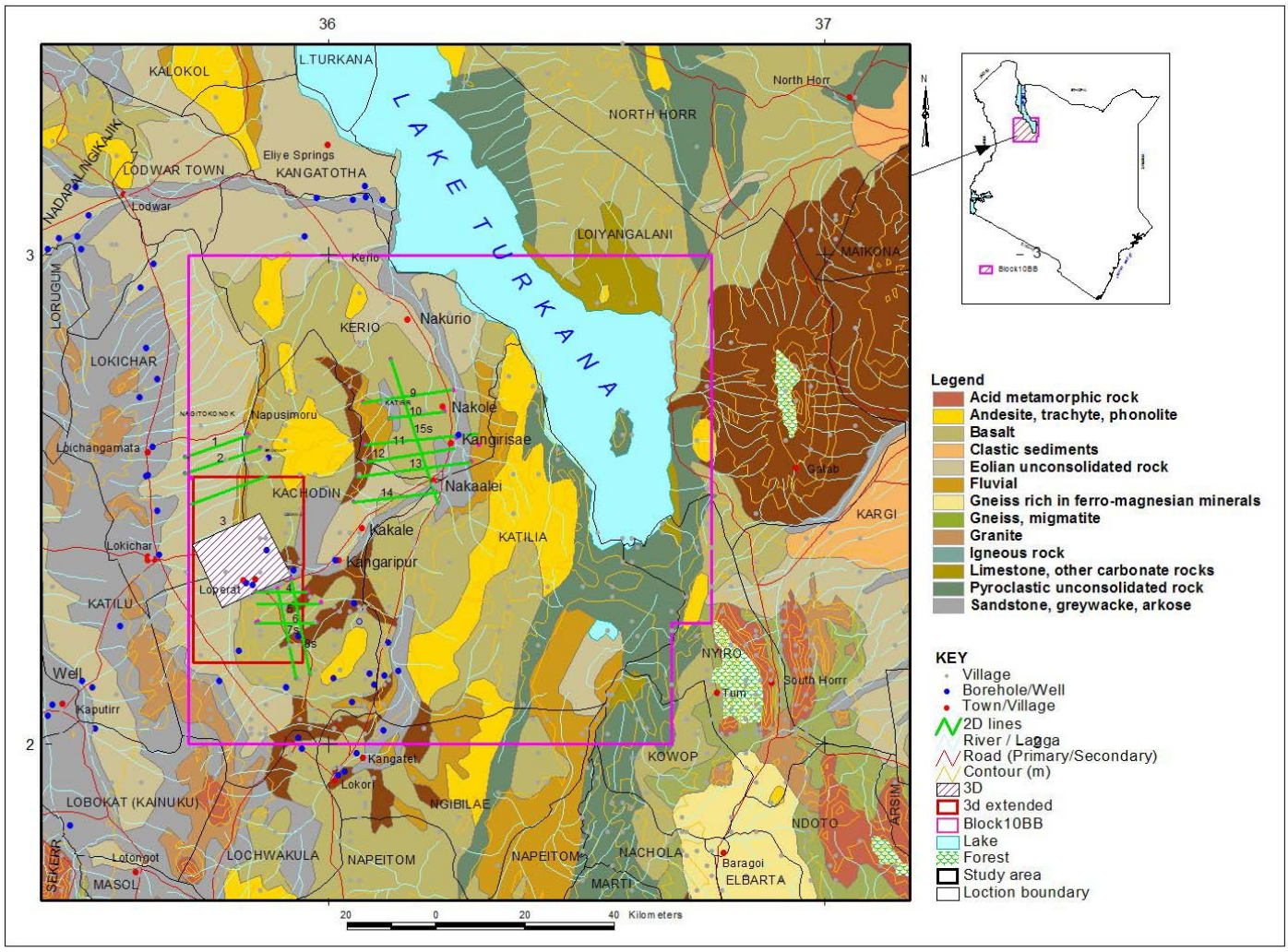


Figure 3.1 Geology of the study area

NNW trending lineaments associated with mobile belts at depth are common and are responsible for the North to NNW trending Lokichar/Loperot Mesozoic basin (Smith and Mosley, 1993). Such NNW trending lineaments controlling the Lokichar/Loperot basin include Nyangea-Athi-Ikutha and Muglad-Anza-Lamu shear zones (NOCK, 1987), which have resulted from a weakened and stretched lithosphere in northern Kenya (Bosworth et al., 1986). The NNW lineaments are the foci of Tertiary volcanism where NNW trending volcanic hills occur.
The geology of the area is dominated by rocks of various ages in the Geological timescale ranging from Precambrian (NeoProterozoic) to recent deposits. These include:

(i) The Precambrian (NeoProterozoic) basement rocks consisting of a variety of gneisses and undifferentiated brecciated rocks;
(ii) Tertiary metamorphics such as quartzites and Tertiary lavas mainly basalts, phonolites, nephelinites, trachytes, andesites and overlying tuffs and gritty tuffs;
(iii) Pleistocene to recent deposits.

Denudation has been active within the study area and the once volcanic capped hills now reveal exposures of basement system rocks. The main products of denudation include recent deposits

which denote recent activity and are mainly a product of weathering and erosion. The study area is also characterized by occurrence of Pleistocene deposits which are mainly composed of the lake/water deposits especially on the expansive plains.

The volcanic sequences comprise the hills as well as a few localities of the plains in the area. Intra-montaine plains are common and are underlain by moderately thick (10 to 40 m) layers of largely clayey sands, sandy clays and clayey alluvium, which in most cases covers a complex of fractured, weathered and fresh volcanics mainly basalts and phonolites. Within the Lokichar/Loperot sedimentary basin, the alluvium extends to over 50 m (Groundwater Survey (K) Ltd., 2001). The texture is generally clayey, although local sand lenses occur near the major river courses (luggas). Weathered volcanic sequences are suspected to underlie most of the plain at intermediate depths. The maximum thickness of the sediments in the Lokichar/Loperot basin ranges from 4-8 km and the stratigraphy is characterised by clayey alluvium, tuffs and gritty tuff, pyroclastics deposits, interbedded basalts, phonolites, nephelinites and sedimentary rocks, sub-volcanic sedimentary rocks and Precambrian basement rocks (Wescott et al., 1999; Mariita, 2003).

The Tertiary volcanic formations unconformably overlie metamorphic rocks of the Precambrian basement system which are comprised mainly of gneisses and a variety of undifferentiated brecciated rocks. Outcrops of the Precambrian basement system rocks are localized within block 10BB oil prospect due to thick volcanic and alluvial sediment cover. Most of the basement system rock outcrops are only evident along river courses where they have been exposed due to erosion of overlying sediments and volcanic cover. Where a 'veneer' of sediments and volcanics occur, the estimated depth to basement is probably more than 200 metres, but within the intramontane plains, a moderately thick layer of alluvial clays and sands overlies the weathered and fractured volcanic series. Generally, the sediments reach a thickness of approximately 15 metres, although locally this is considerably more and is between 4-8 km (Wescott et al., 1999) especially in the greater part of Lokichar/Loperot basin, which is largely overlain by a thick series of Pleistocene to recent alluvial and lacustrine clays. The fine-textured sediments form a continuous sheet over the Tertiary basalts, phonolites, nephelinites, tuff and gritty tuffs.

The stratigraphic sequence, from youngest to oldest, of the major geological formations in Turkana south can be summarized as follows:

- Recent deposits:
  Clayey alluvial deposits, clayey sands, sandy clays, superficial limestone

- Pleistocene deposits:
  Lake beds

- Tertiary volcanics:
  Basalts, phonolites, nephelinites, trachytes, andesites, tuffs and gritty tuffs, and
  Tertiary metamorphics:
  Quartzites

- Precambrian (Neoproterozoic) basement system rocks
  Gneisses, migmatites, and a variety of undifferentiated brecciated rocks.

The Pleistocene to recent Lake deposits, clayey alluvium, sandy clays and clayey sands are fine-grained and cover most of the low-lying plains. The local sediments are a mixture of

lacustrine, deltaic and fluviatile deposits. Generally, their texture is fine to very fine, although sand beds and gravel lenses are also common especially near the major river/stream courses. Moderately thick layers of sandy alluvium and gravel beds can be expected. Records of borehole logs indicate that the sediments of the intra-montaine plains usually extend to a depth of 10 to 35 metres (Groundwater Survey (K) Ltd., 2001). Within the Lokichar/Loperot basin, relatively thick sequences of clays and silts dominate. The thickness of these clays and silts is unknown but may locally exceed 70 metres (Groundwater Survey (K) Ltd., 1993, 2000); however, the general regional sediment thickness ranges between 4-8 km (Mariita, 2003; Wescott et al. 1999).

The phonolites overlie the basaltic sequences in the area and appear as remnants especially on the Auwerwer and Hadukhungale hills. The phonolites are somewhat fissile with typical platy jointing and usually have greenish grey aphanitic matrix containing occasional small anorthoclase phenocrysts. The phonolites outcrop locally at Katilia, Kachodin and Kerio areas among others.

Basalts overlie the Turkana grits form the foundation of the hills in Turkana south. The hills are either remnants of flows, are denuded volcanic cones or in most cases have been intruded by large dyke-like bodies along major faults. The basalts are presumed to have covered most the eastern part where Turkana grits are now exposed but are overlain by thick alluvium cover to the west. Borehole logs and outcrops show that basalts are the dominant rock types within the intra-montaine plains within the region. The basalts are highly resistant to weathering and this gives rise to their rugged and steep-sided topography. Their appearance varies little throughout the area: they are of medium to coarse porphyritic texture, with phenocrysts up to 0.5 cm of pyroxene (augite), olivine and plagioclase. The colour varies from blue-grey to black. Most of the outcropping rocks are intensively fractured and borehole logs indicate that such fissured and fractured basalts are the most important local aquifer.

The Turkana grits occur in the eastern parts of Loperot area where they are overlain by Tertiary lavas. However, exposures of Turkana grits are poor and consist of more resistant calcareous rocks, while others occur along the escarpments where gullies are carved into talus of the retreating scarps. Faulting and gentle folding are characteristic and repetition of beds due to successive sediments of similar nature as well as strike faulting are a common occurrence.

The Precambrian metamorphic basement system rocks of Turkana south consists of a stratiform sequence of successive layers of differing lithology that represents a sedimentary succession which has been subjected to granitization and metamorphism of a high degree. These are comprised of an upper fine-grained pelitic series with crystalline limestones and quartzites overlying a series of course gneisses, migmatites and a variety of undifferentiated brecciated rocks. The gneisses are marked by an increase in granularity and are lighter in overall colour. Localized bands of crystalline limestone and highly weathered quartzites are common. Due to the overlying thick sediment and volcanic cover of approximately 4-8 km (Wescott et al., 1999) the basement rocks are of no hydrogeological significance in Turkana south. Localized exposures of the basement rocks occur in river channels and on hills where they have been exposed due to erosion of the overlying volcanic cover.

The main structural features in Turkana south are two parallel, north-south trending synclinal basins occupied by Lake Turkana to the east and Lokichar/Loperot plain to the west. The volcanic fringes of the synclines are moderately faulted and tilted, and the lava sheets are marked by low eastward and westward dips of about 2 to 6 degrees. The volcanic ridges and

hills are characterized by north-south trending faults having downthrows to the east and west. Due to the moderate faulting of the lava blocks, the basalts are expected to be widely fractured.

3.3 Soils

The soils found in the sedimentary and piedmont plains vary from shallow to deep, usually with low or no organic matter. The drainage characteristics vary from imperfectly drained, moderately well to well drained soils. Soil colour varies from pale brown to dark brown. Most of the soils in the plains are calcareous, saline and sodic at various thresholds. These soils are susceptible to wind and water erosion due to the dispersion of clay colloids caused by sodium presence. Surface characteristics vary from loose powdery like soil which is susceptible to wind erosion, surface gravels, stones and rocks which may hinder accessibility to certain classes of machinery and equipment and agricultural activity. Soil texture varies from sand to clay loam. Where saline/sodic conditions exist, the soil structure is columnar or prismatic. Most of the soils classify as luvisols, fluvisols, regosols, lithosols, solonetz, solonchaks, arenosols and cambisols.

Mapping Unit MV

This unit is found to the south of Lake Turkana in Katilia division. Smaller units of the same are to be found in the south western tip of block BB around Kainuk. Its geology is undifferentiated Tertiary volcanic rocks. The landform/topography is mountain with very steep irregular slopes over 30% in steepness. The soils are well drained, shallow, of varied colours, clay loam very gravely, stony and rocky. The topsoil conditions are moderate to high fertile soils of low water holding capacity. The gully and sheet erosion condition is end stage sheet erosion.

Mapping Unit HU

This unit is found in Lokichar Division, an interlude, of the otherwise vast piedmont plain underlying the same area. It stretches southwards to Kainuk division.. Its geology is undifferentiated metamorphic rocks. The landform/topography is Hills with steep irregular slopes of variable steepness. The soils are well drained, of various depths in many places very shallow, of varied colours, loamy sand and sandy clay loams, in most places rocky and stony. The topsoil conditions are moderately fertile soils of low water holding capacity. The gully and sheet erosion condition is locally severe.

Mapping Unit HV

This unit is found on the northwest part of Lodwar and also southwards within the study block, in Central, Kerio, Lokichar and Kachodin Divisions. Its geology is undifferentiated tertiary volcanic rocks. The landform/topography is hills with moderate irregular slopes. The soils are well drained, very shallow, yellowish brown, clay loams and silty clay loams, locally calcareous extremely gravely and stony. The topsoil conditions are moderate to high fertile soils of low water holding capacity. The erosion condition is end stage stone pavement, sheet and gully.

Mapping Unit HsV

This unit is found south east and west of Lake Turkana from Katilia to Ngibilae. Its geology is undifferentiated volcanic rocks mainly basalts. The landform/topography is hills with step fault escarpments and gentle slopes. The soils are moderately well to well drained, shallow to very shallow, yellowish brown, calcareous very gravely to extremely rock, clay to fine sandy clay

loam. The topsoil conditions are moderate to high fertile soils of moderately to very low water holding capacity and moderately to very low infiltration capacity. The erosion condition is moderate sheet to severe sheet erosion.

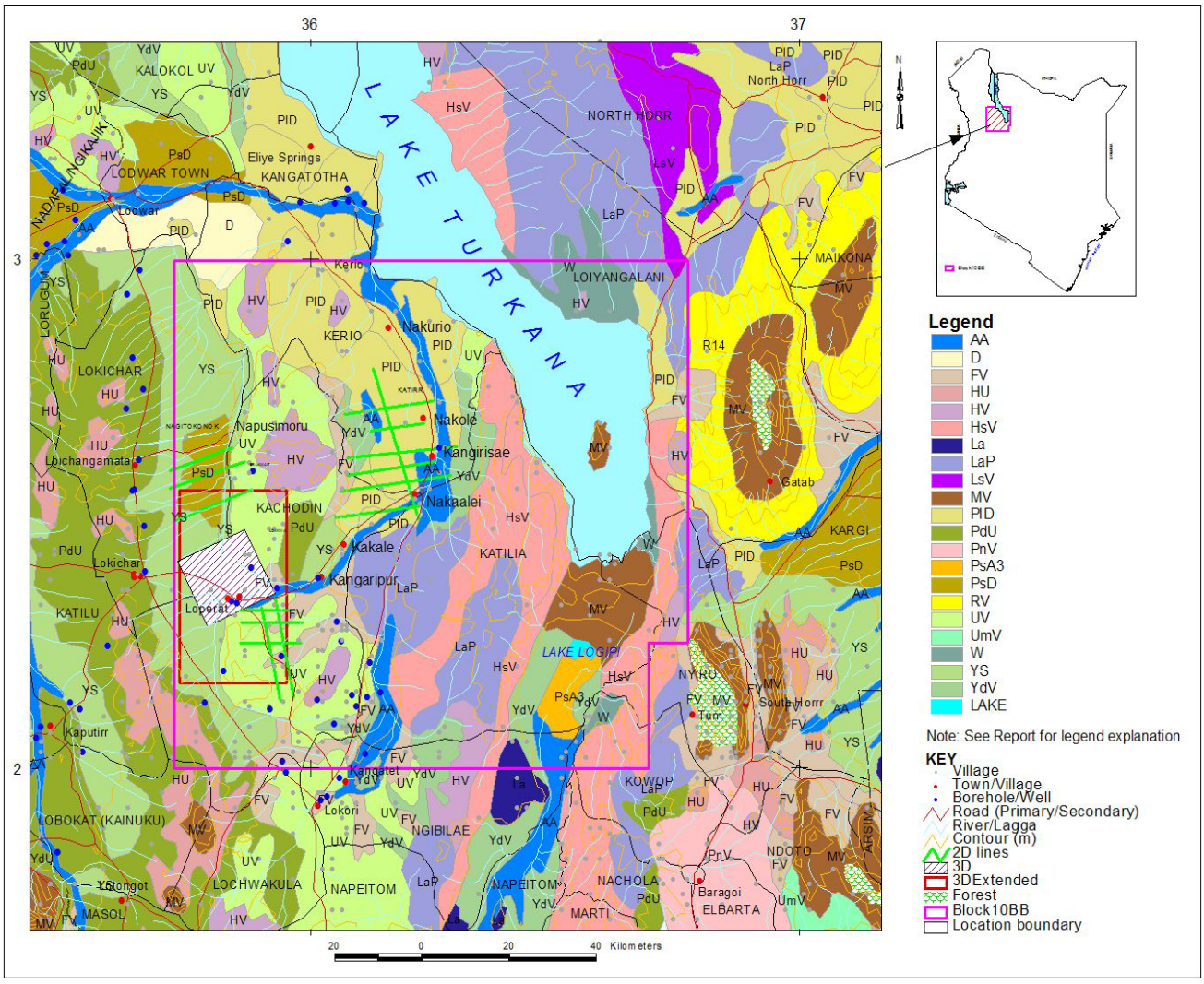


Figure 3.2: Soils of the study area.

Mapping Unit LsV

This unit appears in the north west extremity of Block 10BB, and extends into North Horr. Its Geology is undifferentiated volcanic rocks mainly Basalts. The landform/topography is step faulted plateaus with gentle slopes broken by steep scarps and gorges. The soils are well drained deep and very shallow, yellowish brown extremely stony and bouldery, clay to clay-loam. The topsoil conditions are moderate fertile soils with low to moderate water holding capacity. This unit has a slight wind and water erosion status.

Mapping Unit UV

This is a large unit found to the north of Lodwar and the eastern part of the inner study area from Kerio, flowing southwards to Lokichar and onwards to Napeitom division. The same unit is to be found in Kangirisae area of Kerio division. Its geology is undifferentiated tertiary volcanic rocks. The landform/topography is uplands at differentiated lower levels consisting of rolling topography of short slopes. The soils are well-drained, very shallow, yellowish brown extremely gravely and stony clay loam. They are calcareous and locally saline. The topsoil conditions are moderately to high fertile soils of low water holding capacity. The erosion condition is gravel pavement.

Mapping Unit FV

This unit is found in various parts of the study area South of Lodwar in Kerio and Lokichar divisions and further south towards Napeitom division Its geology is volcanic rocks and derived sediments. The landform/topography is foot slopes, consisting of gentle slopes of 5-3%. The soils are well drained, deep and shallow, dark reddish brown, locally stony, clay loam and clay, locally saline and calcareous. The topsoil conditions are moderately fertile soils of moderate water holding capacity. The erosion condition is moderate sheet and gully.

Mapping Unit YdV

This is a small unit found in various parts of the study area. It is predominant south of Lake Turkana, from Lake Logipi to Napeitom division. Pockets of it are found in Kangirisae and Nakalalei.. Its geology is undifferentiated tertiary volcanic rocks and derived colluvial, alluvial deposits. The landform/topography is piedmont plains, consisting of intricately dissected gentle slopes. The soils are well drained, shallow to moderately deep, dark reddish brown to dark greyish brown, clay to loam, locally saline and calcareous with gravely and stony surface. The topsoils are moderately fertile with moderate water holding capacity. The erosion condition is gravel pavement, sheet and gully.

Mapping Unit PnV

This is a small unit within the study area and is found in Baragoi area of Samburu district. Its geology is undifferentiated volcanic rocks mainly basalts. The landform/topography is non-dissected plains, consisting of gently undulating to almost flat topography. The soils are moderately well drained, moderately deep, greyish brown calcareous clay, locally stony and bouldery. The topsoil conditions are moderately fertile

Mapping Unit PdU

This unit is found north east of Lodwar around Kalokol and southwards covering Turkwel and Lokichar divisions to Kainuk and Lochakula divisions. Its geology is undifferentiated metamorphic rocks. The landform/topography is dissected erosional plains, consisting of gentle long slopes intrically dissected. The soils are well drained very shallow yellowish red to dark brown locally calcareous and saline loamy coarse sand to sandy clay loam. The topsoil conditions are moderate fertile soils of very low water holding capacity and moderate to low infiltration capacity. The surface is extremely gravely. Local gully erosion is evident.

Mapping Unit PsA3

This is a small unit in the study area found south of Lake Logipi. Its geology is (sub) recent saline–sodic sediments. The landform/topography is sedimentary plains, consisting of flat, topography. The soils are imperfectly to poorly drained, very deep, olive brown, strongly saline and sodic, silty loam to clay texture. The topsoil conditions are moderately high fertile soils, of moderate water holding capacity. The erosion condition is locally active dune formation (wind erosion and deposition). Hazard of local ponding and flooding are envisaged.

Mapping Unit PsD

This unit is found around Lodwar town and around Lochwangamanak area in Lokichar division. Its geology is undifferentiated sediments and windblown deposits. Its landform/topography is sedimentary plains consisting of very gently undulating slopes with small dune ridges. The soils are excessively to imperfectly drained, very deep, pale brown to dark brown, none saline and sodic loamy sand to sandy loam. The topsoil conditions are moderate to low soil fertility, high to low infiltration capacity and with a moderate to low water holding capacity. The unit suffers from slight to moderate sheet and wind erosion and is susceptible to local ponding.

Mapping Unit PID

This unit is found adjacent River Turkwell and Kerio flood plains and also bordering Lake Turkana to the south. Its geology is lake deposits and windblown deposits. The landform/topography is lacustrine plains (almost flat) with dune ridges and coastal bars topography. The soils are somewhat excessively and moderately well drained, very deep, locally shallow, pale greyish brown calcareous locally extremely saline of various sandy textures, with local gravel beds. The topsoils are moderately fertile and, of low water holding capacity. The erosion condition is stable, no features recorded. Hazard of local ponding is noted.

Mapping Unit AA

This unit forms the Turkwell and Kerio River floodplains. It is also found around Kangatet and south of Lake Logipi. Its geology is (sub) recent riverine alluvium. The landform/topography is riverine (flood) plains, consisting of almost flat, partly with braiding river channels, topography. The soils are well drained, very deep, pale greyish brown locally calcareous, stratified fine sandy to clayey texture. The topsoil conditions are high fertile soils, of high water holding capacity. The erosion condition is local gullying along channels and locally active dune formation due to wind erosion. Hazard of local ponding is noted.

Mapping Unit D

This unit is found south of Lodwar bordering the Turkwell River floodplains west and east of Lodwar. Though not indicated in the map due to scale factor, the unit is also found in pockets towards Nakalalei and Kangirisae, bordering the PID mapping unit. Its geology is windblown sands. The landform/topography is dunes consisting of undulating relief, with short slopes. The soils are well to excessively drained, very deep, slightly yellowish brown non-saline slightly calcareous sand texture. The topsoil conditions are moderate fertile soils, of high infiltration capacity and moderate water holding capacity. The unit has slight wind erosion.

Mapping Unit La

This unit is found around Lochakula and Napeitom divisions. Its geology is recent volcanics mainly basalts. The landform/topography is lava flows consisting of very irregular, rugged mesotopography. This topography is extremely rocky. No soils are present.

Mapping Unit LaP

This unit is found around Kangaripur and Katilia areas to the south east. It is also found near Lake Logipi to the south east, bordering Block BB and extending to Marsabit and Samburu districts. Its geology is recent volcanics mainly basalts, partly covered by volcanic ashes. The Landform/topography is lava flows consisting of irregular and flat terraced mesotopography. The soils are very shallow to various depths yellowish brown, slightly calcareous, fine gravely sandy clay loam withy rock outcrops. Soil fertility is moderate. This unit has stable to slight erosion class.

Mapping Unit W

This unit is found around Loiyangalani in Marsabit and bordering Lake Turkana to the south east. Its geology is Plio-Pleistocene bay sediments (Marafa beds). The soils are excessively drained, reddish brown, firm; strongly calcareous, slightly to moderately saline, strongly eroding and in many places with a gravel or stone surface. The surface is stony and bouldery.

Other Mapping Units in the environs of the study area but outside Block BB are: RV, UmV and PnV. The landforms/topography are volcanic footridges, uplands and non-dsissected plains respectively. The geology is of various volcanic origins.

3.4 Climate

This project was carried out in an area which is classified as semi arid and arid land (ASAL) characterized by harsh climatic condition most of the year. Temperatures range between 29 ^{o}C and 41 ^{o}C, depending on the time of the year. The area is hot and dry for most part of the year and this explains why the vegetation cover is relatively low. Wind speeds range between 22-28 m/s measured at 50m height. Though fairly low compared to Lodwar with 44-48 m/s wind speeds, the wind in the study area causes windblown erosion especially around Nakaalei where there are sand dunes.
The study area is in Agro-climatic zone VII (ACZ V11-1) and a small unit in Agro-climatic zone VI, [(ACZ V1) Figure 3.3]. ACZ V11 covers the area from Lodwar and most of the study area and only varies at the south western and south eastern parts which are in ACZ V1-2 towards the eastern and western parts of Kangetet divison and around Katilia area. The rest of the area is in ACZ VII comprising of Loperot, Kachodin, Kerio, Loiyangalani locations and Loriu plateau within the study area.

According to Sombroek *et al*, 1982, ACZ V1 is classified as arid with average rainfall of 300-550 mm, while V1I is classified as very arid with average annual rainfall of 150-350 mm annually. Rainfall is unreliable and famine is a constant threat. Flash floods are common during the rains and with the inherent sparse vegetation cover in the area, this leads to degradation of the soil.

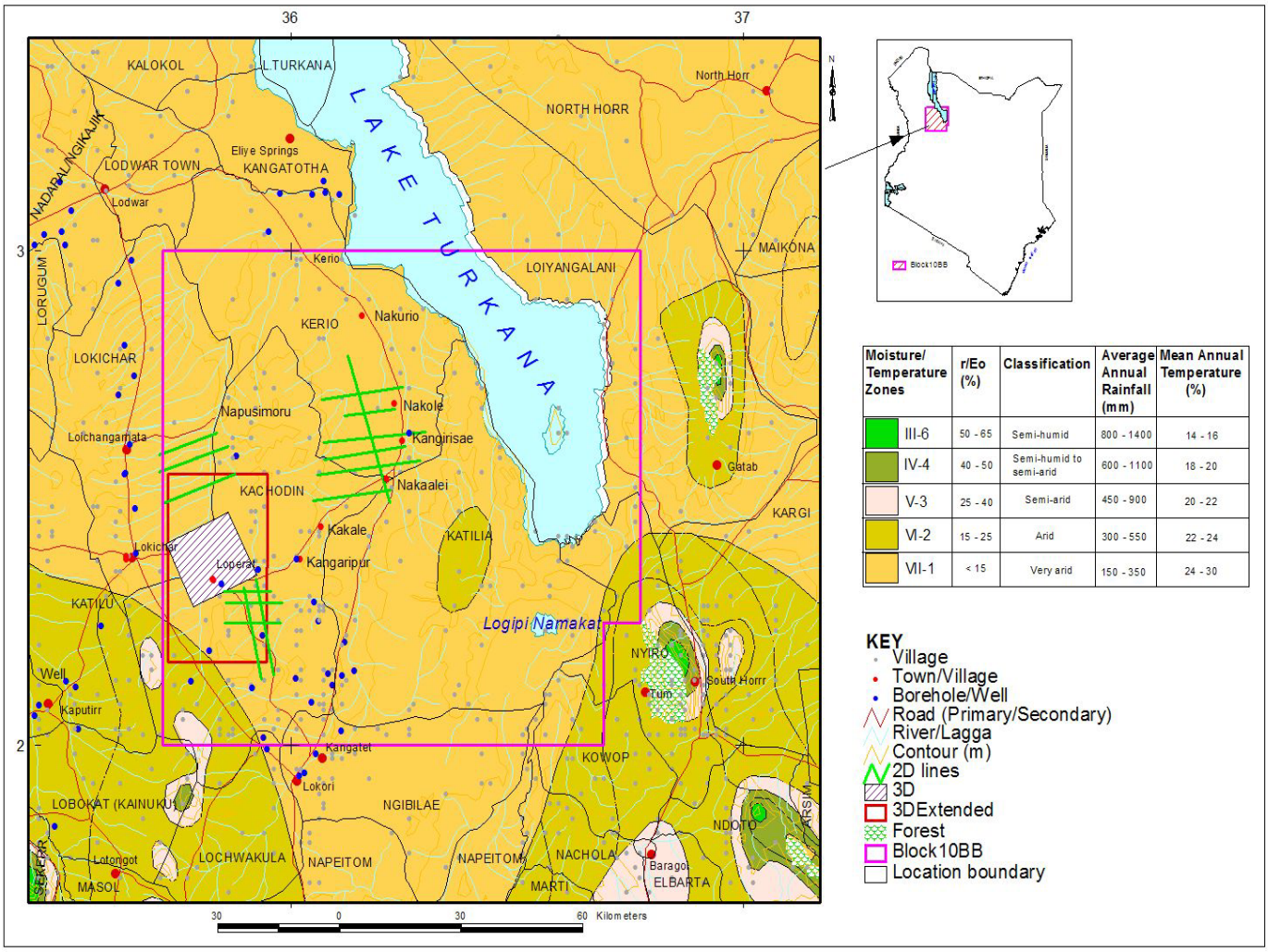


Figure 3.3: The agro-climatic zones (Sombroek et al., 1982).

3.5 Air Quality

The air quality is good as the area is rural, sparsely populated, generally undeveloped and far removed from major towns, cities, agricultural and industrial centres that are major contributors to air pollution.. There is some natural pollution related to wind blown dust as the sometimes strong easterly winds blow across the sparsely vegetated surface. Minimal air pollution is also as a result of the few vehicles traversing the survey area and raising dust as well as releasing exhaust fumes. In addition, herds of grazing animals contribute to minimal air pollution as they raise dust in the course of movement from one point to another.

3.6 Surface and Groundwater Resources and Effluents

3.6.1 Surface water

Lake Turkana is the main surface water body in the area.. Other sources of surface water are seasonal rivers flowing during and shortly after the rains. Water pans and earth dams are significantly absent in the study area. River Omo is the main and permanent river draining into

Lake Turkana and this enters the lake from the north and contributes more than 90% of the total water influx. The second largest river, Turkwel River, is now being dammed for hydroelectric power generation at Turkwel Gorge 150 km west of the lake. The waters of this river are however murky due to high content of silt/alluvial clays and therefore not likely suitable for domestic and/or industrial uses.

Most of the other rivers in block 10BB are dry for most of the year and water flows sporadically after heavy rains. The flows are often torrential and flooding outside the shallow stream/river channels is a common phenomenon. River is Kerio other big but seasonal river that reaches the lake bed. The dry river beds that are covered with sand and are seasonal are generally referred to as *luggas*. Also noted in the study area is a bottomland within an upland landform, at Lokwamising, with a high water table yielding water through spring outlets. This area is used as a grazing ground by the local community and the water is used for human and livestock consumption.

Generally, Turkana region is characterized by a water divide which trends in a N-S direction more or less along the middle of the region. The luggas to the west of this water divide flow towards the vast Lotikipi plain in Turkana north whereas those to the east of the water divide flow towards Lake Turkana in a NNE direction. Turkana south district and the investigated area falls under the latter regime of the water divide and all the streams/rivers flow towards L. Turkana.

3.6.2 Groundwater

Hydrogeology and groundwater potential

Groundwater resources form the most available source of water supply in the study area. The groundwater is exploited through boreholes and shallow wells excavated in luggas within the study area. The water is often clean and this signifies low content of total dissolved solids (TDS). However, some recently dug wells have yielded somewhat murky water. The water is used both for domestic and livestock consumption. Some boreholes have however dried up due to lack of recharge which has contributed to fluctuating levels of the water table (e.g. boreholes at Kanga'kipur area-- Kerio river basin, Lomunyenkuprat and at Napusimoru area) whereas others have slightly saline water.

Generally, the hydrogeology of volcanic rocks and sediments found in the investigated area cannot be compared with the general groundwater conditions within the older metamorphic rocks of the Precambrian basement complex. Basement rocks usually display a simple weathering profile, marked by a gradually decreasing degree of alteration with depth. The base of the weathered zone is formed by fresh and impermeable Basement rocks. Water -if present- is exclusively found in the weathered zone (usually towards its base), local fracture systems, and sediments overlying the unaltered and dry bedrock. Deep weathering and low clay content are good indicators of probable groundwater occurrence.

Lava flows such as basalts and phonolites, rarely posses significant primary pore space; their porosity is almost entirely governed by secondary features, such as fissure zones, fractures, cooling and shrinkage joints, pyroclastic layers, lithological contacts (which include different lava flows within the same lithology), and Old Land Surfaces (OLS) due to weathering and erosion of pre-existing rock surfaces during periods of quiescence characterized by lack of volcanic activities. Groundwater in the volcanics occurs within these secondary aquifers and more often, their thickness is limited to a few metres. A significant difference with the Basement System

rocks is the fact that potentially water-bearing altered zones may be encountered below a level of fresh, unaltered rocks. As such, the chances of striking water increase with the drilling depth. Provided that the penetrated depth is sufficient, it is comparatively rare to have a dry borehole in a volcanic environment. There is however a tendency of deteriorating water quality at deeper levels (although this is not always the case).

Even though the mean rainfall is less than 550 mm per annum, a combination of alluvial and/or fractured volcanic aquifers ensures that the overall potential for groundwater development in the investigated area is considered to be reasonable. However, the hydrogeological conditions are variable, and strongly linked to the physiography and secondary features.

The floodplains of the major rivers/luggas will be marked by good opportunities for shallow groundwater development, especially in their middle reaches. Dry river beds are often underlain by water bearing, sandy alluvium. For the nomadic Turkana people, shallow wells dug within the stream channels are the most important traditional sources of water supply.

The Lokichar/Loperot basin is often characterised by very poor opportunities for fresh groundwater, especially at increasing distance from the main surface water courses (luggas). Chances of drilling dry boreholes or striking brackish aquifers are rampant. The local aquifer system is formed by a combination of alluvial, alluvial-volcanic and volcanic regimes, which are distinguished by the geology and recharge.

There are essentially five rock formations that significantly influence the hydrogeology of Turkana south and the investigated sites. The stratigraphic sequence, from youngest to oldest, of these rock formations is as follows:

- Pleistocene to Recent alluvium
- Phonolites
- Olivine Basalts
- Turkana grits
- Precambrian Basement rocks

Each of the above rock formations has been discussed exhaustively in chapter one, section 1.2 above.

Turkana south is dominated by vast plains and towering volcanic capped hills and the lava sheets are anticipated to continue underneath the alluvial deposits of the plains. Generally, a volcanic series is built up like a sandwich, comprising different lava flows, pyroclastic beds and weathered zones which have presumably been reduced to thick clays. A favourable aspect of such layered formations is that the number of potential water strikes increases with the total drilling depth. Unlike the typical basement rock situation, water-bearing zones may be encountered below a level of fresh and dry volcanic rocks provided that the penetrated depth is sufficient. It is thus comparatively rare to have a dry borehole in a volcanic environment. There is however a tendency of deteriorating water quality at deeper levels (although this is not always the case).

Despite the layered nature of most volcanic series, extensive layers of homogeneous lava can be found. Basalts, in particular, have a tendency to be very massive. This can be an unfavourable attribute, considering that older lava flows (such as the basalts and phonolites of Turkana south rarely posses significant primary pore space. Instead, groundwater is mostly stored in secondary features, such as fissure zones, fractures, cooling and shrinkage joints, lithological contacts and Old Land Surfaces (OLS). In strongly stratified or fractured lavas,

substantial yields can be obtained from relatively thin but highly permeable, water bearing layers. Often, the thickness of these individual aquifers is limited to a few metres.

Individual aquifers formed within OLS, pyroclastic layers and contact zones generally produce in the range of 1 to 2 m^3/hr. This means that several consecutive water strikes are generally required to obtain a reasonably high discharge. Yields in excess of 5 m^3/hr can be achieved from boreholes located in "open" faults and fissure zones. The potential of structurally altered rocks is three-fold:
The fractures form additional open pore space, thus increasing the transmissivity of the formation and storativity of water.
Along faulted or fissured rocks, weathering can penetrate much deeper, thus creating sub-vertical zones filled with relatively coarse, weathered material. These zones generally have a much higher transmissivity than their surroundings. Groundwater recharge occurs over large areas since faults may extend well beyond the limits of the surface catchment.

Although faults and fractures are often associated with water bearing zones, it should be noted that they may also form barriers to groundwater flow especially when filled with clays (Mulwa, 2001; Mulwa et al, 2005). In this case the structure acts as a "groundwater dam" and significant storage may build up on its upstream side. Drilling inside such a closed fault system, however, would in most cases be futile. Thirdly, there are faults or fissure zones that, despite having all the properties of a water bearing zone, are not productive due to a lack of recharge (dry, open fractures). Evidence from borehole logs confirm that most groundwater resource in this area is tapped from fractured aquifers developed within the basalts.

Alluvial aquifers are formed within the unconsolidated deposits of river floodplain areas which include both active and abandoned stream channels, sedimentary basins, and alluvial fans. River sediments normally present favourable conditions for groundwater occurrence. Deposits of pure unconsolidated sands are characterized by high transmissivity but the permeability rapidly decreases in the presence of clays even if the clay content is very small. To evaluate the aquifer potential of alluvial deposits, the thickness and distribution of silt and clay layers are important. The occurrence of clays will reduce recharge, effective storage and potential borehole yields. In the larger Turkana south district, river flow patterns are highly variable. As a result, the composition of river beds and alluvial deposits is very erratic and heterogeneous: their texture may range from alluvial clays to gravels and boulders. Sediment loads may be extremely high during periods of heavy rains and flash floods. Since the gradients further away from the hills are typically very low, once the flow rate declines, sediment particles will be deposited in order of decreasing grain size. Hence, the alluvium becomes finer downstream. In the flat and gentle plains or at other points of rapidly decreasing gradient, the rate of deposition is generally much higher that the rivers are not able to maintain their fixed river channels. Instead, the streams/rivers spread out over a wide area, forming a braided river channel and deltaic fans.

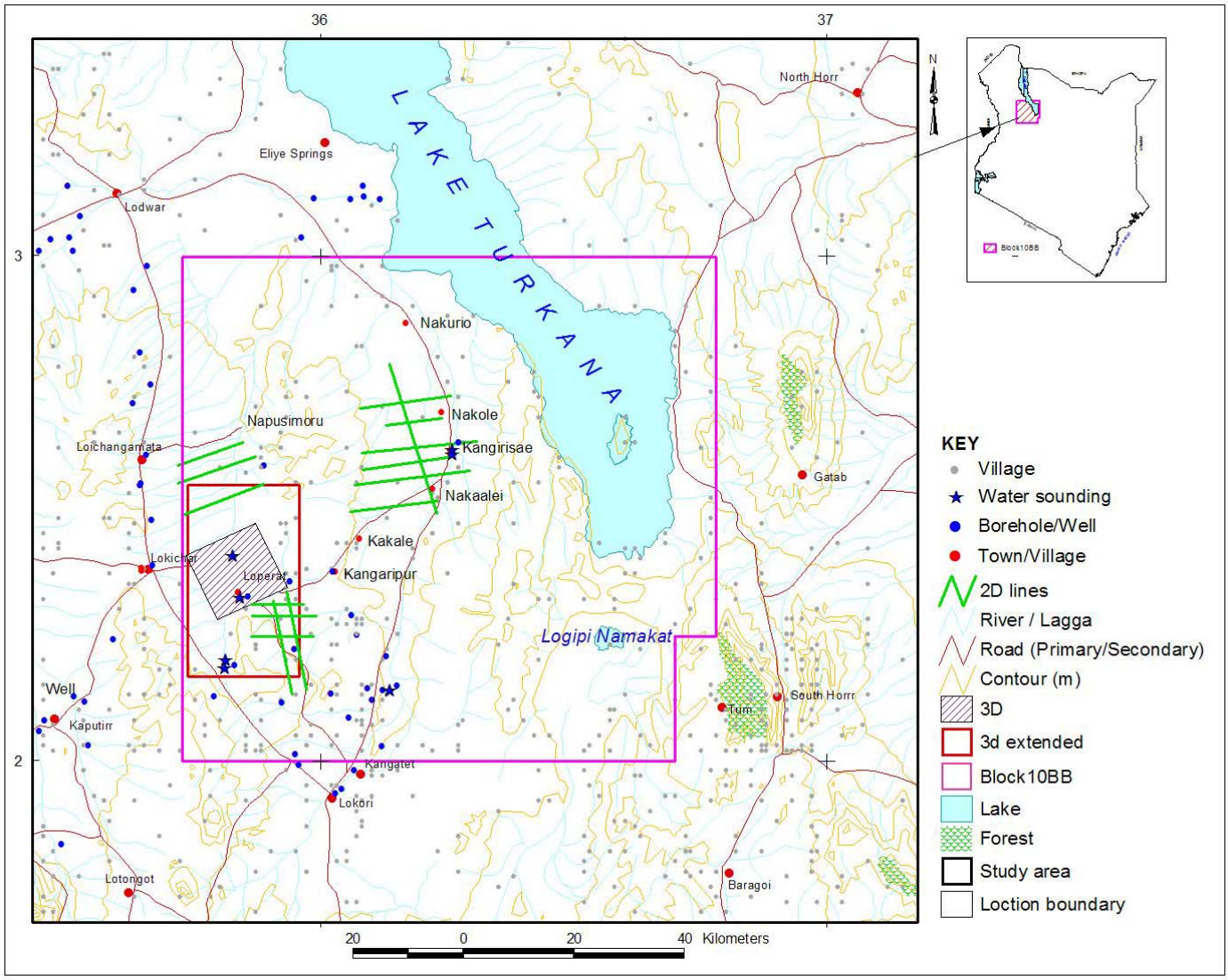


Figure 3.4: Water points of the study area.

Groundwater is only one of the elements of the hydrological cycle and its occurrence and value as a water supply source is not determined solely by geological formations. For a geological unit to be described as an aquifer, the material must not only be porous and permeable but it must also receive and be able to transmit water. Recharge is the general term used for the mechanisms which account for the passage of water from the surface to the "groundwater store". The primary recharge water can only come from rain (meteoric origin), while secondary recharge may occur *via* streams and swamps. Once underground, water will move in response to gravity and hydro-geological gradient: its velocity and direction being determined by the gradient and hydraulic conductivity of the material through which the water drains. Water which passes straight into an aquifer contributes to direct recharge. Water which percolates laterally from higher elevations into aquifers at lower elevations as well as water leaking from rivers, swamps and other surface water sources contributes to indirect recharge.

Within the plains, direct recharge from rainfall is estimated to be low (0-3%), due to a combination of irregular, erratic and unreliable rainfall and a generally clayey underground.

However, a fairly high portion of rainfall (5-10%, or ≅30-60 mm/year) is expected to infiltrate into the fractured basalts and phonolites of the higher grounds. Groundwater drainage from the hills is responsible for replenishment of the adjacent aquifers on the plains and as well as lowlands. Indirect recharge from seasonal streams and rivers is difficult to quantify. However, it can be assumed that the effective precipitation (i.e. the portion of rainfall that is drained as streamflow) over the hills and the intra-montaine plains is probably close to 20%. Most of the surface water disappears before the streams reach their ultimate destinations, i.e. Lake Turkana. Even if only 15% of the streamflow were lost through the river bed, this would still be equivalent to 3% (or approximately 10-17 mm/year) of the total rainfall. While this may not seem much, it must be noted that recharge from streamflow concentrates the effective precipitation of a large area into a relatively narrow zone bordering the main drainage channels.

3.6.3 Water Quality

Practically all types of water, i.e. surface water, groundwater and even rainwater, contain some dissolved salts and impurities. If certain elements are present in high concentrations, the application of the water for a particular purpose may be limited.

Water sampling was carried out from selected locations in the study area for the purpose of water quality analysis. The quality analysis results of surface water show that the water is slightly acidic to slightly alkaline (6.75-9.02) and turbidity of the water is highly variable ranging from low to high turbidity (15 – 307 N.T.U). The water is often coloured (40-255 mgPt/l) and has high content of iron (2.23-5.7 mg/l) and magnesium (6.8-37.9 mg/l), and low to high fluoride content (0.68-3.5 mg/l). Such water may require treatment before it can be used for domestic purposes. The other chemical characteristics are however satisfactory.

The physical and chemical properties of groundwater from the operational boreholes in Turkana south district can be summarized as below:-
Colour – clear (<5 mgPt/l); however groundwater from Luaga shallow well is coloured (75 mgPt/l).
Total Dissolved Solids (TDS) – ranges from 305.7 to 4787 mg/l
Taste – good
Turbidity – ranges from 0 to 865 N.T.U.
Odour – none
Hardness – moderate to very low but highly variable depending on aquifer formation.
Iron – ranges from 0.017 to 2.62 mg/l
Magnesium – ranges from 6.82 to 51.99 mg/l
Fluoride – ranges from 0.19 to 7.6 mg/l
Manganese – ranges from < 0.01 to 16 mg/l
pH – slightly acidic to slightly alkaline (6.68 to 8.67)
The other chemical characteristics are satisfactory.
Groundwater having relatively high content of fluoride, iron, magnesium and manganese will require treatment before it can be used for domestic and/or other purposes.

Based on the above physical and chemical properties, the groundwater in the study area is highly variable; some is good for domestic, agricultural and industrial purposes,

whereas some is not suitable for these purposes. It is therefore recommended that thorough chemical and biological analysis of groundwater from the proposed borehole(s) be undertaken to determine its suitability for various purposes.

The World Health Organization (W.H.O, 1993) and the European Community have stipulated guidelines for maximum permissible concentrations of various ionic substances in water as well as the uses for such waters. Such guidelines should be strictly adhered to so as to determine the suitability of groundwater for various uses. Currently, the groundwater in the study area is being used for domestic and livestock consumption. The groundwater is essential for human and livestock consumption as well as for industrial use. It is therefore recommended that thorough chemical analysis be undertaken to determine its suitability for drilling and other industrial purposes.

Table 3.1: Groundwater quality.

PARAMETERS											
Lab Sample Nos.	**1749**	**1750**	**1751**	**1752**	**1753**	**1754**	**1755**	**1756**	**1757**	**1758**	**WHO limits**
Field Sample Nos.	**B/H TC001**	**B/H TC004**	**B/H TC005**	**B/H TC006**	**Lugga S/Well TC007**	**Lokwamsing Bottomland TC010**	**Kangatet-Morlem TC011**	**Katilia B/H TC012**	**Kangirisae TC015**	**Napusimoru B/H TC018**	
pH	8.67	6.78	6.68	7.44	7.38	9.02	6.75	8.1	7.45	7.98	6.5-8.5
Colour (mgPt/l)	< 5	< 5	< 5	<5	7 5	40	255	< 5	100	< 5	15
Turbidity (NTU)	2	2	Nil	1	865	15	307	10	205	80	5
PV (mgO_2/l)	1.19	,<0.4	1.98	1.19	14.6	8.27	6.72	4.38	<0.4	4.38	
Conductivity (25°C) (S/l)	1458	493	771	1657	837	1474	231	605	326	4090	
Fe (mg/l)	0.08	0.02	0.017	0.05	2.62	2.23	5.7	1.1	3.24	1.1	
Mn (mg/l)	< 0.01	0.06	< 0.01	<0.01	16	0.14	0.4	0.2	0.12	0.01	
Ca (mg/l)	10.4	35.2	14.4	14.4	91.2	17.6	25.6	20.8	28.8	5.6	
Mg (mg/l)	51.99	26.3	28.2	28.2	30.2	37.9	6.8	6.82	10.22	18.5	
Na (mg/l)	222	21.6	310	310	42.8	246	10.5	102	22.1	900	200
K (mg/l)	2.2	1.6	1	1	1	0.2	0.3	0.2	0.4	0.2	
Total Hardness ($mgCaCO_3$/l)	240	196	152	152	352	200	92	80	114	90	500
Total Alkalinity ($mgCaCO_3$/l)	560	230	5162	5162	412	658	106	210	146	214	
Cl (mg/l)	85	4	97	97	3	30	4	40	6	1165	250
F (mg/l)	3	0.45	0.9	0.9	0.19	3.5	0.68	2.5	0.8	7.6	1.5
Nitrate (mg/l)	6.4	1.3	14	14	0.64	0.7	0.56	1.205	1.8	3.2	10
Nitrite (mg/l)	0.032-	0.02	0.01	0.01	0.113	0.041	0.106	0.113	0.214	0.061	
Sulphate (mg/l)	8	5.14	117	117	<0.3	24.3	<0.3	25.4	<0.3	130	400
Free Carbon Dioxide (mg/l)	10	10	16	16	68	Nil	6	6	8	Nil	

3.6.4 Water Supply

Groundwater resources form the most available source of water supply in the study area. The groundwater is exploited through boreholes and shallow wells excavated in luggas within the study area. The water is often clean and this signifies low content of total dissolved solids (TDS). However, some recently dug wells have yielded somewhat murky water. The water is used both for domestic and livestock consumption. Some boreholes have however dried up due to lack of recharge which has contributed to fluctuating levels of the water table (e.g. boreholes at Kanga'kipur area-- Kerio river basin, Lomunyenkuprat and at Napusimoru area) whereas others have slightly saline water.

3.7 Terrestrial Environment: Flora and Fauna

3.7.1 Terrestrial Flora

The ecosystems in Turkana are unique in terms of environmental characteristics with the ecosystem being influenced by the following physical factors: climate at regional as well as continental scales; by topographic effects on rainfall and landscape water redistribution, geomorphic effects on soil and plant available water at the landscape to regional scales; and by water redistribution and disturbance at local and patch scales. (Coughenour and Ellis, 1993).

The study area fell under an ASAL region with heterogeneous and highly variable habitat conditions that were influenced by prevailing soil units and water availability. The mixture of habitat types ranged from near barren landscapes interspersed with shrubs in areas such as Loperot, Lokori airstrip and some parts of Katilia, and dwarf shrublands in areas close to Nakukulas.. In hilly areas such as the Lokoriokot hills north east of Loperot, a mixture of bushed grassland and shrublands were encountered. Riverine forests were common along luggas that were seasonally inundated.

The area was not very rich in terms of species diversity with very few species of woody plants. In some instances single stands were observed. The most common floral species were: *Acacia senegal, Acacia mellifera, Grecian tenax, Acacia tortilis, Ziziphus mucronata, Maerua crassifolia, Commiphora africana, Balanites aegyptiaca, Indigofera spinosa, Cadaba farinosa, Salvadora persica, Sericocomopsis hildenbrandtii, Delonix elata, Sporobolus spp, Chloris virgata,* and Sedge *(Cyperacea spp)*

On a broader scale, the ecosystem in Block 10BB could be categorised into 5 sub-types namely;

- Near-barren or Sparse
- Dwarf shrublands
- Shrublands
- Shrub-grassland
- Riverine forest

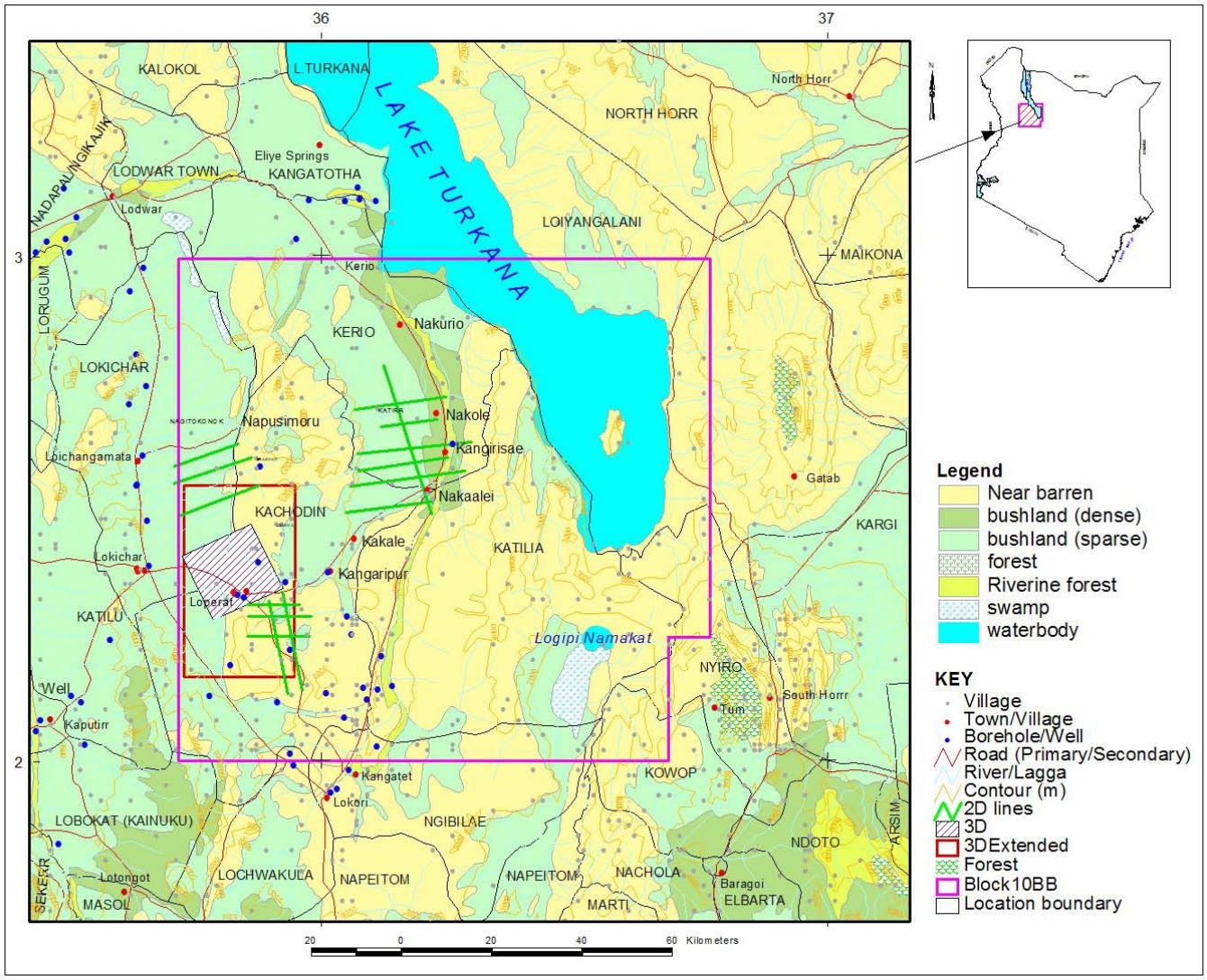


Figure 3.5: Vegetation map of the study area

Near-barren (NB)

Near barren conditions can be described as areas where woody vegetation contributes less than 2% of ground cover. The study area had a crown cover of approximately 1% woody plants with the dominant species being *Acacia tortilis*, and *Hyphaene compressa* (in areas that experienced seasonal inundation such as luggas). Other species observed but occurring sparsely included: *Euphorbia heterochroma, Caralluma acutangula* and *Opuntia spp* (cactus).
Near barren conditions were found in areas around Lokichar Health centre, at the Loperot, Lokori airstrip and areas of Katilia.

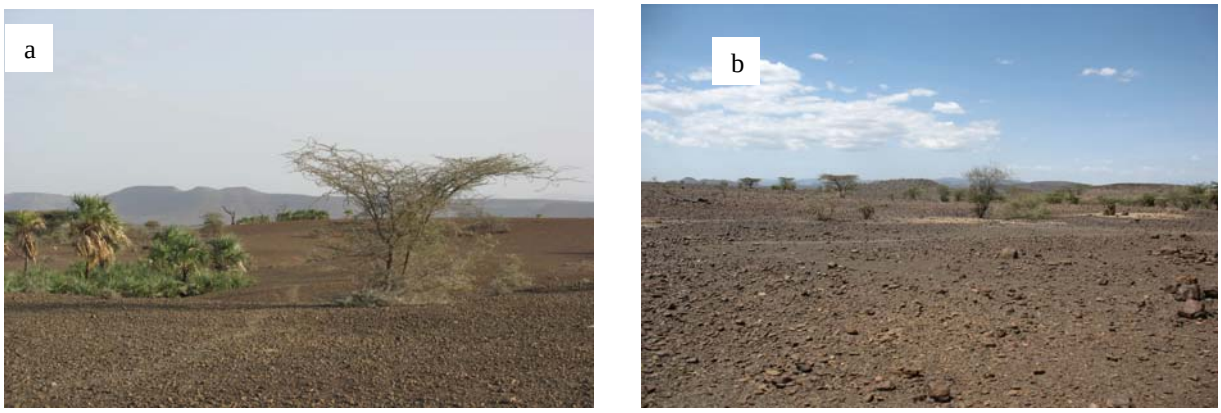


Plate 3.3: Near barren landscape with scattered vegetation. (a) Loperot area (b) Lokori Airstrip

Dwarf shrubland (DS)

This habitat type was among the three dominant vegetation types in the area, the other two being shrubland and riverine forest. Woody plants were hardly more than one metre in height except in depressional areas where the soils were deeper. The vegetation was dominated by *Acacia tortilis* shrubs, *Indigofera spinosa* and occasionally *Salvadora persica, Cadaba farinosa, Acacia condyloclada, and Balanites aegyptica*. This habitat type was found in Lokichar, Loperot, and Napusimoru areas.

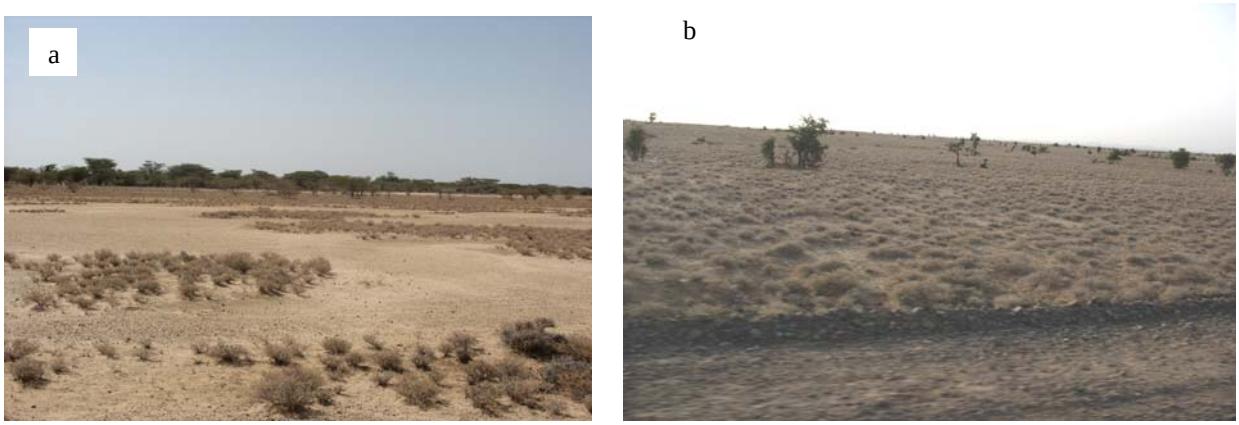


Plate 3.4: Various dwarf shrublands in the study area. (a) Lokichar and (b) Napusimoru area

Shrublands

This habitat type was primarily found in areas with seasonal rivers / luggas floodplain areas (areas with fluvisols). Localities with this type of vegetation were the Kerio river floodplains, sections of Morlem settlement scheme, Kangatet alluvial floodplain, and Elelea sub-location.

Salvadora persica was the most dominant species in this habitat type and was often interspersed with *Acacia tortilis*, and *Boscia coriacea.* In some areas where *Salvadora persica* was absent, especially in areas where there was anthropogenic influence such as settlements along flood plains, the invader species *Prosopis juliflora* and *Calotropis procera* were common.

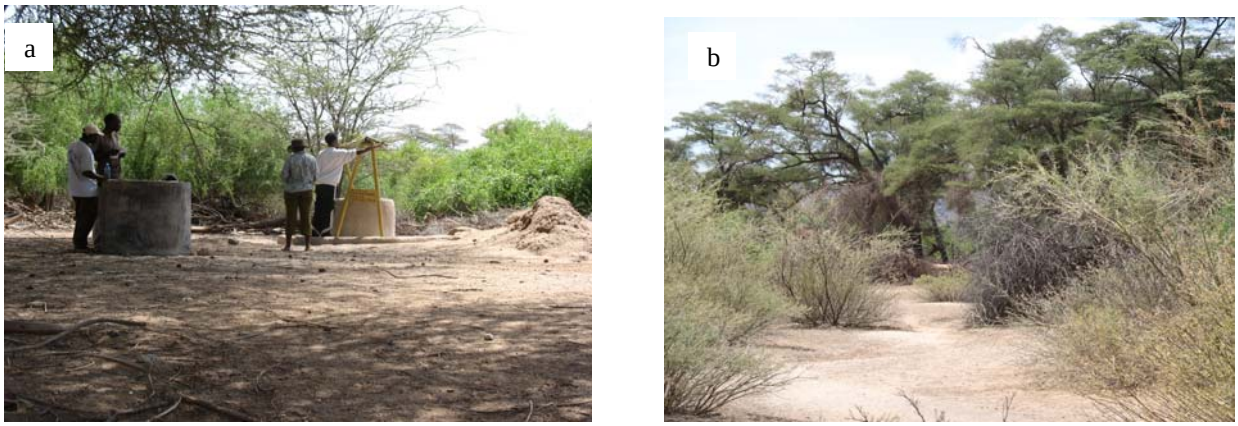


Plate 3.5: Shrubland habitats in study area. (a) *Salvadora persica* around Kerio River bed (b) *Prosopis juliflora* in Katilia and (c) *Calotropis procera* in Nakukulas

Shrub-grassland

This habitat can be described as an ecotype between grassland and bush, with woody cover being less than 10%. Species were dominated by *Acacia tortilis, Balanites aegyptiaca, Salvadora persica, Grewia spp*, *Cadaba farinose, Eragrostis cilianensis, E. racemosa* and *Chlosis virgata* and occasionally *Sericocomopsis hildebrandtii* along roads. This habitat type was found around areas adjacent to Katamanak hills.

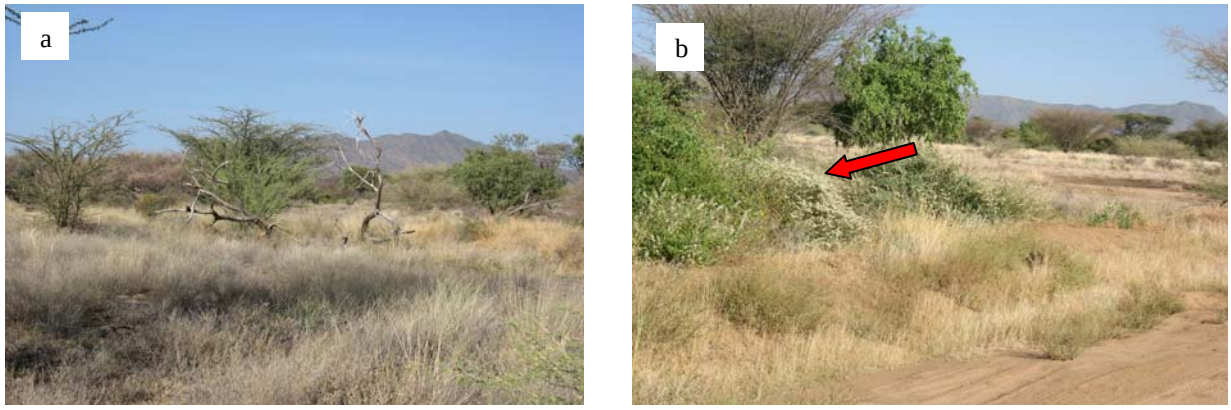


Plate 3.6: Shrublands interspersed with grassland (a) shrub-grassland area near Katamanak hills (b) *Sericocomopsis hildebrandtii* with white flowers (red arrow).

Riverine Forest (RF)

This vegetation type was generally encountered along the seasonal rivers and luggas such as Kerio River, Lokosmekori lugga, Katwosin lugga, Nakalalei-Kalapata lugga and Napusimoru area. The vegetation followed the river floodplains, with *Salvadora persica* and *Maerua crassifolia,* both evergreen shrubs marking the extent of the floodplains boundary. Other species found were *Acacia tortilis, Ziziphus mucronata, Balanites aegyptiaca, Salvadora* persica and *Hyphaene compressa. Calotropis procera* was frequently encountered in disturbed areas prone to seasonal floodings. The species was an indicator of a high water table and probably alkaline substrate conditions.

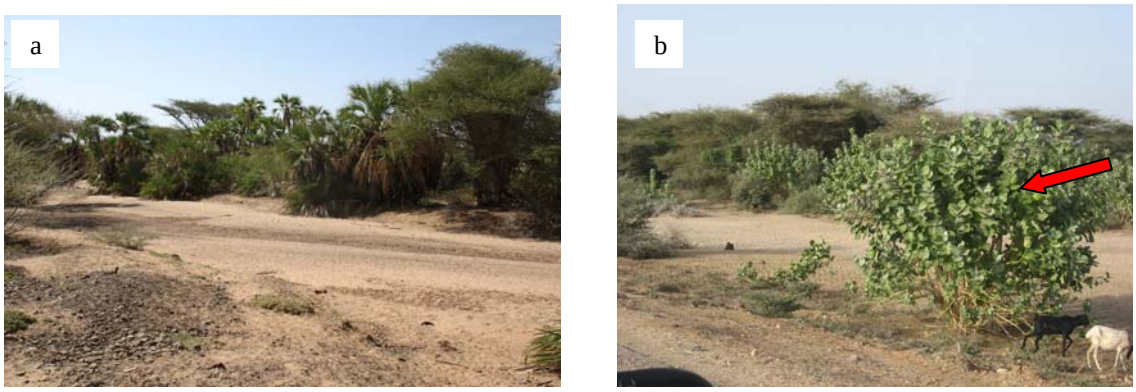


Plate 3.7: Typical riverine and lugga vegetation. (a) *Acacia tortilis* and *Hyphaene compressa* (Doum palm) and (b) *Calotropis procera*

3.7.2 Terrestrial Fauna

Despite the low carrying capacity of the area the fauna is relatively diverse in terms of mammal and birds species. Mammals in the area include olive baboon, *Papio anubis,* wild dog, *Lycaon pictus*, striped hyaena *Hyaena hyaena,* caracal *Caracal caracal,* lion *Panthera leo* and cheetah *Acinonyx jubatus* , plains and Grevy's zebras *Equus burchelli* and *E. grevyi*, warthog *Phacocoerus aethiopicus*, hippopotamus, Grant's gazelle *Gazella granti*, reticulated giraffe *Giraffa camelopardalis reticulata*, Beisa oryx *Oryx gazella beisa*, hartebeest *Alcelaphus buselaphus*, topi *Damaliscus lunatus korrigum,* greater kudu *Tragelaphus strepticeros*, lesser kudu *T. imberbis*, gerenuk *Litocranius walleri* and dikdik *Rhyncotragus guntheri.*
The lion *Panthera leo,* and the cheetah *Acinonyx jubatus* are classified as vulnerable while the *Grevy's zebra Equus g*revyi is classified as endangerd by IUCN in 1994.

The area is an important breeding and migratory route for both terrestrial and aquatic bird species. At least 23 bird species are known to breed in the environs of the shores of Lake Turkana, including the Goliath heron *Ardea goliath*. Regionally threatened bird species in the area include great egret *Casmerodius albus,* saddle-billed stork *Ephipiorhynchus senegalensis*, banded snake eagle *Circaetus cinerascens*, fish eagle *Haliaeetus vocifer*, fox kestrel *Falco alopex*, African skimmer *Ryncops flavirostris* and Somali sparrow *Passer castanopterus* (Bennun & Njoroge, 2001). The area also serves as breeding habitats of the Nile crocodile *Crocodylus niloticus*, puff-adder *Bitis arietans*, cobra *Naja haje,* sawscaled viper *Echis pyramidum* and 47 fish species, seven being endemic, live in Lake Turkana..

However, block 10BB had a low mammalian and reptilian species count but a relatively high birds species count and insect life as evidenced by the presence of insectivorous mammals (e.g dwarf mongoose, squirrels and black backed jackals) and birds species (e.g shrikes, drongo, hornbills, rollers, and hoopoe among others). The low species count for mammals and reptiles could be attributed to the harsh environmental conditions of the area, hunting, and other pressures by the local community.

Mammals

Several mammal species were encountered during the field study conducted from 25th June to 4th July. Some of these species were sighted directly while the presence of others was confirmed through the presence of signs such as footprints/ tracks and scants. Species such as the dwarf mongoose were commonly sighted within the shrubland area in tandem with termites' mounds. The black-backed jackal were sighted directly at Loperot area and indirectly (through evidence of scants Plate 3.8 a and b)).

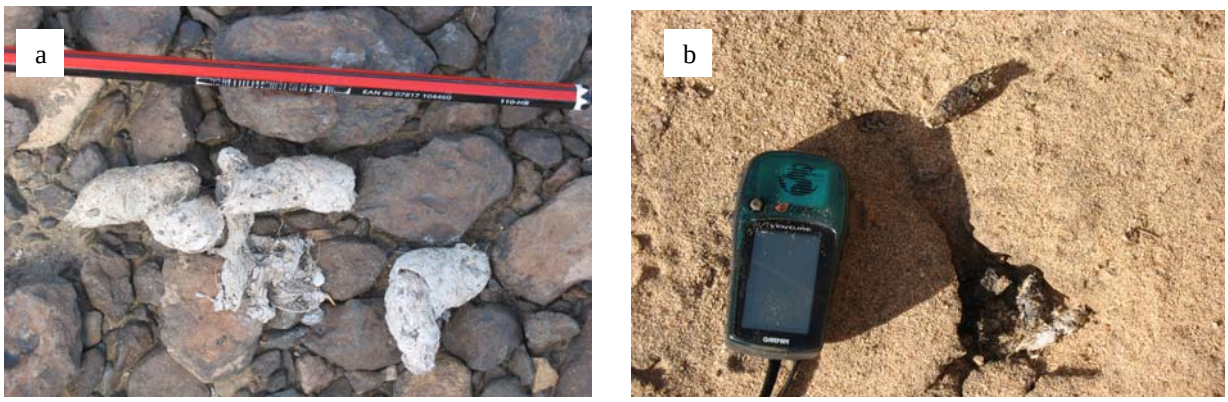


Plate 3.8: Black backed jackal scant (a) Katwosin area of Katilia and (b) Lokoriokot hills

Small mammals' species such as the Cape hare, dik diks, bats and ground squirrels were found in shrubland areas around Lokichar and Nakukulas

Plate 3.9: A ground squirrel

Birdlife

Despite the area being dry, the diverse habitat characteristics present were an ornithological heaven harbouring a rich variety of birdlife, such as: Somali courser, Black-headed plover, Augur buzzard, Sandgrouse, Brown parrot, Red-billed hornbill, Abyssinian schmitarbill, Abyssinian roller, Common drongo among others, for full list of common and scientific names see appendix.

Plate 3.10 Abyssinian Roller, Chest nut bellied Sandgrouse and Common drongo

Arthropods

The area also had a varied diversity of insect species with occasional towering termite mounds dotting the landscape (Plate 3.11), bees, moths, butterflies, sand flies, and dragon flies.

Plate 3.11 Termite mound

Other arthropods species present were centipedes, spiders, ticks, and scorpions.

3.8 Aquatic Flora and Aquatic Fauna

The major aquatic ecosystem within the larger Turkana area are the Lake Turkana, River Kerio, River Turkwel and associated ephemeral streams (luggas) systems. The area is of great global significance for both terrestrial and aquatic conservation, harbouring a wide variety of unique plants, mammals, birds, reptiles, amphibians and arthropods species.

Common plant species in this ecosystem include emergent macrophytic species such as the grasses *Paspalidium germinatum* and *Sporobolus spicatus* which cover the seasonally exposed shallows and provide important nurseries for fish (Hughes & Hughes 1992), and Pondweed (*Potamogeton spp)* found in the shallow bays of Lake Turkana (Hughes & Hughes 1992). The watercourse ways of Rivers Kerio, Turkwel and their lugga systems are characterized by riverine forests with the dominant species being *Acacia tortilis, Balanites aegyptiaca, Salvadora persica, and Hyphaene coriacea. Calotropis procera* and*, Prosopis juliflora* are common in disturbed areas.

Mammals in the area include olive baboon, *Papio anubis,* wild dog, *Lycaon pictus*, striped hyaena *Hyaena hyaena,* caracal *Caracal caracal,* lion *Panthera leo* (VU) and cheetah *Acinonyx jubatus* (VU), plains and Grevy's zebras *Equus burchelli* and *E. grevyi* (EN), warthog *Phacocoerus aethiopicus*, hippopotamus, Grant's gazelle *Gazella granti*, reticulated giraffe *Giraffa camelopardalis reticulata*, Beisa oryx *Oryx gazella beisa*, hartebeest *Alcelaphus buselaphus*, topi *Damaliscus lunatus korrigum,* greater kudu *Tragelaphus strepticeros*, lesser kudu *T. imberbis*, gerenuk *Litocranius walleri* and dikdik *Rhyncotragus guntheri.* Reptilian

species include Nile crocodile (*Crocodylus niloticus)*, puff-adder *Bitis arietans*, cobra *Naja haje* and sawscaled viper *Echis pyramidum.* 47 fish species, seven being endemic, live in Lake Turkana (Fitzgerald 1981; KWS 2001). At least 350 species of aquatic and terrestrial birds are known to occur in the Turkana area with Lake Turkana serving as an important breeding habitat and stopover for migrant birds (Bennun & Njoroge, 2001)

3.8.1 Aquatic Flora

Flora species within Block 10BB are greatly influenced by water availability, with the most dominant vegetation type being riverine forests. This vegetation type was generally encountered along the seasonal rivers and luggas such as Kerio River, Lokosmekori lugga, Katwosin lugga, Nakalalei-Kalapata lugga and Napusimoru area. The vegetation followed the river floodplains, with *Salvadora persica* and *Maerua crassifolia,* both evergreen shrubs marking the extent of the floodplains boundary. Other species found were *Acacia tortilis, Ziziphus mucronata, Balanites aegyptiaca, Salvadora* persica and *Hyphaene compressa. Calotropis procera* was frequently encountered in disturbed areas prone to seasonal floodings. The species was an indicator of a high water table and probably alkaline substrate conditions.

The main river system in the area is the Kerio River with its numerous tributaries (luggas). The rivers are seasonal and intermittent forming floodplains along the cause ways in certain localities such as Morlem, Katilia, Elelea, and Kangirisae.

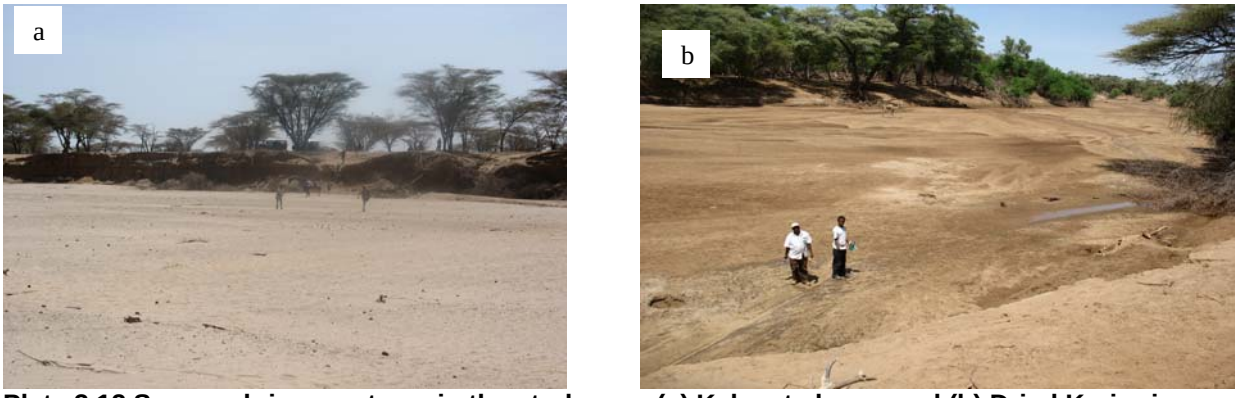


Plate 3.12 Seasonal river systems in the study area (a) Kalapata lugga and (b) Dried Kerio river bed at Katilia

Plate 3.13 Kerio river floodplain with scattered dried logs of *Salvadora persica* at Elelea

A unique characteristic aquatic feature found within the study site was a bottomland within an upland landform, at Lokwamsing. There was evidence that the area had a high water table and yielded water through spring outlets. The water from the bottomland was used for human consumption as well as watering livestock. The bottomland had strikingly different vegetation characteristic from the surrounding areas. The vegetation in the area comprised of sedge grasses and papyrus reeds.

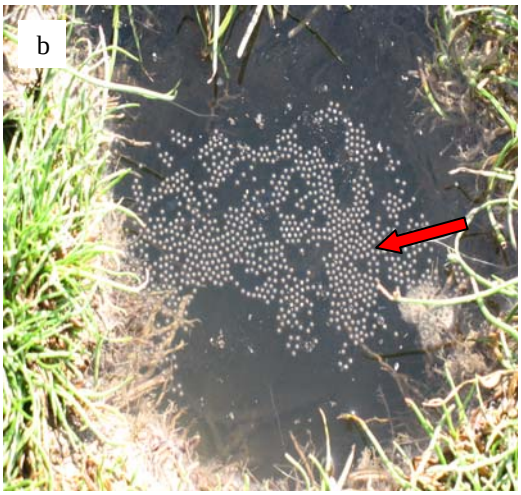
Plate 3.14 Wetland vegetation at Lokwamsing bottomland

3.8.2 Aquatic Fauna

Fauna species found within the confines of the aquatic ecosystems included: various birds' species such as sacred ibises, black headed plover, and hammerkop; insects as such the dragon flies; fish species e.g. catfish, and herpetiles such as frogs and geckos.

Plate 3.15: Black headed plover (red arrow) and sacred ibises at Kerio river bed

Plate 3.16: Dragons fly at Lokwamsing bottomland



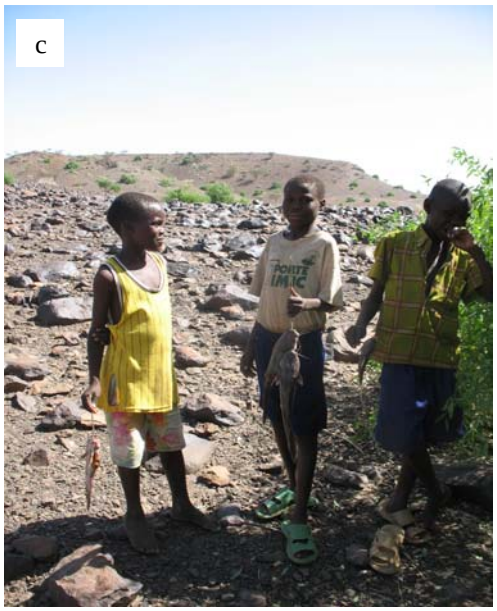


Figure 3.17: (a) Frog spawns (red arrow) at the Lokwamsing bottomland (b) geckos at Napusimoru and (c) Turkana boys with catfish

3.9 Land Resources and Natural Heritage Sites

Pastoralism is the main land use in the project area, thus pasture and browse in a key land resource. There are pockets of gypsum deposits especially at Napusimoru though mining has not been fully commercialized. There are no significant cultural, historical, archaeological or protected resources or areas on or near the project site. Individual villages, clans and households have their own revered areas such as *Laibon* burial sites or public meeting areas. The burial sites can be identified as they are marked by stacking stones on the grave.

Table 3.2: Medicinal plants used by local inhabitants in the project area.

USES OF SELECTED VEGETATION			
Botanical name	**Local name**	**Conventional uses**	**Traditional uses**
Acacia condyloclada	Ekalale	Wood is used for fuel, to make tools, construction of bomas, fodder for animal and bee forage	It has varied medicinal uses.
Acacia senegal	Ekunoit	Controls soil erosion. Wood is used to make posts and poles. Root fibres are used to make fishing nets. Produces edible Arabic gum used in beer, confectionery, and the pharmaceutical industry. Provide fodder for domestic and wild animals, bees. Beetles and butterflies.	Used for making traditional stools, and as wood fuel. Bark is used as a remedy for diarrhoea and stomach ailments, while the root is used as a mild purgative and in the treatment of gonorrhoea
Acacia tortilis	Etirr	Used as a fuel, timber, and for live fencing. Serves as fodder for animals and livestock. Bark used to make tannins dyes. Its an excellent shade tree, ornamental purposes	Medicine for stomach ache and diarrhoea. Used for witchcraft among some communities
Adeniem obesum	Egales	Ornamental in dry and rocky areas. Seeds and root yield arrow poison and fish poison.	A bark infusion is used to remove ticks and lice on camels and cows.
Balanites aegyptiaca	Edapal	Wood is used to make furniture, tool handles. Poles, carvings and construction timber. Fodder for livestock	It is an evergreen tree that has edible seeds that are boiled before they are eaten. The gum is used to fix spear heads and arrow heads to their shafts.
Calotropis procera	Etetheru	The wood is used to make canoe paddles, fire sticks and for fencing.	Dried stem used as fencing material. Dried leaves eaten by goats. Roots are a remedy for coughs, snake bites, hook worms and it is an emetic (An agent that induces vomiting).
Delonix elata	Ekurinchanait	Used as a fodder, also to make utensils, poles, and as fuel wood	Twigs used as a toothbrush, and to cure bleeding gums and other mouth diseases. The bark is used to treat bilharzia and diarrhoea.
Hyphaene compressa	Eng'oli		Sap is used to make a coarse brew. The leaves are used to make woven baskets, makuti and mats.
Indigofera spinosa	Erin		Eaten by donkeys and camels especially during drier periods of the year.
Prosopis juliflora	Eterai	The wood is used to make poles, carvings and fuel. Leaves and pods are eaten by livestock.	

		Roots are soil friendly and are used for nitrogen fixation. It's grown as a live fence in dry areas.	
Salvadora persica	Esekon	The fruit is edible, and is a very important emergency fodder when all else is unavailable.	The stem is used as a toothbrush. It contains an antibiotic that keeps the mouth clean and prevents tooth ache. A decoction of the root is taken as a remedy for gonorrhoea, spleen pain and general stomach ache. Roots also feature in the treatment of chest diseases. The latex is used in treatment of skin sores.
Ziziphus mauritania		The fruit pulp can be used to make a thirst quenching drink and a potent spirit. It can be used as a hedge. The wood is hard and heavy and used for making beds, dhow ribs, poles, bows and arrows, carving, firewood and charcoal. Can be used for soil conservation, as bee forage and for the supply of resin, gum tannin, and dyes.	

3.10 Visual Aesthetics

The area has a pristine and rugged scenic beauty with hills, extensive plains, and several sand rivers (luggas). The varying landscape is psychologically soothing and spots of interest manifests themselves as surface stones and various rocks of varied colours in uplands, to gentle sandy plains and hills. Intensely dissected piedmonts flood plains and sand dunes also characterize the area. The presence of abundant birdlife and scanty wildlife augment the aesthetic effect of the environment.

3.11 Noise and Vibrations

The study area is generally rural and therefore has fairly low noise levels. Much of the variance in the noise readings indicated in the Figure 3.6 is due to fluctuations in wind speeds, which range between 22-28 m/s.

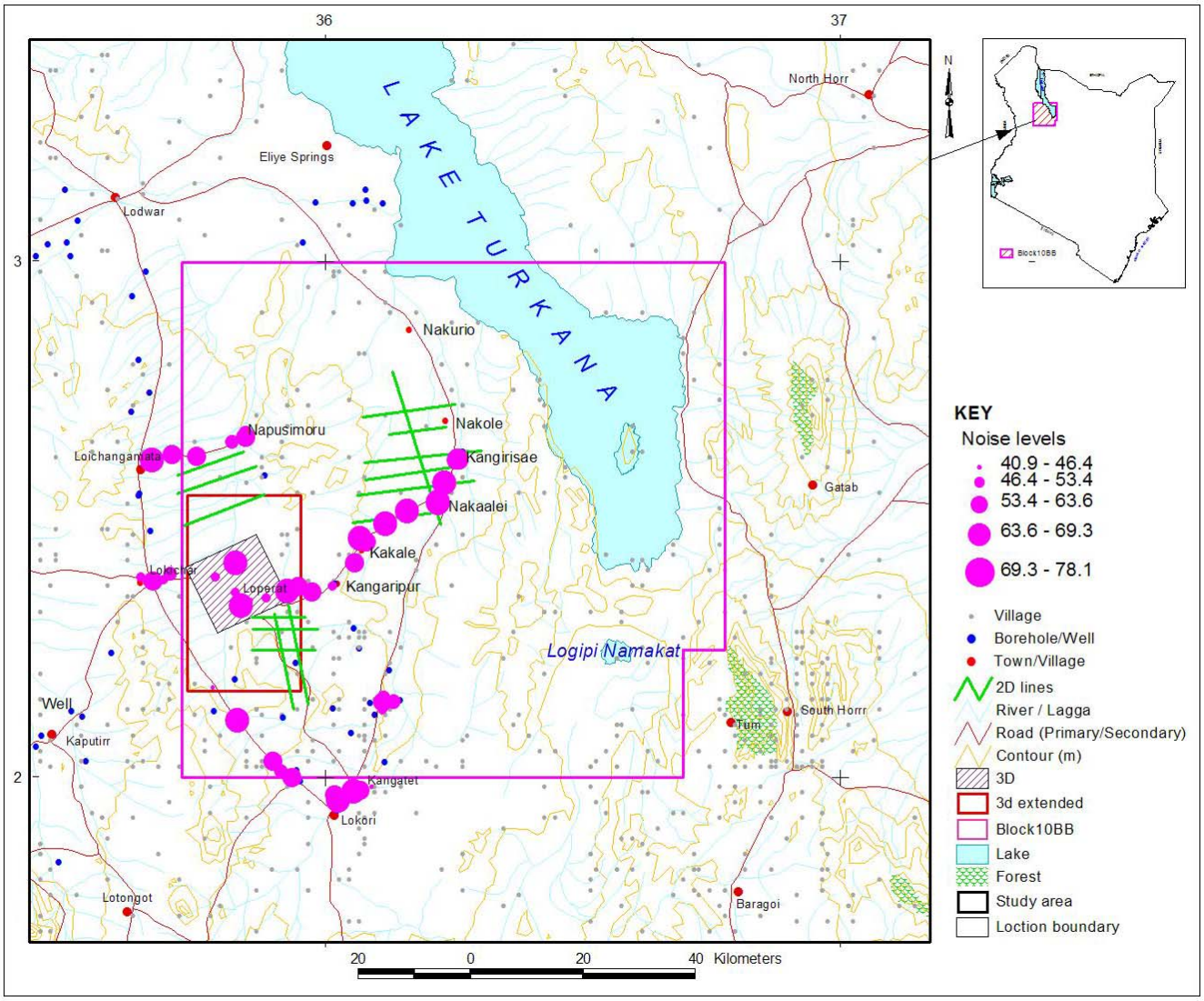


Figure 3.6 Noise readings (in decibels) in the project area.

3.12 Offensive Odours

No offensive odours were detected other than the areas surrounding the settlements, and more specifically, locally associated with pit latrines used by the local communities.

3.13 Archaeological, Historical, Cultural Sites and Landscape

There are no significant cultural, historical, archaeological or protected resources or areas in or near the proposed project site. Individual villages, clans and households have their own revered areas such as *Laibon* burial sites or public meeting areas. The burial sites can be identified as they are marked by stacking stones on the grave.

3.14 Solid Wastes and Waste Oils

There are no significant solid waste threats in the project area as there are no industrial or major commercial activities generating such wastes is in the project area. Waste generated at household level and in institutions is managed through sorting and eventual incineration in open fields. Waste oils mainly from garages and equipment repair shops in urban centres are highly localised withy minimal waste produced as a result of the very low vehicle and other leaky equipment and lack of industries, therefore it does not warrant a management plan

3.15 Socio-Economic Characteristics

3.15.1 Social Characteristics

Demography

Turkana South district has an estimated population of 100,357 people (based on the census of 1999??) with men slightly more than the women. Men account for 52% of the total population. The population growth is estimated at 2.4% annually while the population density for the district is 4 people per km^2. Town centres like Lokichar and Lokori have high population density due to the influence of urban life and irrigation agriculture at Morlem respectively. Other areas with high population in the district include Kainuk and Katilia divisions. Population pattern is also largely affected by the inherent pastoralism lifestyle that has seen movement of herders across the larger Turkana district in search of pasture making it hard to track population numbers in the area.

Education

The Turkana North, Central and South districts together have 168 primary schools with attached early childhood development centres with a total enrolment of 78,500 children in 2006. All primary and attached pre-primary schools in the district are covered under the government assisted school feeding program as a way of encouraging enrolment and stabilizing attendance. There are very few secondary schools in the project area which make the transition rate, just like in other ASAL areas, from primary school very low at only 27%. This is as a result of lack of school fees, rampant insecurity and frequent movement of parents in search of pasture and browse for livestock. Some of the challenges facing the Education Sector in the project area are:

- Lack of adequate teaching staff
- Inadequate teaching facilities like classrooms and desks
- Early marriages to young girls
- Food insecurity among households leading to drop out of pupils
- The devastating famine over the years has led to movement of pupils with their parents in search of pasture for livestock.
- Long distances to cover to schools for instance pupils in Kangakipur sub location cover up to 40 kilometres to and from school
- Insecurity as a result of cattle rustling particularly in Lokori division.

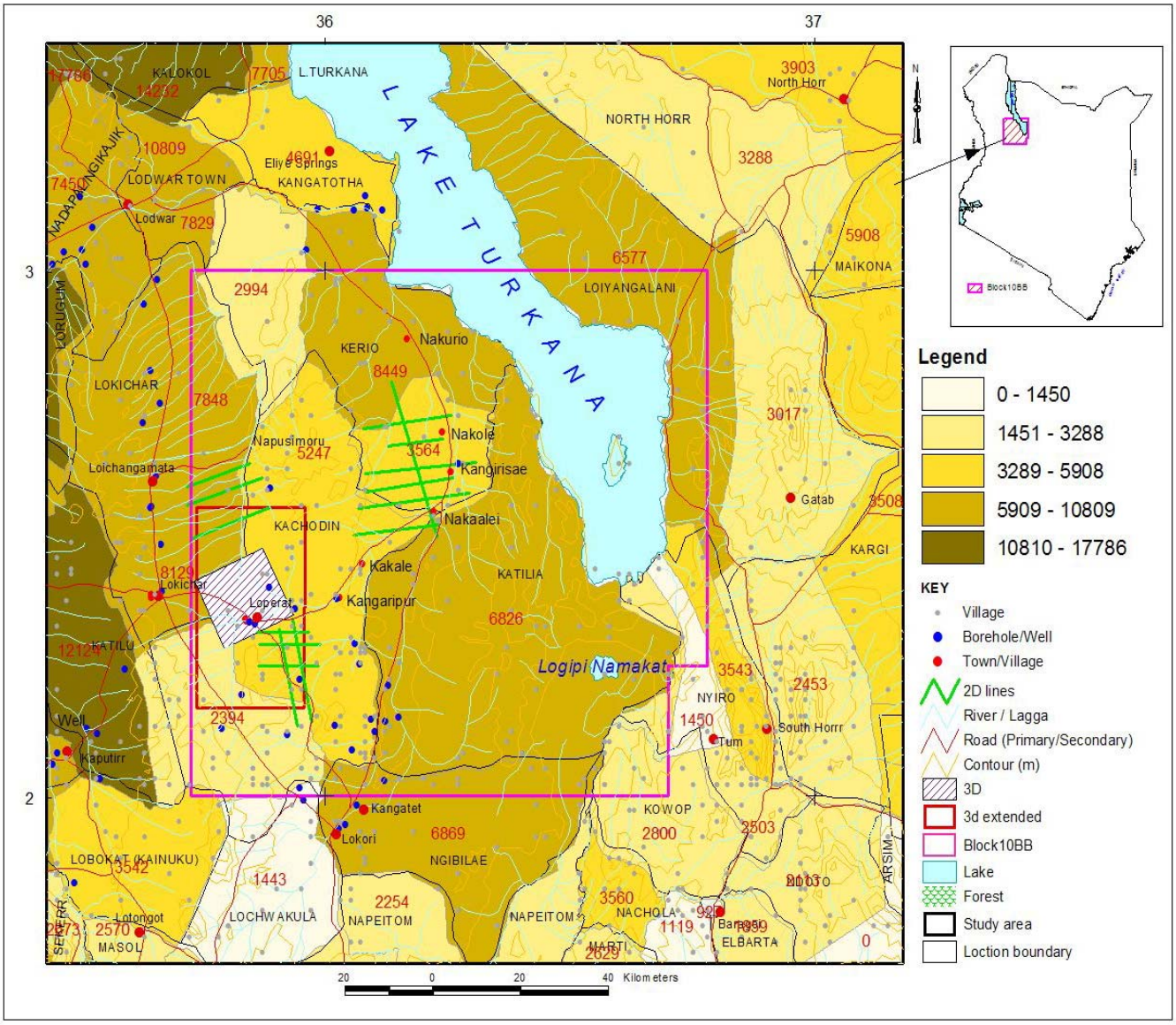


Figure 3.7: Population of the study area

Housing

The project area is in an arid and semi arid land (ASAL) and is also an area where Turkana traditional lifestyle is still pronounced, thus modern housing facilities are few and confined only in the urban centres. Trading centres in the interior part of the district include Lokori, Katilia, Nakalalei, Kangirisae among others have a few government houses and pockets of residential houses. However, most of the residential houses are semi permanent or temporary huts commonly referred to as *ngakais.* The local communities still retain their traditional pastoralism lifestyle thus the construction of these temporary houses is arbitrary and location depend entirely on availability of water supply, pasture and browse for the livestock. The government is, however, encouraging sedentary lifestyle by developing social amenities to attract the communities to the centres. Lokori township, Kangirisae and Katilia are key centres where

urban lifestyle is setting in and a lot more need to be done especially in terms of improved housing facilities.

Plate 3.18: Traditional housing units in Block 10BB

Land tenure

The project site lies largely in the Turkana South district in Lokori and Lokichar and parts of Turkana Central district that is in Kerio division and is under the jurisdiction of the Turkana County Council as trustee on behalf of the Kenya government. Tenurial issues in the pastoral areas revolve around communal use of grazing resources without control over individual actions. Conflict and overgrazing have been the inevitable result. Pressure from growing numbers of livestock is leading to overgrazing and pastures degradation in most parts of the project area. Land adjudication has not taken root in most parts of the project area. However, in urban centres like Katilia, Lokichar and Lokori among other land owners has been issued with letters of allotment from the County Council.

3.15.2 Economic Characteristics

Livestock is the most important natural resource in the district and supports the main pastoral livelihood system in the district. The main livestock species found in the district in order of importance are cattle, goats, sheep, donkeys, camels and poultry. Household food security in the project area is uncertain due to the continued impact of the prolonged drought experienced in the last three and a half years. A large number of pastoralists have lost some of their livestock to famine and to the impacts of *Peste des petits ruminants* (PPR) a viral livestock disease hence significantly reducing their purchasing power. Most households in the area depend on food aid/ relief from the government and non-governmental organization particularly the World Vision Kenya and Religious-based organizations for instance Reformed Church of East Africa and the Catholic Church.

Subsistence agriculture is practiced in some parts of the larger Turkana district comprising about 30% of the district or about 30,000 hectares. Irrigation farming is carried largely along Kerio and Turkwel rivers. The crops grown include maize, sorghum, cowpeas, green grams, kales and some fruits like water melon. In the project area irrigation farming is practiced at

Morlem and Lokubae in Lokori division. Rain fed agriculture is practiced in Kangirisae along the banks of River Kerio and at Napusimoru sub location. The local communities with the assistance of Arid Lands Resources Development project (ALRDP), a local government agency and World Vision Kenya have constructed water canals and irrigation basins along the Kerio river bank. Some of the crops grown in these areas include kales, beans, green grams, onions, water melons and tomatoes. In some parts of the study area charcoal burning and sale is being practiced particularly in Kangirisae, Lokori and Napusimoru areas. Other economic activities practiced in the project area include mat and basket handicraft and pockets of fish mongering along the Kerio River.

Livelihoods

The district has an area of 28,000km^2 and can be categorized into four livelihood zones as shown in the table below:

Population and livelihoods

Livelihood zone	Percentage of population
1. Pastoral	64%
2. Agro-pastoral	18%
3. Fisher-folk	6%
4. Urban Population (Formal and informal workers / business people)	12%

Source: Kenya Long Rains Assessment Report 2007

Labour Situation

The proposed project area has largely been negatively affected by the prevailing famine that has ravaged pastures and browse leading to loss of livestock. Irrigation agriculture has also been affected while rain-fed agriculture has not been practiced for the last 3.5 years due to unreliable rainfall. These have led to a large number of idle able bodied youths in the project area. Thus there is an abundant non skilled labour in the area and the high levels of unemployment creates creating a recipe for criminal activities.

Infrastructure and its Relationship to Livelihoods and Economy

The project area has a poor road network and low economic activities. This situation has discouraged would be investors to venture in the public transport service in the project area. Travellers to Lokichar and other centres in the area rely on the goodwill of government or non-governmental organization vehicles that operate in the area for transportation. Residents in the area also trek long distances of up to 60 kilometres for days in search of social services, food and water. A few public service vehicles ply the Lodwar – Lokichar – Kitale route. There is a civilian airstrip at Lokori Township that is, however, rarely used.

Taxes by TURKANA DRILLING CONSORTIUM

The taxes paid by company are directly associated with the project and contribute to the welfare of the local economy and the national economy in general. Among the direct taxes associated

with the operation of the project are: Import duty; Value Added Tax; CESS and Royalties; Corporate Tax; Income tax (PAYE), and Licenses. Indirect taxes paid to the government include taxes accruing from vehicle use, fuel costs, etc.

3.16 Health and Public Safety

Health Services

The project area has limited government run health centres and dispensaries distributed at sub location levels. Lokichar township for instance has two health facilities, one run by the government and the other by Reformed Church of East Africa. The general assessment of the health facilities is that they cannot handle emergencies services or a major outbreak. In particular the government run health centre at Lokichar is ill equipped in terms of personnel and facilities.

The health facility at Lokichar is strategically placed in the project area and shall be useful in providing general medical services to workers during seismic survey. The facility can be easily accessed from Loperot as well as Kangirisae area that have been proposed to host the two camp sites. The district also has numerous dispensaries located at the trading centres. The dispensaries in the project area face the following key challenges:-

- Lack of adequate medical personnel
- Inadequate medical facilities including drugs and other supplies
- Unreliable source of energy and
- Inadequate water supply

According to the Clinical officer at the Reformed Church Lokichar health centre the facility was established in 1973 and has an inpatient capacity of 26 beds. The health facility has an operational laboratory with one laboratory technician, one old ambulance and has no operating theatre. The facility has no morgue and there is no regular doctor. The health facility handles a large number of out patients estimated at between 150 to 200 on Mondays and Tuesdays. The number, however, reduces to an average of 50 patients per day in the rest of the week. The facility gets regular assistance from UNICEF, Merlin, RCEA and Ministry of Health that seconds nurses and other medical officers.

Plate 3.19: Napusimoru dispensary situated in Kachodin location.

Diseases

The most prevalent diseases in the project area include malaria, malnutrition in children and the aged, pneumonia, tuberculosis, diarrhoea, assault cases and skin infections. According to the health officials at the Lokichar hospital, HIV/AIDS prevalence in the district is rising particularly as a result of the recent influx of internally displaced persons (IDPs) from Kyushu and Eldora to the area. However, cultural belief and stigma in the local communities has hindered efforts to stem down the spread. HIV/AIDS is still treated as a foreign condition in the area and the communities still shun the use of protective aids. The health facility has a VCT centre and plans are underway for the introduction of anti-retro viral drugs by the International Rescue Committee.

Security and Public Safety

Insecurity is rampant in the project area particularly in Lokori and Lokichar divisions and often involves theft of livestock by the neighbouring Pokot community. Conflict over grazing resources is also common in part due to the breakdown of traditional pasture management systems and increasing individually owned herds. Insecurity is often cross-border and makes sustainable utilization of livestock resources difficult. There have been recent attempts to reduce insecurity in the area through disarmament but this is meeting stiff opposition from sections of the community. For instance at Katilia the senior chief informed us that the locals are now strongly opposed to the government supported voluntary disarmament exercise. This is because they believe that their rivals the Pokot are not being disarmed and this put them in a vulnerable situation during cattle raids. A multi-pronged approach to solving insecurity needs to address the socio-cultural and economic roots of the problem in tandem with the management of the proliferation of small arms.

3.17 Corporate Social Responsibility

3.17.1 Community Views

The project area being in an ASAL area faces many challenges particularly on socio-economic aspects. The community's members have expressed varied views and issues that they would like considered by the proponent. The proponent should consider any assistance that it could provide during this project. Turkana Drilling Consortium has indicated that they are committed to operating in an environmentally sound manner, and is committed to improving the communities in which they work. There are requirements in the Production Sharing Contract that has been signed by Turkana Drilling Consortium which includes provisions for economic support and training. Turkana has indicated that it is their intention to meet and exceed these requirements. In addition Turkana is ready to assist the local communities to provide additional support. Based on the meetings held with the local officials and communities Turkana recognized that the greatest need to be reliable water supply. As a part of the project requirements, water supply wells will be drilled to support the seismic activity. At the end of the project, Turkana will endeavour to leave these wells in a usable manner for the benefit of the local communities. There will be additional costs to Turkana to leave these wells in usable condition, but Turkana will provide this for the local communities.

The view of local leaders including that of the county council is that the Consortium should hold an area leaders meeting to inform and sensitize them of their survey plans prior to commencing the survey work. The company should work closely with the local county council in order to harmonise their operations particularly on matters of land and security concerns.

(a) Employment and Wages

In most of the areas the EIA team visited the communities welcomed the proposed seismic survey project and expressed optimism that the Consortium will employ non-skilled employees from the project area. Meetings held with the community members at Loperot, Napusimoru, Kangirisae, Lokori, Katilia among other places recorded the issue of employing local community as a priority concern for them to avoid any conflicts.

(b) Potable Water

Water is a key resource that helps in supporting sedentary life in the proposed project area. The water wells that will be drilled during the seismic project and left after the project is completed for the use of the local communities will be a big benefit in this area. To assure the optimum location of the proposed water wells, Turkana has already spent additional money above what it was required to do to study the hydrological resources of the area. This is an example of Turkana's commitment to assist the local communities.

(c) Road Network

The community members feel that the road network in the area is a major impediment to development and growth. The members expressed desire for the proponent to help in rehabilitating the access roads and tracks. This they feel would help in easing transportation and promote trade with other parts of the district. During the course of the seismic acquisition program, there may be need to upgrade some of the roads in the area. The road improvements that are done in the area will be left after the project completion for the benefit of the local communities.

3.17.2 Housing and Recreational Facilities for TURKANA DRILLING CONSORTIUM Staff

The exploration team may also consider putting up base camps at Loperot and Kangirisae area that are centrally located for effective operations according to the proposed seismic tracks locations. The company may also rent permanent houses for logistics and coordination purposes at Lokichar Township or at Lodwar town.

CHAPTER 4:
POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

4.1 Policy Framework

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 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 youths 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, 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 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 utilization, 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 behavior 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.

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:

1. Preserve, conserve and protect available water resources and allocate it in a sustainable, rational and economic way.
2. Supply water of good quality in sufficient quantities to meet the various water needs, including poverty alleviation, while ensuring the safe disposal of wastewater and environmental protection.
3. Establish an efficient and effective institutional framework to achieve a systematic development and management of the water sector.
4. Develop a sound and sustainable financing system for effective water resources management, water supply and sanitation development.

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:

(i) provide sustainable quality energy services for development;
(ii) utilise energy as tool to accelerate economic empowerment for urban and rural development;
(iii) improve access to affordable energy services;
(iv) provide an enabling environment for the provision of energy services;
(v) enhance security of supply;
(vi) promote development of indigenous energy resources; and
(vii) promote energy efficiency and conservation as well as prudent environmental, health and safety practices.

Mining Policy

The National Mineral Resources and Mining Policy are currently at an advanced stage of being adopted. In tandem with this process, the Government has developed a 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 Environment Management Authority 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.

Health Policy[1]

The Kenya Health Policy Framework (1994) sets out the policy agenda for the health sector up to the year 2010. This includes strengthening of the central public policy role of the Ministry of Health, adoption of an explicit strategy to reduce the burden of disease, and definition of an

essential cost effective health care 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 decentralization 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 (MoH) 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 supervises the operations of health activities at the district level.

Economic Recovery for Wealth and Employment Creation Strategy

The overall goal of the Strategy is to ensure clear improvements in social and economic wellbeing 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 the last four years, essentially subsumes the Poverty Reduction Strategy Paper (PRSP).

4.2 Legal and Institutional Framework

Environment considerations for new and existing developments are subject primarily to the Environment Management and Co-ordination Act (EMCA), 1999. The Act establishes certain institutions indicated below, with the functions directly relevant to this Environmental Impact Assessment outlined as follows.

1. The National Environment Council has the following functions:

a) Responsible for policy formulation and direction for purposes of this Act;
b) Set national goals and objectives and determine policies and priorities for the protection of the environment;
c) Promote co-operation among public departments, local authorities, private sector, Non-Governmental Organisations and such other organizations engaged in environmental protection programmes; and
d) Perform such other functions as are assigned under this Act.

2. National Environmental Management Authority

1. The object and purpose for which the Authority is established is to exercise 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.

2. Without prejudice to the generality of the foregoing, the Authority shall:

a) 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;
b) Take stock of the natural resources in Kenya and their utilisation and conservation;
c) Establish and review in consultation with the relevant lead agencies, land use guidelines;
d) Examine land use patterns to determine their impact on the quality and quantity of natural resources.
e) Carry out surveys which will assist in the proper management and conservation of the environment;
f) Advise the Government on legislative and other measures for the management of the environment or the implementation of relevant international conventions, treaties and agreements in the field of environment, as the case may be;
g) Advise the Government on regional and international environmental conventions, treaties and agreements to which Kenya should be a party and follow up the implementation of such agreements where Kenya is a party;
h) 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;
i) Mobilise and monitor the use of financial and human resources for environmental management;
j) Identify projects and programmes or types of projects and programmes, plans and policies for which environmental audit or environmental monitoring must be conducted under this Act;
k) 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;
l) 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;
m) Publish and disseminate manuals, codes or guidelines relating to environmental management and preventing or abatement of environmental degradation;
n) 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.
o) Prepare and issue an annual report on the state of the environment in Kenya and in this regard may direct any lead agency to prepare and submit to it a report on the state of the sector of the environment under the administration of that lead agency;

p) Perform such other functions as the Government may assign to the Authority or as are incidental or conducive to the exercise by the Authority of any or all of the functions provided under this Act.

The minister shall lay every annual report on the state of the environment prepared under subsection (2) (p) before the National Assembly as soon as reasonably practicable after its publication where the National Assembly is in session, or where not in session, within twenty-one days of the day the National Assembly next sits after such publication.

3. Provincial and District Environment Committee shall:
- Be responsible for the proper management of the environment within the province or district in respect of which they are appointed.
- Perform such additional functions as are prescribed by this Act or as may, from time to time, be assigned by the Minister by notice in the Gazette.

Other Acts of relevance are (cf. Mumma, 2002):
- Public Health Act, Cap 242
- Water Act 2002
- Factories Act, Cap 515
- Local Government Act, Cap 265
- Local Government Act, Cap 265
- Penal Code, Cap 63
- Mining Act, Cap 309
- Electric Power Act, 1997

The Water Act 2002

This is one of the most up to date environment-related statutes in the country (Okidi, 2006). It has introduced comprehensive and, in many instances, radical, changes to the legal framework for the management of the water sector in Kenya (Mumma, 2005). These reforms revolve around the following four themes (Mumma, 2005): the separation of the management of water resources from the provision of water services; the separation of policy making from day to day administration and regulation; decentralization of functions to lower level state organs; and the involvement of non-government entities in the management of water resources and in the provision of water services. The role of non-government entities in the management of water resources and in provision of water services is thus clearly recognized. The Water Act goes hand in hand with the Water Quality Regulations, Legal Notice No.120 (Kenya Gazette Supplement No.68, 29th September 2006 – Legislative Supplement No.36) which regulates, amongst others, water for industrial use and effluent discharge, providing standards and monitoring guidelines for effluent discharge into the environment.

The Energy Act, 2006

This Act has now superseded the Electric Power Act 1997 that has been inadequate in providing incentives to the private sector and in accelerating electrification in the country, and the Petroleum Act Cap 116 that has been wanting in offering an effective regulatory framework for the petroleum industry (GVEP Kenya 2006). The Energy Act 2006 stipulates that petroleum based projects should comply with Environment Management and Co-ordination Act (1999) and the Environmental (Impact Assessment and Audit) Regulations, 2003, with respect to mandatory environmental impact assessments and that no licenses be granted prior to their implementation.

The Petroleum Act, Cap 308

This Act specifies the role of the exploration company in the project area and indicates circumstances upon which compensation for destruction of the environment should be made. Section 9 (i) stipulates that exploration should be conducted in accordance with sound professional and technical skills and adopt measures necessary for the conservation of petroleum and other resources and the protection of the environment and human life. Sub section (g) also gives preference to the use of products, equipment and services that are locally available in the project area. Section 10 (2) and (3) deals with issues of private land and compensation thereof if exploration activities is to use part of the land. The section also gives situations where a legal redress can be sought by the private land owners in case of dissatisfaction.

The Public Health Act

The Act contains a comprehensive provision on discharges of pollutants into watercourses (Mumma, 2002). The Act makes it the duty of every local authority (in the capacity of "health" authority) to take all lawful, necessary and reasonably practicable measures to safeguard and promote public health (s.13). Part IX of the Act deals with sanitation and housing, and is of most significance for the control of polluting discharges. S.116 imposes a duty on every local authority to maintain its district in a clean and sanitary condition, to prevent nuisances and prosecute those responsible for nuisances. Nuisances include drains and sewers for the discharge of pollutants into watercourses and lakes.

Section 126 of the Public Health Act empowers the Minister to make rules on:

- The drainage of lands, streets or premises, the disposal of offensive liquids, and the removal of, *inter alia*, waste matters;
- The standards of purity of any liquid which, after treatment in any purification works, may be discharged as effluent;
- The establishment and carrying on of factories or trade premises which are liable to cause effluent, or to discharge liquid liable to, *inter alia*, pollute streams.

Similarly, under section 126A local authorities have the power to make by-laws to regulate drainage and sewers (Mumma, 2002). The act also makes provision for protecting from pollution sources of drinking water supply. Section 129 makes it the duty of the local authorities to prevent such pollution, to purity a pollution supply and to prosecute the polluters. The Minister may make, and require local authorities to enforce, rules for preventing polluting activities threatening such drinking water supply, and for purifying polluted water.

The Public Health (Drainage and Latrine) Rules made under Section 126 of the Act, makes more specific provision for drainage (Mumma, 2002). The Rules –

- Require the drainage of new buildings;
- Prohibit the drainage of surface water into foul water sewers;
- Prohibit the discharged into sewers of matter which may interface with the free flow of the sewage or injure the sewer;
- Empower the local authority to prohibit the discharge of injurious matter into sewers;
- Empower the local authority to require the treatment of effluent before discharge into sewers ; and

- Impose a requirement for permits to be obtained from the local authority before the making of sewer connections or the construction of sewage treatment works.

The Factories Act Cap 514

This is the primary Occupational Safety and Health Act. The Act has been revised several times in order to reflect not only developments in technology and knowledge but also to address new areas of coverage other than factories/ industries (Muchiri, 2005). The last such amendment was in 1990 when the Act was amended to include among others:

- "Other places of work"
- List of occupational diseases
- Establishment of health and hygiene standards
- Reporting of occupational diseases
- Direct penalties for medical practitioners failing to report occupational diseases that they diagnose
- Pre-employment, periodic and post-employment medical examinations
- Research into causes of work-related diseases among others

A new Bill "Occupational Safety and Health Bill" was drafted in 2003 to replace the "Factories and Other Places of Work" and currently awaits parliamentary debate (Muchiri, 2005). This Bill is closely linked to the draft Bill on "Work Injury Benefits Act" that will also cover OSH financing, including rehabilitation, prevention and promotional activities among others. The Bill awaits parliamentary debate and once passed, both these two Acts will be implemented under the same management (Muchiri, 2005).

The Local Government Act

Also contains provisions empowering local authorities to control discharges. Under section 163 (a) local authority may control or prohibit activities, both industrial and domestic, which constitutes 'a source of danger, discomfort or annoyance to the neighbourhood', as an offensive trade or as have been gazetted by the Minister (Mumma, 2002). One further way of control is for the local authority to refuse to licence the activity on the ground that the treatment method proposed is not adequate [s.165]. Generally, it is the local authority's duty to establish and maintain sewerage and drainage works within its area (s.168). It may charge for this service [s.176 (2)], and the charge is recoverable from the owner of any land or premises served (Mumma, 2002).

The Physical Planning Act 1996

This Act makes provision for development control. Persons wishing to undertake development must apply for and obtain consent from the local authority. The planning authority when considering a planning application shall have regard, *inter alia*, "to the health, amenities, and convenience of the community generally, and the proper planning and density of development and use of land in the area (Mumma, 2002).

Conditions imposed in granting consent to a planning application may require or prohibit specified activity. They may also require the applicant to enter into an undertaking to observe the conditions imposed and to furnish security to this end (Mumma, 2002).

The Food, Drugs and Chemical Substances Act

This Act makes it an offence to use or dispose of chemical substances in a manner likely to cause contamination of food or water for human consumption (section 24) (Mumma, 2002).

Registration of Land Act

Private land is registered under the Land Titles Act, Chapter 281 of the Registration of Land Act (RLA), Chapter 300. The RLA provides for the issuance to land owners of a title deed, and in cases of leasehold interests, a certificate of lease, which shall be the only prima facie evidence of ownership of the land (Mumma, 2005). The RLA provides that the registration of a person as the proprietor of land vests in that person the absolute ownership of that land together with all rights and privileges belonging or appurtenant thereto and free from all other interests and claims whatsoever.

Land registration, granting private ownership, has been completed in those regions of the country with high agricultural potential whereas in the areas in which pastoralism is predominant communal tenure is recognized by the law. But despite the registration of land in the names of private individuals empirical evidence suggests that, even in high agricultural potential areas, among rural communities, land use and access rights continue to be based largely on customary and traditional systems, statutory law, notwithstanding. Indeed studies have revealed what one author (Migot-Adhola et al, 1990) has described as “a surprising recalcitrance of indigenous institutions and land use practices” (Mumma 2005)

Mining Act, Cap. 306 of 1940

While the Mining Act still remains effective, efforts are underway and at an advanced stage to replace this old and ineffective Act with a new one. Under the new mining legislation, rights and interests in minerals of all kinds, including commonly found minerals, will be regulated. The environmental and social standards under which economic activities should be conducted in Kenya and the methods by which the Government seeks to enforce them is already part of established national policy and regulatory framework established under the Environmental Management and Coordination Act 1999 ('Environment Act'). The Government’s objective is to achieve a socially acceptable balance, within this framework, between mining and the physical, ecological and human environment and to ensure that internationally accepted standards of health, mining safety, human rights and environmental protection are observed by all participants in the mining sector. 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 Environment 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.

CHAPTER 5:
ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Impact Identification, Evaluation, Prediction and Suggested Mitigation

5.1.1 Physiography and Geology

No alterations to physiography and geology are envisaged. Natural geohazards are relatively unimportant in the area. The area is generally a seismic and flat lying so risk of earthquakes and landslides is low.

Suggested mitigation:

- None.

5.1.2 Soils

The excavation of the seismic lines will affect the transect areas negatively more so in soil units that are denuded of vegetal matter due to salinity, overgrazing, wind and water erosion. Soils of the floodplains and lacustrine plains especially, are susceptible to impeded drainage conditions. Further, these units are locally saline and sodic and hence lack structural stability. This means that when cutlines are excavated, the truncations may form gully heads that may be exacerbated by local ponding during the rains forming full gullies traversing along the drainage lines. This would occur in the mainly calcareous, saline and sodic soils (soil mapping units UV, YS, YdV, PdU, PsA3, PsD, PID, and AA). The seismic tracks will also entail the removal of vegetation along the intended transects and along roadways where machinery would traverse. In a place where vegetation is limited, the removal of vegetation matter would affect the environment negatively. Where the use of heavy equipment and machinery is employed, compaction of the soils would further degrade the local environment.

Suggested mitigation:

- Consider the use of existing utility and transport corridors for access roads to the extent possible
- Gabions should be constructed where the seismic tracks and roads cross luggas, or existing gullies, to stave the effect of gully formation, or deterioration of the same respectively.
- Minimize the width of tracks as far as possible
- As is reasonable the seismic survey should be conducted during the dry season in relatively vegetated and cultivated areas to prevent damage to plants and crops, and to reduce compensation payments and soil compaction.
- Seismic lines and transport corridors should be deviated as is reasonable to avoid established trees / vegetation as much as possible and thereby minimise impacts on flora and fauna.
- Roads construction needs to take into account the landscape gradients and should be constructed in a manner that prevents long-term erosion, through, for example, the installation of proper drainage channels and switchbacks on steeper gradients.

5.1.3 Climate

No major impacts are envisaged on the microclimate of the area.

Suggested mitigation:

- None

5.1.4 Air Quality

Dust emanating from construction operations of the base camps, access ways and that generated by moving trucks and equipment are likely to cause air pollution according to the local communities. Further, the disturbed surface with fine textured soils as a result of site clearance would be susceptible to wind blown erosion. Burning of the resultant litter, exhaust fumes from construction trucks would also contribute to air pollution.

Suggested mitigation:

- Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation. Machinery and vehicles should be switched off when not in use as appropriate.
- Site clearance and burning of litter should be done rapidly and in a time of low wind movement
- Regular servicing of vehicles and machinery to reduce exhaust emissions should be considered.
- Provision of dust (face) masks for employees is essential.
- Fine grained construction material transported from excavations to site should be done in covered trucks if reasonable, to reduce dust emissions.

5.1.5 Surface and Ground Water Resources and Effluents

Water is a key resource in the project area. Its scarcity has often led to conflicts and the locals expressed a desire to protect the few sources of water currently available in the project area. The construction and exploration phases of the project will create additional demand to the water supply due to the increase in the number of people within the project area. The project area does not have piped water and the company shall have to drill its own water boreholes for its operations. Members of the community felt that the track lines may disrupt the natural water-course ways and springs near grazing grounds. Further, activities as a result of this may cause sedimentation along rivers and ultimately physically altering the river banks. Effluent management along the seismic tracks would be a challenge as there is no sewage network in the project area. There being no sewerage or septic system within the project site, the disposal of human excrement would be a challenge. This includes effluent management in the base camps. The installation of water closets and a septic system may not be feasible at this stage considering the project period and the cost implication.

Suggested mitigation:

- Encourage water re-use/ conservation especially at the base camps during seismic tracks construction and operation phases of the project
- Liquid effluent if any should be treated before discharge
- Hazards and toxic wastes materials should be managed according to international protocols and practices and comply with local regulations as well.

- The company should consider the use of pit latrines at the campsites and portable toilets along the seismic lines.
- Seismic operation should be minimised as is reasonable when conducted close to watercourse.
- Install drainage channels on roads where reasonable where natural drainage may be affected

5.1.6 Terrestrial Environment: Flora and Fauna

Due to the arid and semi arid nature of the area large sections of the seismic acquisition area will be exposed to wind and water erosion. Soil excavation as well as vibration from the heavy machinery may have an impact on the resident flora and fauna and the wider ecosystem. Impacts are anticipated to be: clearing and excavation of vegetal matter during construction, interfering with dry season grazing refuges, destruction and disturbance of nesting, roosting and foraging sites, and behavioural changes in some species such as the shy dik dik.

Suggested mitigation:

- The seismic survey should be acquired in such a manner that reasonable measures are taken to protect the vegetation cover as much as possible.
- Facilities should be sited in locations that minimize contact with critical habitat patches such as foraging areas, roosting sites, nesting sites, dry season grazing grounds.
- Clearing of vegetation cover should be minimized as is reasonable , and the activity, if inevitable, should take place in the dry season if reasonable to do so in order to avoid unnecessary removal of vegetation cover and topsoil layer, thus reducing wind and water based soil erosion.
- Areas set for vegetation cover clearing should be minimized as much as possible. Use of heavy machinery such bulldozers on steep slopes and ecologically sensitive areas should be minimized.
- Riverine forests are vital habitats for a variety of fauna species; therefore seismic operations in these areas should be minimized if reasonable, through, for example, instituting appropriate line offsets.
- During the planning of the seismic lines, hilly terrain and steep slopes should be avoided if possible.
- Seismic lines should be deviated if reasonable to do so to avoid established vegetation and sensitive soils, and through areas of easiest access on river crossings.
- Where fences and other structures cannot be avoided, permission should be sought before their removal and plans should be made for their restorations.
- Measures to minimize noise and vibration levels in the project areas should be employed in order to cause the least possible disturbance.

5.1.7 Aquatic Environment: Flora and Fauna

Owing to the arid and semi arid conditions of the area, large sections of the seismic acquisition, aquatic habitat areas may be exposed to water erosion. Soil excavation may have an impact on

the resident aquatic flora and fauna and the wider ecosystem. The anticipated impacts resulting from clearing and excavation of vegetal matter during construction are: exposure and loosening of soil making it prone to water erosion. The clearing of vegetation cover and soil conditions may lead to a change in rainfall-runoff characteristics which may lead to change in river flow regimes. Loosened up soils can be easily washed by rain into luggas and later into the main river channels and eventually deposited into Lake Turkana. The washed-up soil may lead to silt build-up at the river-lake interface (delta areas) leading to sedimentation, and increased turbidity. These may lead to a change in the ecology of the river and lakes and also the socio-economic well being of the local communities because of the reduced productivity of the aquatic habitats in the area.

Suggested Mitigation:

- The seismic survey should be acquired in such a manner that necessary measures are taken to protect the vegetation cover as much as is reasonably possible.
- Clearing of vegetation cover should be avoided as much as is reasonably possible, and the activity, if necessary, should take place in the dry season if it is reasonable to do so in order to avoid unnecessary removal of vegetation cover and topsoil layer, thus reducing water based soil erosion.
- Areas set for vegetation cover clearing should be minimized as much as possible, Use of heavy machinery such bulldozers on steep slopes and ecologically sensitive areas should be minimized
- Riverine forests are vital habitats for a variety of fauna species; therefore seismic operations in these areas should be minimized if possible.
- During the planning of the seismic lines, hilly terrain and steep slopes should be avoided as much as is reasonable
- Seismic lines should be deviated as it is reasonable to do so avoid established vegetation and sensitive soils, and through areas of easiest access on river crossings.

5.1.8 Land Resources and Natural Heritage Sites

Pasture and browse are the major land resource in the area and supports the pastoral lifestyle of the local community. Certain areas like *Katirr* are normally left fallow during rainy seasons to allow for regeneration of pasture.

There are minimal built land resources within the project area which may be affected by the cut line construction. However, the concession area of seismic operations which is extensive may cause significant impact on livestock pasture and browse area. This is due to the fact that free-range (movement and browse) area of the livestock may decrease or become altered significantly. There are no reserved natural, heritage or cultural sites within the project area that may be affected by the operations of the project.

Suggested mitigation:

- 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

- Sensitize the local community through their leaders' forum and *barazas* on the possible impacts of the project on pasture and browse.

5.1.9 Visual Aesthetics

The visual aesthetic effects of the study area as a result of the project will be minimal disruption of the pristine environment composed of the vast piedmont plain with indigenous vegetation, as a result of the buildings constructed within the base camps, seismic tracks and access ways and the requisite infrastructure.

Suggested mitigation:

- Backfilling any degraded areas should be considered, reforestation and re-vegetation to restore the environment to its original form during the project decommissioning should be considered

5.1.10 Noise and Vibrations

The use of heavy road construction and exploration machinery is likely to be a major potential source of environmental pollution. All materials with the exception of material for earthworks will be imported and stockpiled in adequate constructed and protected areas. Noise and vibration from road/ tracks construction and exploration exercise will be a major environmental concern. The vibroseis equipment would generate noise and vibration along the seismic lines during the exploration exercises. The support vehicles and recording truck which will move in the survey areas would further contribute to noise pollution.
Contractor mobilization and the import of construction material and exploration machineries will also create vehicular noise along the access roads.

Suggested Mitigation:

- As is reasonable, equip vehicles with compliant silencers to muffle noise.
- Provision of full protective gear for workers like helmets and earplugs. Workers shall also be sensitized on hazards encountered in such work environment
- The suggested restriction for seismic operations close to wells, buildings and/or settlements is 1000 m.
- Use local leaders to sensitize the neighboring community about the project and its possible noise and vibration impacts.
- monitor noise levels during the survey

5.1.11 Offensive Odours

Offensive odours may be limited in a spatial extent and would be related to sanitation and combustion of fossil fuels expected from the construction and exploration machinery.

Suggested mitigation:

- Put in place proper sanitation facilities for workers at the campsite.

- Ensure that vehicles and equipment with defective exhausts are repaired

5.1.12 Archaeological, Historical, Cultural Sites and Landscape

There are no significant cultural, historical, archaeological or protected resources or areas in or near the proposed project site. Individual villages, clans and households have their own revered areas such as *Laibon* burial sites or public meeting areas. The burial sites can be identified as they are marked by stacking stones on the grave.

Suggested mitigation:

- The exploration team should liaise with local leaders to help them identifying any sensitive sites to prevent any conflicts with the local communities.

5.1.13 Solid Wastes, Waste Oils

The mobilization and operation of the proposed project is expected to generate solid waste due to the expected human influx and activities in the area. Some of the likely waste materials to be generated include cans, wrappings, paper, and plastics waste, among other at the base camps. Plastic waste is of particular concern especially if ingested by the livestock. Waste oils and petroleum used in vehicles and exploration machinery may spill or leak on/into the ground hence into 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.

Suggested mitigation:

- Solid wastes shall be properly segregated and separated if it is reasonable to do so to encourage recycling of some useful waste materials. Use of an integrated solid waste management system through a hierarchy option that is source reduction, recycling and reuse shall be encouraged.
- Ensure that solid wastes are disposed of in a designated area. All the wastes generated within the project site and at the camps shall be collected at a central weatherproof bin, checked to ensure no toxic material retained and stored for incineration.
- Oil drip traps should be regularly maintained as per a maintenance schedule for maximum performance particularly in the garage area
- Regular servicing of equipment should be carried out in the garage area with oil drip trap
- Hazards and toxic wastes materials should be managed according to international protocols and practices and comply with local regulations as well.

5.1.14 Social Impacts

The projected increase in the number of people in the project site and within the neighbouring areas either as employees or itinerant business people may have negative implication to the social and cultural fabric of the local people. Some of the negative implications that may come into the area include prostitution, child labour, child abuse and drug peddling. The influx may also disrupt the inherent pastoral lifestyle in the project area. These vices may cause friction with members of the community who are known to adhere to strict traditional moral standards and adore their pastoral lifestyle. Some of the social issues identified by the community were:-

- The construction of seismic tracks may lead to displacement of pastoralists and private land owners
- Petroleum exploration activities may trigger insecurity and heighten hostility between the Turkana and the neighbouring Pokot community.
- Importation of casual workers from other parts of the district/county may lead to intra community and inter clan rivalry and/ or conflicts
- Increase in vehicular activities in the area could lead to motor vehicle accidents to livestock and children
- The project will lead to an influx of people in the area that may bring with it immoral behaviour like prostitution, drug abuse, child labour and thuggery
- The accruing resources may not be shared equitably and this may be a source of conflict
- Questions of real participation and involvement of local communities in the project were raised. Turkwel Gorge project in the 1990s was mentioned as one that never lived up to its billing in terms of public involvement
- Compensation where applicable shall be a major challenge since a large part of the project area is a trust land that has not been adjudicated.
- Job opportunities created during the exploration exercise may lead to young people abandoning livestock herding and this may endanger the traditional pastoralism lifestyle
- The influx of people into the project area may exert pressure on the available natural and anthropogenic resources and may also lead to culture shock to the locals
- Poor communication between the exploration company and the local may create a barrier and lead to misunderstanding and conflicts

Suggested mitigation:

- Any human settlement displaced by the cut line construction should be considered for compensation or relocation. This should be done in collaboration with the Turkana County council.
- Non skilled labour should be sourced from the local community where no special training is required if it is reasonable to do so
- During seismic survey, care should be taken to avoid any accidents or incidents with the locals or livestock
- The company should consider the creation of a communication office based at the project site. Misinformation is rampant among the locals about the project. Again communication between the company and the local authority should best be handled by one who understands the local issues. A local resident liaison officer would handle the emanating issues expeditiously.

5.1.15 Economic Impacts

The proposed project is located in a low population density area. Human settlement is concentrated within trading centres whose existence has largely been influenced by availability of water points and other social amenities like schools. Gypsum mining has been practiced around Napusimoru area, however, according to the local chief there has been no activities in the minefields since 2004 due to political interference. The proposed seismic survey project will have significant positive economic benefits on the livelihoods of the local people around the project site. There shall be direct non skilled employment opportunities and related business opportunities shall be created for the locals and outsiders. The exploration exercise will also

spur investment from related companies into the area particularly in the communication and transport sub sectors.

Suggested mitigation:

- Encourage the use of local labour as is reasonable to avoid conflicts.
- Involve the local leadership throughout the project cycle

5.1.16 Health and Safety Impacts

Due to the nature of the proposed project, there may be increased hazards to health and safety as a result of dust, air and vibration pollution. The workforce and general public living at, or near the seismic tracks site would be more subjected to these environmental hazards and disturbances. The district does not have a disaster management committee or strategy at the moment and there is no fire fighting engines at Lokichar. Similarly there are no adequately equipped and manned health facilities in the project area that may handle emergencies or serious health outbreaks.

Suggested mmitigation:

- Avoid building the company operational base camps in close proximity to human settlements.
- Worker health and safety should be assured through the development and implementation of standard workplace practices and the Company HSE/OHS Policies must be adhered to.
- Health and safety in nearby communities should be assured through implementation of safe operating practices by workers, restrictions on activities that produce loud noises during night time hours, restrictions on earthmoving and refuse burning activities to preclude downwind impacts on communities or sensitive receptors, and installation and maintenance of adequate site security to prohibit entry by unauthorized persons.
- Adequate sanitary facilities shall be provided and cleanliness shall be ensured as per set health standards at the camps.
- Safety awareness on machinery use will be created through training and regular safety meetings held.
- It is recommended that the company should have a fully equipped first aid kit during operation and ensure that only well trained personnel handle the equipment.
- The company should ensure that it has adequate fire fighting equipment and trained personnel to man the equipment.
- The company should liaise with the local health centres as is reasonable to develop areas of cooperation should medical emergencies occur.
- The company should liaise with the provincial administration to determine the level of security needed during project operation

5.1.17 Positive Impacts Perceived by the Communities

The local communities outlined the following issues as the possible positive impact in the area in the short- and/or long-term if the project is implemented:

- The project will create job opportunities for local residents
- The project will catalyze development opportunities in the area, help in fighting poverty and thus improve the livelihoods of the people in the area.

- The project will improve the area's and country's economy if the exploration succeeds
- The seismic tracks will assist security forces to access cattle rustling prone areas easily and thus help in improving security
- The project may catalyze other companies like the ones in communication industry to venture into the area
- The drilling of water boreholes will help in alleviating water problem in the area increasing the number of existing water points
- It may offer on job training for the local employees
- The success of the project may help in peace building and cooperation with other communities particularly the Pokot

In general, the local community has strong support for the project and it's hoped that there oil reserves would be discovered in the area.

5.2 Categories and significance of impacts

This categorization of the impacts, contrasting baseline with all components of the survey and post-survey impacts of the project, takes into account the likely potential effects, *in the event of non-compliance with the suggested mitigation measures specified above*. The criteria for significance determination are shown in the table below (Table 5.1). After considerations of the criteria, the environmental impacts are scored as follows: Score 0 = no known impact; Score -1 = slight negative impact; Score -2 = moderate negative impact; Score -3 = strong negative impact; Score +1 = slight positive impact; Score +2 = moderate positive impact; Score +3 = strong positive impact. The impacts are further classified as: actual or potential; direct or indirect; short term or long term. Risk levels are classified as low, medium and high.

Table 5.1: Scoping scores and impact classification

Parameter assessed	**Baseline**				**Development and Operation**			
	Pressures/Impacts	**Duration of Impacts**	**Risk Level**	**Impact Score**	**Pressures/Impacts**	**Duration of Impacts**	**Risk Level**	**Impact Score**
Physiography and Geology	None	-	-	0	None	-	-	0
Soils	Compaction from grazing animals, wind erosion, water erosion	Long-term	High	-1	Gullying, excavations, aggregate material, compaction by vehicles	Long-term	High	-2
Climate	Global climate change	Long-term	Medium	-2	None	-	-	0
Air Quality	Dust generated by wind and enhanced by low vegetation cover	Long-term	Low	-1	Spread of dust and exhaust gases by vehicular traffic and exposed surfaces(seismic tracks)	Short/long term	Low	-1
Surface and Ground water	Pollution of shallow groundwater in luggas from	Short/long-term	High	-2	Alteration of water courses, pollution (human)	Short/Long term	High	-2

	humans and livestock							
	High demand for potable groundwater sources	Short/long-term	N/A	-3	New boreholes commissioned	Short/long term	N/A	+1
Terrestrial environment	Land degradation	Long-term	MEDIUM	-1	Land degradation, wildlife disturbance	Short/Long-term	Medium	-1
Aquatic environment	Land degradation/ water siltation	Long-term	Medium	-1	Wildlife disturbance, siltation	Short/ long-term	Medium	-1
Land Resources	Land degradation	Long-term	MEDIUM	-1				
Offensive Odours	Local, related to human/livestock organic wastes	Short-term	LOW	0	Improper disposal of effluents and solid waste and uncontrollable exhauast emissions	Short/long-term	High	-1
Archaeological, cultural sites, landscape	None	-	-	0	Disturbance of graves	Short/Long-term	MEDIUM	- 2
Economic setting	Slow economic growth rate	Long-term	LOW	-1	Diversification of alternative livelihoods, job creation, etc.	Short/Long-term	LOW	+3
Social setting	Stable community	Long-term	LOW	0	Job opportunities, Opening of markets, migrants, etc.	Long-term	HIGH	-1
Health setting	Inadequate provision of services	Long-term	MEDIUM	-1	Vulnerability to dusts/gases, accidents at workplace and surrounding areas	Short-term	HIGH	-1

CHAPTER 6:
ANALYSIS OF PROJECT ALTERNATIVES

6.1 Project Sites

The Kenyan government through previous exploration works by various companies has identified a number of 'blocks' with potential for oil and gas. These blocks are found in coast, eastern, north-eastern and rift valley provinces and Kenya's territorial waters and exclusive economic zones in the Indian Ocean. Turkana Drilling Consortium Ltd has been granted the exploration license for block 10BB in North Western Kenya. For this reason, 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.

The primary exploration site in Block 10BB is around the Loperot 1 well that was drilled in 1992 by Shell International. This well discovered oil, when tested. Loperot area will be explored using 3 dimensional Seismic Exploration techniques (a method that will be used for the first time in Kenya but is now the normal technique throughout the world for deriving well locations).

There are secondary areas of interest to both the North and South of Loperot, as well as inside the Kerio Valley. There areas will be explored using 2 dimensional Seismic Techniques – the data gathered during these surveys will be used to enhance existing data shot by Shell in 1991. The combined results will be interpreted and the results used to design possible future 3D surveys in these potentially oil bearing areas.

6.2 Technology

The survey will be conducted by Seismic Contractors using current state of the art recording equipment and source vehicles.

1) Vibroseis Source vehicles. This equipment is designed to generate seismic energy without causing damage to the local environment. The vehicle has a large pad which lowers onto the ground at each seismic shot position. A hydraulic piston induces a controlled vibration onto a plate positioned on the ground to generate a seismic wave that can penetrate through rock layers several kilometres deep. The reflected waves are then detected by geophones positioned along the seismic survey track line at regular intervals. These signals are then electrically amplified and returned in digital format to a computer located in the recording track for processing.

Plate 6.1: Trucks carrying the equipments

1.) GPS survey equipment. The seismic square and receiver geophone positions are accurately measured using GPS satellite equipment. They are marked with bio-degradable pegs on the ground which are removed after the survey. The equipment is carried on a back pack which ensures no damage by vehicles moving around the survey area.

Plate 6.2: Grounds men placing receiver geophones

2.) Recording Equipment. This comprises strings of Geophones which measure the signals coming from the Vibroseis vehicles, recording boxes into which the geophones are attached and cables that join the boxes to a central recording truck. This equipment is laid out in a grid around the survey area. It sits on top of the sand and is removed without damaging the terrain once the recordings have been completed. The electronics within this system are comprised of very low power DC current – this presents no threat to wildlife or people.

Plate 6.3: Strings of Geophones measuring the signals coming from the Vibroseis vehicles

3.) The recording and support trucks. The recording truck contains the central recording system where all seismic Data is collated and stored on magnetic tape. During the course of a survey, it moves around the area from time to time but generally occupies a fixed position in the middle of where the crew is working. Support vehicles are used to carry personnel and equipment around the survey area. They are strictly governed by safety procedures to ensure that no accidents happen to the local population or wildlife.

Plate 6.4: The recording truck containing central recording system

6.3 Designs

The following map shows the proposed 3D and 2D lines which Turkana Drilling intends to acquire in 2008. The proposed 2D lines are in GREEN. The 3D is a brown square. The black lines are those that were shot in 1991 by Shell.

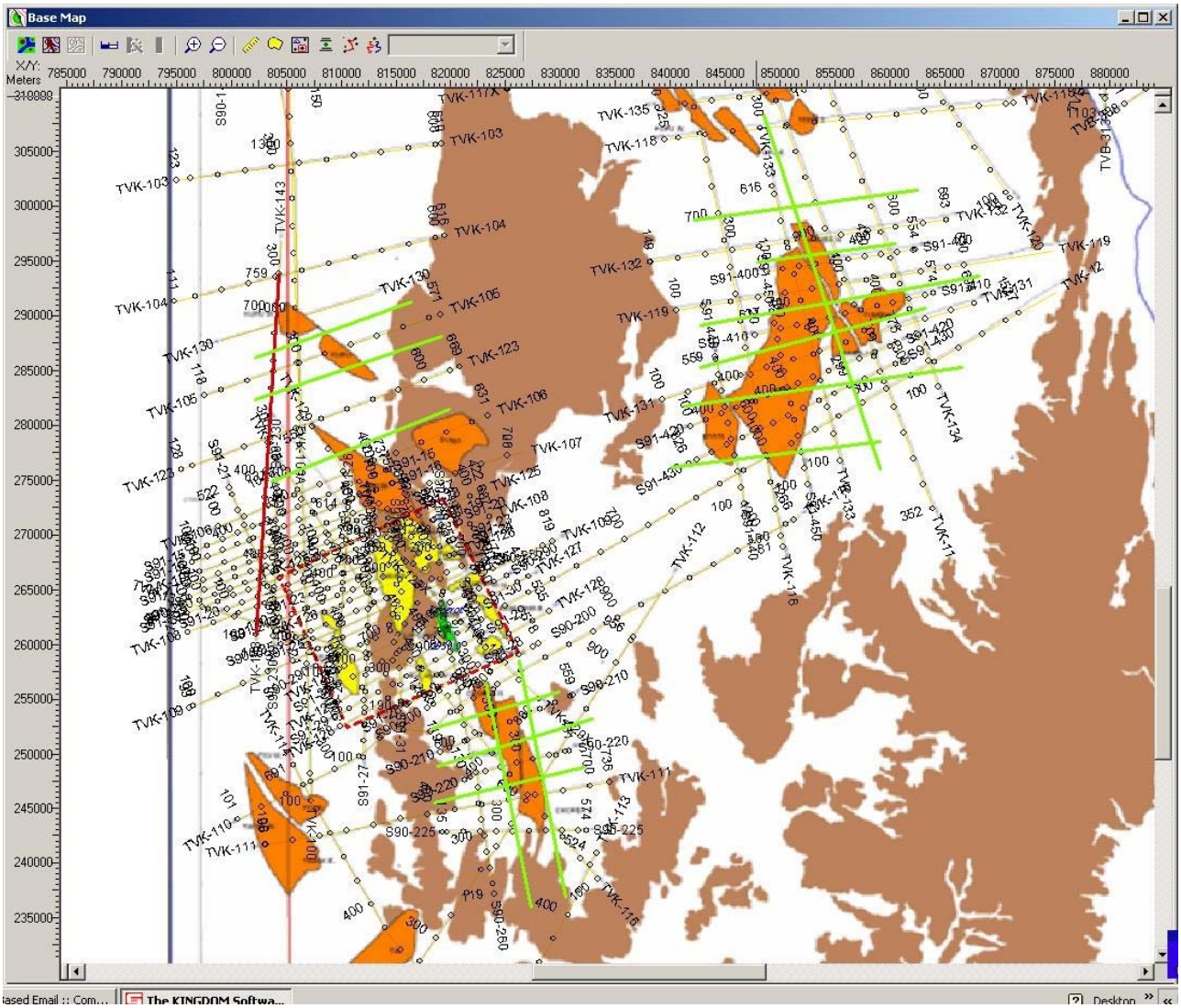


Figure 6.5: 3D and 2D design lines for seismic survey.

6.4 Scale and Extent

The minimum requirement for shooting seismic under the Production Sharing Contract (PSC) agreed with the Government of Kenya is 200 Sq Km of 3D and 200km of 2D but could extend to 250 sq km of 3D and 300 km of 2D (figure 6.5). Any additional seismic would enhance the possibility of accurately positioning the first exploration well, reducing the drilling phase of the project and hence reducing further environmental impact.

CHAPTER 7:

ENVIRONMENTAL MANAGEMENT PLAN

7.1 Institutional Arrangements

Environmental concerns, that will be monitored and audited during the proposed project's construction and exploration phase include: air pollution, occupational health and safety (including worker accidents and hazards); socio-economic benefits, vibration pollution, pasture and pastoralists displacement, solid waste management and security concerns. In order to maintain environmental quality, a consistent monitoring action plan must be formulated. Turkana Drilling Consortium Kenya Limited must work closely with the local county council in the area to keep them appraised of their operating procedures, changes, or developments that may be of concern to local interests. It is also essential that there is liaison with any emergency rescue teams. Finally, the company should strive to maintain good relations with the council and the community through contact points in recognized community organizations, and also, working together, help to minimize environmental, social, health and safety impacts through, perhaps, coordinated awareness campaigns and other avenues of public education and information exchange.

7.2 Environmental Management Plan (EMP)

Environmental Management Plan (EMP) involves the protection, conservation and sustainable use of the various elements or components of the environment. The EMP for the proposed project provides all the details of project activities, impacts, suggested mitigation measures, time schedules, costs, responsibilities and commitments proposed to minimize environmental impacts of activities, including, monitoring and evaluation during implementation and decommissioning phases of the project. Suggested mitigation measures for the proposed project have been dealt with in Chapter 5 of this report.

7.3 Timeframe and Cost of Implementation of the Project

Table 7.1 Environmental Management Plan Table

Environmental Issue	Suggested Mitigation	Monitoring Parameters	Monitoring Frequency	Management Measures	Net Effect	E.g. Cost (Ksh.)
Physiography and Geology	- None	None	None	-	-	Nil
Soils	- See section	Checking of soil stability by soil expert	Monthly	- Avoid/minimize activities that can extensively impact on soil structure and stability	Soil conservation	150,000
Climate	- None	None	None	-	-	Nil
Air Quality	- See section	Check dust levels	Monthly	- Monitor use and status of vehicles and machinery.	Preservation of air quality	100,000
Water Resources and	- See section	- Adherence to riparian zones	Monthly	- Checks on adherence to	- Protected surface and	300,000

Effluents		- Microbial load in potable water - Treated effluent, if any		riparian zones - Implementation of waste/effluent management plan	groundwater resources - Safe water supply	
Terrestrial Environment: Flora and Fauna	- See section 5.1.6	- Area of vegetation cleared - Protection of ecologically sensitive areas	Monthly	- Adherence to EMP - Rehabilitation plan developed for post-survey period	- Avoid disturbance to flora and fauna	200,000
Aquatic Environment: Flora and Fauna	- See section - 5.1.7	- Area of vegetation cleared - Aquatic habitats	Monthly	- Adherence to EMP - Rehabilitation plan developed for post-survey period	- Avoid alteration of aquatic habitats - Avoid disturbance to flora and fauna	200,00
Land Resources	- See section 5.1.8	- Visual inspections	Monthly	- Consultation with local leaders/ Stakeholders	- Protected and/ or preserved land resources and natural heritage sites	100,000
Visual Aesthetics	- See section 5.1.9	None	None	- Project design and drawings refers (track lines and camp sites)	- Acceptable visual effects	Nil
Noise and Vibrations	- See section 5.1.10	- Noise levels using dosimeter - Vibration level optimization (vibro-meter)	Daily	- Noise and vibration nuisance to humans, livestock, wildlife checked - Vibration effects on surrounding environment	- Noise and vibrations maintained at conducive level	200,000
Offensive Odours	- See section 5.1.11	- Regular checks and servicing on sanitation and machinery/vehicl es	- Daily for sanitation levels - As appropriate for machinery/vehicl es	- Implementation of maintenance schedules	- Clean environment	500,000
Archaeological, Historical, Cultural Sites and Landscape	- See section 5.1.12	- Pre-survey check on locations of graves sites	-	- Consultation with local elders	- Protected and preserved sites	50,000

Solid Wastes, Waste Oils	- See section 5.1.13	- Solid wastes, oils and grease for waste oils	- Visual checks monthly	- Implementation of waste management/ monitoring plan	- Hygiene standards maintained and pollution checked	300,000
Social Impacts	- See section 5.1.14	- Monitor social parameter impacts	- As appropriate	- Regular consultation /discussions with local stakeholders/ leaders - Proponent to comply with all applicable legislative, statutory, local by-laws & respects community traditions and culture	- Improved social harmony, acceptance, cooperation and community empowerment	400,000
Economic Impacts	- See section 5.1.15	- Periodic assessments of economic impact	- As appropriate	- Regular consultations with local stakeholders/ leaders	- Develop measurable parameters	100,000
Health and Public Safety Impacts	- See section 5.1.16	- Inspection for compliance to OHS and HSE policies - Follow laid Safety guidelines	- Daily	- Proponent to comply with all applicable legislative, statutory, local by-laws & communal rites. - Security codes adhered - Relationship building with Provincial Administration and the Police	- Health well maintained - Safety assured	100,000

CHAPTER 8:
CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary of the Project Components

Turkana Drilling Consortium Kenya Limited was founded 2007. The company signed a Production Sharing Contract with the Government of The Republic of Kenya on 25th October 2007. The Company has been granted a license in block 10BB to explore oil and gas resources.

The Company is proposing to carry out a seismic survey in parts of the block order to assess its potential for oil deposits and to locate traps where such deposits may occur. The critical role that energy plays as an input to socio-economic development and environmental protection is now universally acknowledged, as it is an important vehicle for income and employment generation and for satisfying basic human needs, and the provision of adequate, quality and affordable energy services can play a decisive role in poverty reduction (GVEP Kenya, 2006). Currently, Kenya is faced with insufficient, costly, and erratic energy supply and this has in part resulted in high cost of production. This project, which involves seismic survey for oil and gas, aims at discovering and exploiting oil and gas as an alternative source of energy which will boost the country's energy supply and help in reducing the cost ofenergy and over reliance on hydro-electric power and importation of crude oil. The country also stands to benefit from oil and gas exportation to other countries thus increasing the per capita income from foreign exchange.

Turkana Drilling Consortium Kenya Limited having won the exploration license for the area has already analyzed the initial airborne gravity/ magnetic and seismic surveys that determined and detected the largescale features of the sub-surface geology. The project will also entail the creation of base camps at Kangirisae and Loperot areas. Fifteen seismic line tracks (4.5 – 5.5 metres wide) will be cut along pre-specified transects, each traversing a range of 20 to 100 kilometers. This will entail earthworks that will slightly modify the environmental settings. Final selection of the seismic survey track lines will be made in the field at the commencement of the survey, using an RTK-GPS surveying system. Line clearance will be done using a Bulldozer CAT8D, and machetes when needed.

8.2 Recommendations

The proposed seismic survey project will have no significant adverse impacts on the surrounding environment. The clearing of seismic track lines and the drilling of water boreholes, while involving considerable earthwork, will use proven construction techniques and modern technologies. Potential minor adverse impacts, particularly vibration pollution from seismic survey, can be readily avoided by good site management, and adherence to the suggested mitigation measures proposed in this report as well as to internationally acknowledged HSE codes and practices for the Oil Industry Sector. In addition to this, close consultation with local leaders and

communities at all times during the survey will ensure that the exercise runs smoothly and with the full support of the local communities. From our field survey we noted that there is strong community support for the project and high hopes that oil reserves would be discovered.

The key recommendations relating to environmental impacts and concerns are as follows:

- The Consortium should hold an area leaders meeting to inform and sensitize them on the survey plans prior to commencing the work. This idea was expressed by most of the leaders that we spoke to.
- For non-technical personnel, the jobs should go to people from the local communities as is reasonable. It is understood that the majority of the people hired will be by the seismic contractor and not Turkana Drilling Consortium; consequently, Turkana may not have influence on this issue, but will impress upon the contractor the need to take this into consideration. This was strongly expressed by the leaders and communities.
- Ensure that community health and socio-cultural traditions are protected and that worker's occupational health and safety standards are maintained through capacity building, proper training, providing protective clothing and managing their residential camps according to the required health standards.
- Liaise with the local administration, the local authority and all other stakeholders throughout the process and prior to any seismic activities in, or close to, important cultural sites.
- Consider the use of existing utility and transport corridors for access roads as is reasonable. The right-of way should be kept to a minimum.
- The seismic survey should be conducted during the dry season as is reasonable however it is recognized that this may not always be possible. This is for the relatively vegetated and cultivated areas to prevent damage to plants and crops. Cutting of trees should be minimized as far as possible and more generally, minimise areas that will be cleared. Minimize the use of heavy equipment such as bulldozers, especially on steep slopes, water and wetland crossings, and ecologically sensitive areas.
- Seismic operations should be avoided when reasonably possible within 30 m of any watercourse, and within 300m of any well, borehole, building or settlement depending on the amount of vibratory energy to be applied to the ground. Gallery forests should be avoided if reasonably possible.
- Seismic line clearing should as is reasonably possible deviate around established vegetation and sensitive soils, steep gradients, and pass through areas of easiest access on river crossings.
- Proper management of both solid and liquid waste to avoid soil and groundwater contamination.

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Turkana Drilling Consortium is committed to operating is an environmentally sound manner, and is committed to improving the communities in which we work. There are requirements in the Production Sharing Contract for economic support and training which Turkana will fulfill and exceed. In addition, Turkana will work with the local people to provide to help provide additional assistance. One area that Turkana is focused on is in the area of reliable water supply. As a part of the project requirements, water supply wells will be drilled to support the seismic activity. At the end of the project, we will endeavor to leave these wells in a usable manner for the benefit of the local communities. Turkana recognized the greater needs of the local communities as indicated in the following meeting summaries. It should be noted that even though Turkana will provide support to the communities, it is in no way committed to any of the suggestions or recommendations that are indicated in the following meeting minutes.

Annexes

Minutes of Meetings with Community and Community Leaders

Certified copies of laboratory results

Socio-economic questionnaire

Noise readings

Bird sightings

Mammal sightings

ANNEX 1

MINUTES OF THE MEETINGS HELD IN THE FIELD

Meeting with Turkana Central District Commissioner Mr. G. Ayonga on 24th June 2008

The D.C welcomed the E.I.A team to Lodwar and Turkana Central district. The team leader Prof. Opiyo introduced the team and gave a background of the team's mission in the district.

The D.C informed us that there was anxiety already in the district in relation to the petroleum prospecting activities scheduled in the larger Turkana area. He informed the meeting that local councillors practising double standards in that they supported projects during take off but later on putting unnecessary road blocks behind the scenes for the prospecting companies, especially in Turkana North.

The D.C informed the meeting that the district has potential for mining and pointed out that gold deposits were currently being mined albeit in a crude method by locals.

The D.C informed the meeting that unskilled labour should be sought from the district to avoid any possible conflict with the local politicians.

The D.C also assured the team of his cooperation during the time the team will be in the district.

The D.C took time to call his counterpart from Turkana South District who was visiting Lodwar. The Turkana South D.C Mr. Julius Kavita met the team briefly and gave us an appointment to visit his office the following day.

On security – the DC said the district had not experienced any major security challenges and assured the team that the provincial administration would provide adequate security during the study.

On security during operation – he suggested that the company should liaise with local provincial administration to determine the level of security personnel to be deployed to them.

ANNEX 2

Meeting with Anne Itubo, District Forest Officer (DFO) Turkana District on 25th June 2008

The team leader Prof Opiyo gave a brief background of the project.

The DFO informed us that she was in charge of forestry in the larger Turkana district and has also been handling environmental issues. She informed the meeting that a district environment officer had now been posted in the district.

She said the district had a fragile ecosystem and any activities that may put pressure on the environment should be properly planned. She suggested that a comprehensive environment monitoring and management plan need to be put in place.

On social structures she said the project is likely to attract more people at the operation area and this may have negative social issues like spread of HIV/AIDS and other diseases, increase in crime and pressure on available resources. Similarly if the project attracts people to a central place it may deny other parts of the district a chance to develop.

She therefore suggested the need of having other economic projects at satellite locations to ensure that there shall be continuity and sustainability of livelihoods even if the main project is decommissioned. She gave an example of Lokichoggio Township that is slowly dying after most of the international organizations pulled out of the region following the peace deal in Sudan.

She said her department has supported many women and youth groups in afforestation programmes in the district. However, one key challenge facing the district was rampant charcoal burning that has threatened forest cover in the area. She informed the meeting that the new Charcoal bill shall regulate the burning, sale and movement of charcoal. The law shall also ensure that the government gets revenue from charcoal dealers.

The DFO also informed the team that there was need to involve the local leadership fully in the entire project process. She suggested that there is need for the team to attend District Steering Committee meetings to sell the idea of the project. At the same time she informed the team that attending a more inclusive leaders' meeting would also help in creating awareness to the local leaders who would in turn enlighten the local people on the ground.

In this regard the DFO accepted a request from the team leader to organize a leaders meeting in collaboration with the local MPs and the provincial administration. A consultative meeting between the team leader, the DFO, representative from the prospecting companies and the area MPs was slated for Saturday 28th June 2008 at the Stanley Hotel, Nairobi.

The DFO informed the meeting that the Neem tree is doing well in the area and more people are interested in planting it.
She also told the meeting about the challenges of water supply in the area and cited the case of boreholes within the area that have been drilled in close proximity. This she said may affect the ground water supply in future.

The DFO took time to fill in our questionnaire.

ANNEX 3

Meeting with Mr. Julius Kavita, District Commissioner Turkana South District on 25th June 2008

The team leader gave a brief background of the proposed project and sought to know about the security situation on the ground.

The team also met three councillors from the district at the DC's office. The councillors requested to know the nature of the project and how the local communities will benefit.

They also wanted to know the relationship between data gathered earlier by the Kenya Oil company in the 1990s and the current proposed prospecting project.

The councillors also sought to know the measures the company will take to ensure that any open ground like wells are covered to avoid incidents/ accidents that may affect livestock or humans.

The team leader responded to the issues raised by the councillors and assured them that the legal situation had changed tremendously in the country thus the need for Environmental Impact Assessment study before any project is undertaken. This he said will ensure that all the needs and fears of the communities are taken into consideration before implementation.

The DC said the security situation was a big concern in the area particularly at Lokori division but the security team was doing every thing possible to maintain peace and order. He said the cattle rustling menace along the Turkana/ West Pokot border was a major challenge.

He advised that the company should recruit non skilled employees from the area through the assistance of local leaders as a way of cultivating good working relationships with the local communities.

On security during operation – he advised that the company should liaise with his office in order to determine the level of security needed. He said the police could provide armed escort during operation and also said that there are Kenya Police Reserve officers in the villages who provide regular security.

He said that if implemented the project will improve the living standards / lifestyles of the local people significantly.

The DC also gave the team current district data on administrative structure, population, education among other.

The DC once again welcomed the team in Turkana South district and assured them of his cooperation throughout the study in the area.

ANNEX 4

Meeting with Chief Phillip Elimlim (Kalapata Location) and other local leaders on 25th June 2008

The team leader gave a brief background on the proposed project to the community members.

The members said that the proposed project if implemented would improve infrastructure in the area and this would open up this area to new development opportunities.

The members felt that water projects in the area should be given a priority as part of the company's corporate social responsibility.

Members felt that if no chemical is to be used during operation then the proposed project will not be harmful to the environment and the community.

On the possible negative impacts the members said that the project may affect water points especially water springs meant for livestock during dry spells.

The project, the leaders observed, shall also affect pasture area and displace people from their settlements and asked for consideration of compensation should that occur.

The leaders expressed fears that the project may affect pasture area; however, they advised that the company should liaise with local leaders to sensitize the local communities during construction of seismic tracks to avoid conflicts.

The leaders also expressed fears about the prevailing famine in the area that had affected most pastoralists who had lost most of their herds to the phenomenon. They also sighted the impacts of PPR a viral livestock outbreak that had led to the death of goats and sheep a in the area.

As part of corporate social responsibility the member listed the following as their priority project besides water supply.

- Water point project
- Improvement of education facilities and
- Improvement of health facilities in the area

The local councillor Mr. Samson Ekwan of Kalapata Ward and the area Assistance Chief Daniel Ayeng took time to fill in our questionnaires.

ANNEX 5

Meeting with Assistant Chief John Lengiro (Kanga'kipur Sub-location) and other local leaders on 26th June 2008

The team leader gave a brief background on the proposed project to the assistant chief and his team.

The assistant chief felt that the project will go along way to improving the lives of the local people. The chief said the project if implemented would ensure that local youths get a source of livelihood and thereby assist the community.

The project he said would improve water supply in the area which he observed was the biggest challenge in the area.

On the negative sides the assistant chief observed that the project may affect pasture area thus cause conflicts with pastoralists. He said vibration and noise pollution may scare away livestock and people if not properly sensitized prior to commencement.

The project may also lead to influx of people in the area and cause social pressures like drug abuse, crime and increase in sexually transmitted diseases.

He said the only primary school in the area was facing acute pupil dropout as most of them had moved with their parents in search of pasture for their livestock.

The leader also lamented that the prevailing famine in the area had killed livestock and most residents had lost their purchasing power.

The chief also cautioned that some conservative elders in the area would like to paint any new development projects as retrogressive and advised the team to develop ways to sensitize this group to support the project.

The leader also said that the other challenge facing the area was insecurity occasioned by attacks from the Pokot cattle rustlers. He said the local Kenya Police Reserves (KPRs) are doing all at their disposal to keep the attackers at bay.

As part of corporate social responsibility the member listed the following as their priority project besides water supply.

- Help to address the needs of the local primary school
- Improvement of health facilities in the area

The assistant chief took time to fill in our questionnaires.

ANNEX 6

Meeting with Assistant Chief Peter Akure (Kangirisae Sub-location) on 26th June 2008

The team leader gave a brief background on the proposed project to the assistant chief and his team.

The assistant chief felt that the project is a timely venture that will go along way to improving the lives of the local people. He said that the project may bring with it associated development programmes like improved water supply, communication, infrastructure development and better living standards.

He said given the level of poverty in the area, the project may be crucial in alleviating food insecurity prevailing in the area due to failed rainfall over the past 3 years.

On the negative sides the assistant chief observed that the project may affect pasture area thus cause conflicts with pastoralists.
The project may also lead to influx of people in the area and cause social immoralities like drug abuse, crime and increase in sexually transmitted diseases.

The leader also said that the prevailing famine in the area had devastated livestock coupled with the viral PPR disease that is killing sheep and goats. The leader also said that the biggest challenge facing the area was insecurity occasioned by attacks from the Pokot cattle rustlers. He said the local Kenya Police Reserves (KPRs) are doing all at their disposal to keep the attackers at bay.

As part of corporate social responsibility the member listed the following as their priority project besides water supply.

- Help to address the prevailing food insecurity situation
- Improvement of road network
- Improvement of education facilities and
- Improvement of health facilities in the area

The assistant chief took time to fill in our questionnaires.

ANNEX 7

Meeting with Ms Leah Sogoti Clinical Officer RCEA Health Centre Lokichar Township on 27th /6/2008

The team leader began by introducing the EIA team members and gave a brief background of the proposed project. He informed the members that the essence of the hospital visit was to find out its capability for disaster preparedness and response capacity in case of an outbreak.

The C/O informed us that the health centre began way back in 1979 and has seen tremendous growth over the years. She said the health centre has the capacity to handle emergencies especially the ones associated with field activities.

She said the hospital is normally very busy on Mondays and Tuesdays getting an average of between 150 to 200 patients. However, the rest of the week averages at 50 patients per day. Inpatient capacity is 26 beds only.

The most common diseases in the area include malaria, pneumonia, diarrhoea, skin infection, eye infection, tuberculosis, domestic assault and common accidents like snake and spider bites in that order.

The hospital is faced with staff deficiency as there is no doctor, has one clinical officer, two nurses and six patients attendants.

It has no theatre and has one old ambulance. Serious medical cases are referred to Lodwar district hospital about 60 kilometres from Lokichar.

Water supply at the hospital – the hospital rely on a borehole that using solar power. There are no records of water analysis at the hospital.

On HIV/Aids – the community has not adopted behavior change on sexual matters. And there is stigma associated with HIV/Aids. HIV/AIDS cases in the area are in the increase as a result of the IDP who moved into the area from Kyushu and Eldora towns.

The local community does not support use of contraceptive especially condoms. The facility has a VCT but does not have an ARV programme at the moment.
The C/O informed the meeting that plans area underway to introduce ARV therapy through the assistance of International Rescue Committee beginning August this year.

She further informed us that solid waste is managed through sorting and incineration while liquid waste is managed through soak pit and/or through pit latrines.
The facility would be glad to cooperate with the oil prospecting company and the C/O sighted key area that need improvement as:

- Acquisition of a better ambulance
- Equipping of the facility's pharmacy with medicine and a qualified staff
- Secondment of more staff members by the company

ANNEX 8

Meeting with Community members at Morlem Irrigation Scheme, Lokori division on 27th/6/2008

The EIA team was introduced by Edwin Omori who also briefed the meeting on the objectives of the study and the essence of public participation.

The area chief was not around; however, the local elders welcome the idea of the exploration project and fully participated in the meeting proceedings.

The members expressed optimism that Morlem area has high potential for growth especially if the irrigation scheme is expended. They sited growth that has been witnessed ever since World Vision Kenya initiated the irrigation scheme in the area. Some of the crops grown in the area include sorghum, millet, maize, beans, water melon and kales among others.

The members identified some of the benefits that will be realized if the proposed project is implemented as: -

- Provision of employment opportunities to the youth
- The proposed compensation for the displaced persons will benefit the entire community.
- Access road linking the area to Lokichar may be improved and thus make them access market for their crop and livestock produce.
- Members felt that this will provide small scale business opportunities and thus improve the living standards of the local residents.
- The construction of water borehole will improve water supply for domestic use, livestock and possibly for irrigation in the scheme.

The members also expressed fears about the project and listed the following concerns.

- If the company employs workers from outside the village to work as casuals this may bring conflict with local residents.
- If the exploration exercise is successful, it may further increase insecurity in the area especially from the neighbouring community and countries.
- The members also expressed concerns about the impacts of *Prosopis juliflora* commonly known as *Mathenge* and suggested that the company assist in uprooting it.
- The issue of seismic tracks leading to displacement of people and pasture land was also raised
- The members also sought to know the possible negative impacts associated with the exploration technology to be used.
- Members also expressed concerns about the rampant food insecurity in the area occasioned by low rainfall in the last three years.
- They also sought to know the level of public participation in the project implementation process.

In response the EIA team assured members that local leaders will be involved in causal workers recruitment and that the government will provide security to the workers through the provincial administration.

Then team also thanked the community members for their participation and input during the meeting.

ANNEX 9

Meeting with Senior Chief James Ngilimo and Community members at Katilia Location Lokori division on 28th/6/2008

The EIA team was introduced by Edwin Omori who also briefed the meeting on the objectives of the study and the essence of public participation.

The area chief welcomed the team and assured us of his cooperation throughout the proposed project

The members expressed hope that the proposed project will change the area significantly by introducing new means of livelihoods.

The members identified some of the benefits that will be realized if the proposed project is implemented as: -

- Provision of employment opportunities to the youth
- Access road linking the area to Lokichar may be improved and thus make them access market for their crop and livestock produce.
- Members felt that this will provide small scale business opportunities and thus improve the living standards of the local residents.
- The construction of water borehole will improve water supply for domestic and livestock use.
- The project will also facilitate the coming into the area of more development opportunities for instance telecommunication services

The members also expressed fears about the project and listed the following concerns.

- If the company employs workers from outside the village to work as casuals this may bring conflict with local residents.
- Corruption may creep in the recruitment exercise particularly through the local county council
- If the exploration exercise is successful, it may further increase insecurity in the area especially from the neighbouring community and countries.
- The issue of seismic tracks leading to displacement of people and pasture land was also raised
- The members also sought to know the possible negative impacts associated with the exploration technology to be used.
- They also sought to know the level of public participation in the project implementation process.

The members informed us that there are no sacred, cultural or heritage sites in the proposed project area.

The chief informed the team that all members in the village had allotment letters from the local.

In response the EIA team assured members that local leaders will be involved in causal workers recruitment and that the government will provide security to the workers through the provincial administration.

Then team also thanked the community members for their participation and input during the meeting.

ANNEX 10

Meeting with Community members at Kangirisae Village, Kerio division on 29th/6/2008

The EIA team was introduced by Edwin Omori who also briefed the meeting on the objectives of the study and the essence of public participation.

The area assistant chief welcomed the team in his sub location and assured them that members would cooperate in spite of being a Sunday.

The team informed the members that Kangirisae had been proposed as one of the camp site area and would therefore benefit from a water borehole project.

The members expressed optimism that the project would open up the area to new development opportunities but were also cautious to note that similar projects in the 1990s never bore much benefit to the community.

The meeting was informed that the area had experienced a long spell of dry weather and rain fed farming activities had not been practiced in the past three years. The members felt that if a dam is constructed along the Kerio River near the village then they would practice irrigation agriculture.

Some of the crops grown in the area include sorghum, millet, maize, beans, water melon and kales among others.

The members identified some of the benefits that will be realized if the proposed project is implemented as: -

- Provision of employment opportunities to the youth
- The proposed compensation for the displaced persons will benefit the entire community.
- Access road linking the area to Lokichar may be improved and thus make them access market for their crop and livestock produce.
- Members felt that this will provide small scale business opportunities and thus improve the living standards of the local residents.
- The construction of water borehole will improve water supply for domestic use, livestock and possibly for irrigation in the scheme.

The members also expressed fears about the project and listed the following concerns.

- If the company employs workers from outside the village to work as casuals this may bring conflict with local residents.
- If the exploration exercise is successful, it may further increase insecurity in the area especially from the neighbouring community and countries.
- The issue of seismic tracks leading to displacement of people and pasture land was also raised
- The members also sought to know the possible negative impacts associated with the exploration technology to be used.
- They also sought to know the level of public participation in the project implementation process.
- The members requested the company to involve the provincial administration and not politicians in the entire project life.

The EIA team assured members that local leaders will be involved in causal workers recruitment and that the government will provide security to the workers through the provincial administration.
Then team also thanked the community members for their participation and input during the meeting.

ANNEX 11

Meeting with Assistant Chief Peter Akure (Kangirisae Sub-location) and Village elders on 29th June 2008

The team was introduced by Edwin Omori who gave a brief background on the proposed project to the assistant chief and his team.

The assistant chief felt that the project is a timely venture that will go along way to improving the lives of the local people. He said that the project may bring with it associated development programmes like improved water supply, communication, infrastructure development and better living standards.

He said given the level of poverty in the area, the project may be crucial in alleviating food insecurity prevailing in the area due to failed rainfall over the past 3 years.

On education the members said that pupils were trekking long distances of about 20 km one way and felt that the company should help in construction of schools in the area.

On the negative sides the assistant chief observed that the project may affect pasture area thus cause conflicts with pastoralists.

The project may also lead to influx of people in the area and cause social immoralities like drug abuse, crime and increase in sexually transmitted diseases.

The members expressed fears that the proposed project may recruit young men from the area and thus deny them herdsmen to take care of their livestock

The elders also said that the prevailing famine in the area had devastated livestock coupled with the viral PPR disease that is killing sheep and goats. The assistant chief also said that the biggest challenge facing the area was insecurity occasioned by attacks from the Pokot cattle rustlers. He said the local relied on the help of the Kenya Police Reserves (KPRs) to repulse the invaders.

As part of corporate social responsibility the member listed the following as their priority project besides water supply.

- Help to development of school and put fence around the existing school to keep away trespassers
- Improvement of road network
- Improvement of health facilities in the area

The members thanked the elders for finding time to attend the meeting.

ANNEX 12

Meeting with Chief Yohanna Ekitela and Community members at Langanamatak Location Lokichar division on 30th/6/2008

The EIA team was introduced by Edwin Omori who also briefed the meeting on the objectives of the study and the essence of public participation.

The area chief welcomed the team and assured us of his cooperation throughout the proposed project

The members expressed hope that the proposed project will change the area significantly by introducing new means of livelihoods.
The chief informed the members that Napusimoru sub location has been an area of gypsum mining but the mining company pulled out in 2004 due to political influence.

Thus the chief observed there are many idle youth in the area that would benefit immensely if the project is implemented.
The members identified some of the benefits that will be realized if the proposed project is implemented as: -

- Provision of employment opportunities to the youth
- Improvement of access road linking the area to Lokichar and thus make them access market for their crop and livestock produce.
- Members felt that this will provide small scale business opportunities and thus improve the living standards of the local residents.
- The construction of water borehole will improve water supply for domestic and livestock use.
- The project will also facilitate the coming into the area of more development opportunities for instance telecommunication services

The members also expressed fears about the project and listed the following concerns.

- If the company employs workers from outside the village to work as casuals this may bring conflict with local residents.
- Corruption may creep in the recruitment exercise particularly through the local county council
- If the exploration exercise is successful, it may lead to insecurity in the area especially from the neighbouring countries.
- The issue of seismic tracks leading to displacement of people and pasture land was also raised
- They also sought to know the level of public participation in the project implementation process.

The members informed us that there are no sacred, cultural or heritage sites in the proposed project area.

The chief informed the team that all members in the area had allotment letters from the local county council.

In response the EIA team assured members that local leaders will be involved in causal workers recruitment and that the government will provide security to the workers through the provincial administration.

Then team also thanked the community members for their participation and input during the meeting.

ANNEX 13

Meeting with Councillor James Ebei and Council official at the Turkana County Hall Lodwar on 2nd /7/2008

Edwin Omori introduced the EIA team to the chairman and his team that included the County council administrator, the council development officer, and the council public health officer. He gave a background of the project and the objectives of the study and also emphasized the need for public consultation and involvement.

The council administrator set the ball rolling by informing the meeting that the approach taken by the Turkana Energy Drilling Company was the best – that is bottom up approach. He commended the team for seeking the views of the council and noted that the project would succeed if the council was fully involved.

In contrast the development officer took issues with another company doing exploration in the North for not involving the Turkana county council in their project at all.

He said that land in Turkana district is a trust land owned by the county council and any development activity in the area must seek a permit and authorization from the council. In this regard the members advised that the company apply for the permit before project commencement.

He noted that there is need to have regular meetings between the prospecting companies and the local authority particularly on issues of casual labour recruitment, camp site location, levies and security matters.

He noted that there is communication barrier between the company in Turkana North and the council as the officer on the ground doesn't understand English language or any local language. He suggested that a public relation officer preferably from the local community should be deployed in the company to liaise with the local people. He said the same should apply to the company in the south.

The leaders also sought to know the compensation program the company will be putting in place for using their land and suggested that the company should have a well documented exploration agreement with the council.

The leaders also emphasized the need for the company to understand and fully comprehend the Local Authorities Act and the by-laws governing Turkana County Council

The council also emphasized the need to involve all district government official for instance land surveyors, road engineers, water officers, forestry officers in order to avoid any damage that may lead to conflict in the future. For instance the development officer said that no road can be constructed without the involvement of land surveyors and road engineers.

The chairman emphasized the need of an all inclusive meeting that will inform the local leadership of the proposed project.

The EIA team assured the leaders that plans were underway for the two oil exploration companies in the region to organize a leaders' meeting in Lodwar in collaboration with the local leaders and the provincial administration. Similarly the EIA team promised to liaise with the

leadership of the company to ensure that all the legal requirements are met before the commencement of the proposed project.

ANNEX 14

Meeting with Samson Mutiso Program Officer, Relief and Humanitarian affairs World Vision Kenya Lodwar Office Turkana on 2nd /7/2008

The EIA team was officially introduced by Edwin Omori who also explained to the officer the objectives of the study in the area. He explained that the team needed to understand the operations of the NGO in the area and specifically in Turkana South.

The team also informed the officer that local people in Turkana South appreciate the organization's programs that they have initiated in the area.

The officer informed the team that the organization is involved in humanitarian and relief activities, children nutrition care programs and other development activities in water, livestock restocking, irrigation schemes at Morlem and capacity building in adult and youths.

The organization is also collaborating with other organization to facilitate logistics for the curbing of the deadly PPR disease.

The officer said that the motive of the organization was to ensure sustainability by empowering the community members and discouraging dependency. In this regard there is emphasis on long term projects like restocking, water project development and capacity building.

On the proposed project the officer said it's a positive development that would among others:

- Bring job opportunities
- Improve the lifestyle of the local people
- It will lead to enhancement of activities by other organization through creating synergy and resource mobilization and direction without duplication.

On the other hand the officer said the project:-

- If the implementation is not inclusive it may lead to conflicts with the locals - that is if their leaders are not fully involved in the project life. In this regard he emphasized the need to particularly involve the chiefs and village elders in the process.
- He also said there is need for transparency and accountability in the activities related to the project including issues like recruitment of casuals.
- The project may also lead to depletion of water resources if borehole sinking is not properly regulated.
- There is also a possibility of conflict with pastoralists whose pasture may be taken to create the seismic tracks.

The officer suggested that the company should work closely with existing organizations in the area and the local administration particularly on security matters. He said most organizations in the area have formed an inter-agency committee specifically to watch over each other on security matter.
The key challenges to expect while working in the area include

- High cost of operation especially of machineries and vehicles
- Political interference from local leaders
- Insecurity and
- Poor communication and transportation network that in most cases shall slow work progress

The officer took time to fill in our questionnaire.

ANNEX 15

Meeting with Geoffrey Kaituko Drought Management Officer Arid Lands Resources Development Project Lodwar Office Turkana on 2nd /7/2008

The EIA team was officially introduced by Edwin Omori who also gave a brief background of the project and the objectives of the study in the area.

The team wanted to understand the operations of ALRDP particularly in Turkana South.
The officer said that the project is involved in:

- Drought management
- Food security monitoring
- Capacity building for marginalized communities through training and identification of common needs
- Supporting of local projects and
- Protection of the environment

He said that Turkana had a fragile environment and any development coming in must be critically examined not to exert pressure on the existing environmental resources.

He said the government has made little investment in the area and thus it lacks in infrastructure and other resources.

The coming of the oil prospecting companies thus is a positive move that may help bring up the area in terms of development.

The project shall create employment opportunities but he cautioned that casual jobs should be given to the locals.

On the flip side he said:

- The project may lead to exertion of pressure on the environmental resources if not properly planned
- The project may erode the traditional Pastoralism way of life and thus the communities must be sensitize to embrace the culture change positively
- It may lead to conflicts with pastoralists if their pasture and browse areas are taken up by the seismic tracks
- There is a possibility of increased insecurity particularly from locals as oil is known to ignite wars if returns are not properly shared out.

He said that insecurity witnessed in parts of Turkana South especially at Lokori division is as a result of cattle rustling and land issues.

He advised that the company should work closely with local leaders both at political and provincial level. Similarly the locals should be approached through the chiefs and village elders.

The officer also took time to fill our questionnaire.

ANNEX 16

Dosimeter readings for areas within Block 10BB

Name of Place	Waypoints	Northings	Eastings	Elevation (m)	Dosimeter reading
Loperot oil well	16	02˚21'35.9"	035˚52'27.1"	612	45.0db
Nakukulas area	22	02˚11'22.6"	035˚48'56.7"	688	78.5db
Lokori- Lokichar Junction	27	02˚10'21.2"	035˚47'09.5"	735	46.4db
Bushed Grassland area near Katamanak Hills	28	02˚06'32.9"	035˚49'57.8"	757	71.0db
Katamanak Hills	29	02˚06'20.8"	035˚50'07.2"	756	41.5db
Lokoriokot Hills	30	02˚01'51.8"	035˚54'11.9"	755	67.1db
Near barren lands on foot slope	31	02˚00'46.9"	035˚55'11.3"	731	57.7db
Lokwamising Hills	32	01˚59'44.6"	035˚56'19.4"	720	51.3db
Lokwamising bottomland	33	01˚59'57.9"	035˚56'24.6"	684	65.2db
Lokori Shopping centre	34	01˚57'11.8"	036˚01'40.4"	598	72.1db
Morlem-Kerio river floodplain	35	01˚58'15.1"	036˚03'31.3"	589	73.5db
Kangatet Alluvial plains	36	01˚58'46.5"	036˚05'36.5"	568	40.9db
Morlem Scheme-Canal point	37	01˚58'33.1"	036˚04'24.0"	581	67.1db
Morlem Scheme-Farm area	38	01˚58'55.2"	036˚04'33.0"	578	52.1db
Lokori Airstrip	39	01˚57'56.9"	036˚01'21.6"	605	68.8db
Lokori Airstrip	40	01˚58'17.8"	036˚00'45.4"	615	68.8db
Katilia Shopping Centre	46	02˚07'47.2"	036˚06'56.3"	552	44.8db
Katilia borehole	47	02˚08'25.7"	036˚08'16.1"	533	52.7db
Katilia floodplains	48	02˚08'21.5"	036˚08'12.9"	532	49.3db
Kerio river basin	50	02˚08'49.0"	036˚08'17.5"	530	62.3db
Katwosin area	51	02˚09'17.8"	036˚07'07.8"	532	61.2db
Foot slope area-Katilia	52	02˚08'43.8"	036˚07'14.9"	538	63.6db
Shoulder slope/ uplands- Katilia	53	02˚08'48.6"	036˚07'04.0"	562	62.9db
Crest slope	54	02˚08'49.6"	036˚07'01.6"	570	63.5db
Lokichar Health centre	55	02˚28'16.8"	035˚38'43.5"	765	51.9db

N.E of Loperot camping site	56	02˚20'33.6"	035˚51'33.6"	612	42.1db
Loperot plains	57	02˚20'49.2"	035˚53'19.7"	605	49.8db
NE Loperot camp	58	02˚21'35.4"	035˚55'44.7"	582	70.8db
Loperot uplands	59	02˚22'16.9"	035˚57'09.4"	588	67.1db
14 km N.E Loperot chief's camp	60	02˚21'37.3"	035˚58'45.3"	567	66.1db
Kanga'kipur area	61	02˚22'14.4"	036˚01'06.5"	559	53.4db
Lugga 26 km N.E of Loperot chief's camp	62	02˚24'59.4"	036˚03'47.4"	540	68.9db
Dry borehole at Kerio river	63	02˚27'27.6"	036˚05'04.6"	524	64.2db
36 km NE Loperot chief's camp	64	02˚29'26.3"	036˚07'11.3"	512	73.6db
41 km NE Loperot chief's camp	65	02˚30'54.8"	036˚09'44.1"	497	73.6 db
Nakalalei-Kalapata lugga	66	02˚31'57.7"	036˚13'21.7"	471	73.4db
Nakalalei dry shallow well	67	02˚31'49.6"	036˚13'22.9"	459	73.0db
2 km N.E Nakalalei	68	02˚34'09.4"	036˚14'04.1"	460	74.3db
Kangirisae area	69	02˚37'10.7"	036˚15'44.4"	443	67.9db
Kerio river shallow wells	70	02˚37'12.2"	036˚15'51.0"	440	66.1db
Kangirisae borehole	71	02˚36'56.7"	036˚15'54.0"	441	67.4db
Kangirisae area	72	02˚36'27.6"	036˚15'35.4"	465	69.3db
Dissected plains	73	02˚27'43.4"	036˚04'14.0"	530	77.3db
Lochwangamanak uplands	74	02˚36'51.3"	035˚39'59.2"	710	78.1db
Lochwangamanak plains	75	02˚37'37.5"	035˚42'25.3"	657	68.2db
Lochwangamanak sedimentary plains	76	02˚37'21.3"	035˚45'17.3"	619	68.0db
Napusimoru area	77	02˚39'05.2"	035˚49'27.7"	564	60.4db
Lomuyen-Kuperat	78	02˚39'42.2"	035˚51'05.3"	548	49.4db
Napusimoru area - sunken well	79	02˚39'38.7"	035˚51'01.5"	542	66.1db

Note: Waypoints where no dosimeter readings were taken are excluded from the list.

ANNEX 17

Bird sightings Block 10BB

Common Name	Scientific Name	Habitat Preference	Siting Frequency
Namaqua Dove	*Oena capensis*	Dry bushland	Common
African Mourning Dove	*Strepopelia decipiens*	Dry country below 1400m ASL	Common
Ring necked dove	*Strepopelia capicolor*	Bush, savannah wood land and cultivation	Common
White bellied go-away bird	*Criniferoides leucogaster*	Bush and open Acacia woodland	Common
Abyssinian Roller	*Coracias abyssinica*	Acacia woodland and Bushed grassland in Northern Kenya	Common
Speckled Pigeon	*Columba g. guinea*	Grasslands,savannahs,towns, cliffs	Common
Brown Parrot	*Poicephalus meyeri*	Wood land and Savannah	Rare
Brown necked raven	*Corvus edithae*	Arid northern Kenya	Common
Fork tailed drongo	*Dicrucus adsimilis*	Savannahs with trees and bushes, open woodlands,forest edges	Common
Superb starling	*Spreo superbus*	Lightly wooded areas in semi arid areas,savannahs	Common
White headed Buffalo weaver	*Dinemellia dinamelli*	Dry bushed and wooded savannah with Acacia	Common
Eastern pale chanting goshawk	*Melierax poliopterus*	Arid, thornbushes,grasslands	Rare
Crested Hoopoe	*Upapa epops*	Wooded savannah, open parklands	Rare
Black bellied Bastard	*Eupodotis melanogaster*	Open and partly treed savannas	Rare
Black headed Plover	*Vanellus tectus*	Dry thorn bush	Rare
Sacred Ibis	*Threskiornis aethiopica*	Freshwater margins	Rare
Hammerkop	*Scopus umbretta*	Ponds, marshes, rivers, rock pools	Rare
White browed sparrow weaver	*Plocepasser mahali*	Wooded Acacia sanannahs in semi arid areas	Common
Northern white crowned shrike	*Eurocephalus rueppeli*	Dry bush and open wodland	Common
Abyssinian schimitarbill	*Rhinoeomastus cyanomelas schalowi*	Open woodland,savannah and bush	Rare
Brubru	*Nilaus afer minor*	Low Acacia trees	Rare
Nubian woodepecker	*Campethera nubica*	Acacia woodland, bush and savannah	Rare
Red billed hornbill	*Tockus e. erythrorhynchus*	Common in Turkana area	Common
Hunters sunbird	*Nectarinia hunteri*	Dry country	Rare

Variable sunbird	*Nectarinia venusta*	Bush and Open woodland	Rare
Augur buzzard	*Buteo a. augur*	Plains and mountains	Rare
White headed mouse bird	*Colius leucocephalus*	Dry bush country:	Common
Somali courser	*Cursorius somalensis littoralis*	Semi arid plains in Northern Kenya	Rare
Egyptian Vultures	*Neophron percnopterus*	Dry plains,savannahs,deserts and mountains	Rare
Snake Eagle	*Circaetus cinereus*	Bush savannah, open country	Rare
Chestnut bellied sandgrouse	*Pterocles exustus olivascens*		Rare
Common fiscal shrike	*Lanius collaris*	Savannah woodlands,semi arid scrub lands	Common

Annex 18

Mammal sightings in Block 10BB

Common Name	***Scientific Name***	**Habitat Preference**	**Altitude**	**Sighting Frequency**
Dik-dik	*Madoqua spp*	Arid thorn bush and forests lining streambeds		Rare
Dwarf mongoose	*Helogale parvula*	Savannas with termite mounds		Common
Black-backed jackal	*Canis mesomelas*	Savannas and woodlands		Rare
Ground squirrel	*Xerus rutilus*	Dry savannas and semi-arid deserts	upto 2000 m asl	Common
Cape hare	*Lepus capensis*	Dry open savannas and deserts		Common

Application Reference No. PR/4550

Registration No: 0002545

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 .....TURKANA..DRILLING..CONSORTIUM..KENYA..LIMITED..... (Name of individual/firm) .....P.O. BOX 47582-00100,NAIROBI..... (Address) submitted to the National Environment Management Authority in accordance with the Environmental Impact Assessment & Audit Regulations regarding .....PROPOSED..OIL..AND..GAS..EXPLORATION..IN..... ....BLOCK..10BB..NORTHERN..KENYA..... (title of project) whose objective is to carry on ..EXPLORATION..OF..OIL..AND..GAS..IN..BLOCK..10BB .... (briefly describe purpose) located at .....TURKANA..SOUTH..AND..TURKANA..CENTRAL..DISTRICTS..... ..... (locality and district) has been reviewed and a licence is hereby issued for implementation of the project, subject to attached conditions.

Dated this.....21ST.....day...JAN..... of 20..09..

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–Gerneral shall be notified of any transfer/variation/surrender of this licence.

3. The proponent shall undertake EIA Study prior to commencement of the exploitative phase, mining and processing.

4. The proponent shall ensure comprehensive rehabilitation of drilled holes and/or excavation through capping, removal of markers, backfilling and where necessary revegetation.

5. The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.

6. The proponent shall collaborate with the EIA Expert(s) and the constructor(s) to ensure that proposed mitigation measures are adhered to during the construction phase and where necessary appropriate mending-up activities undertaken and a report of the same submitted to NEMA. Emphasis must be given to control of dust, noise, vibrations, occupational hazards and provision of sanitary accommodation to construction workforce.

7. The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of Energy Regulatory Commission, Department of Physical Planning, Water Resources Management Authority, Turkana County Council, Ministry of Energy, National Environment Management Authority and other relevant Authorities.

8. The proponent shall ensure that the development adheres to zoning specifications issued for development of such a project within the jurisdiction of Turkana County Council with emphasis on approved land use for the area.

9. The proponent shall ensure that during the construction phase, the operations adhere to The Occupational Safety and Health Act No. 15 of 2007.

10. The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as solid waste and waste water management facilities, noise pollution control & comprehensive site rehabilitation plan are designed, constructed and employed simultaneously with the proposed project.

11. The proponent shall ensure that records on conditions of licences/approval and project monitoring and evaluation shall be kept on the project site for inspection by NEMA's Environmental Inspectors.

12. 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.

13. The proponent shall comply with NEMA's improvement orders throughout the project cycle.

Application Reference No: PR/4550

Certificate No: 0001262

For official use

THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT

CERTIFICATE OF VARIATION OF ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Environmental Impact Assessment Licence No: 0000440

Issued on 21/01/2009 (date) to TURKANA DRILLING CONSORTIUM KENYA LIMITED (name of individual/firm)

of P. O. BOX 47582-00100, NAIROBI (address) regarding PROPOSED OIL&GAS IN BLOCK 10BB, NORTHERN KENYA (title of project)

whose objective is to EXPLORATION OF OIL AND GAS IN BLOCK 10BB

(briefly describe purpose)

located at TURKANA SOUTH AND TRUKANA CENTRAL DISTRICT (locality and district) has been varied to EXTENSION OF EIA LICENCE VALIDITY PERIOD FOR AN ADDITIONAL 24 MONTHS

(nature of variation) With effect from 11/11/2011 (date of variation) in accordance with the provisions of the Act.

Dated this ..... day of ..... 20.....

Signature .....

(SEAL)

For Director General
The National Environment Management Authority

GPK (L)

Application ReferenceNo: PR/4550
Certificate No: ..... 0000094 .....
For official use

THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT

CERTIFICATE OF TRANSFER OF ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Environmental Impact Assessment Licence No: 0002545

Issued on. ....21ST JANUARY 2009.....(date) to.....TURKANA DRILLING CONSORTIUM KENYA LIMITED P.O. BOX 47582-00100, NAIROBI .....(name of previous holder) of .....(address)

regarding ..proposed oil and gas in Block 10BB, Northern Kenya (title of project).....

.....whose objective is to ...exploration of oil and gas in Block 10BB.....

(briefly describe purpose) located at...Turkana South and Turkana Central District

(locality and district) has been transferred to ..Tullow Kenya B.V.

(name of new holder) of ..P.O. BOX 63298-00619, NAIROBI .....(address)

with effect from .....10TH NOVEMBER, 2011 ..... (date of transfer) in accordance with the provisions of the Act.

Dated this .....8TH..... day ...DEC.....of 20.11.....

Signature .....

(SEAL)

Director General
The National Environment Management Authority

Important notes.

1. the transferee as well as the transferor of a licence under this regulation shall be liable for all liabilities, and the observance of all obligations imposed by the transfer in respect of the licence transferred.
2. the transferor shall not be responsible for any future liabilities or any obligations so imposed with regard to the licence from the date the transfer is approved.

GPK (L)