ENVIRONMENTAL IMPACT ASSESSMENT PROJECT REPORT

FOR

PROPOSED EXPLORATORY OIL AND NATURAL GAS WELLS DRILLING PROGRAMME IN BLOCK 13T, TURKANA COUNTY, KENYA, BY TULLOW KENYA B.V.

Prepared by
Earthview Geoconsultants Limited
P.O. BOX 10366-00100, Nairobi, Kenya
Tel: 254-20-2496208
Email: earthview@geologist.com

AUGUST 2012

PROJECT REPORT

FOR

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROPOSED EXPLORATORY OIL AND GAS WELLS DRILLING PROGRAMME IN BLOCK 13T, TURKANA COUNTY, KENYA, BY TULLOW KENYA B.V.

AUGUST 2012

Prepared By:

Earthview Geoconsultants (K) Ltd.,
Utumishi Co-operative House,
6th Floor Mamlaka Road,
P.O BOX 10366-00100,
Nairobi, Kenya
Email: earthview@geologist.com

For:

Tullow Kenya B.V.,
Westlands Office Park,
Waiyaki Way,
P.O BOX 63298-00619,
Nairobi, Kenya.

Submitted by ..... H. Meyer .....

Position ..... Operation Manager .....

Signed .....

Date ..... 7/9/12 .....

We the undersigned, confirm that the contents of this report are a true representation of the Environmental Impact Assessment Project Report of the proposed exploratory oil and ga wells drilling programme in Block 13T: Parts of Central Pokot, Loima, Turkana Central an Turkana South Districts.

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

Sign.....

Date..7/9/2012.....

Dr. Daniel Olago
(Lead Expert and Director)

Sign.....

Date..7/9/2012.....

EXECUTIVE SUMMARY

This Environmental Impact Assessment (EIA) project report presents baseline biophysical and socio-economic information, project mitigation measures, and an environmental management and monitoring plan for the proposed exploratory oil and natural gas wells drilling programme of the National Oil Corporation of Kenya (NOCK, 1987) in parts of exploration Block 13T in Turkana County. This project report has been prepared for the project proponent, Tullow Kenya B.V. (TKBV) by Earthview Geoconsultants Limited in accordance with the requirements of Kenya's Environmental Management and Coordination Act of 1999 and subsidiary legislation, and in fulfilment of the more general requirement that projects maintain a clean, sustained and healthy environment. This EIA project report has aimed at establishing and mitigating any potential impacts of the proposed oil and natural gas exploration wells drilling operations at the identified sites in the project area.

Following the discovery of oil by Tullow Oil and Heritage Oil in Uganda and more recently the Ngamia-1 oil discovery in Lokichar, Kenya, by Tullow Oil and Africa Oil companies, several companies have intensified oil exploration in the Mesozoic and Early Tertiary rift basins and other sedimentary basins, viz; Anza, Mandera and Lamu of Kenya, with the view of meeting the local and global energy demand. The discovery of oil in Kenya followed the acquisition of high quality data due to deployment of advanced data acquisition technologies such as two dimensional (2D) seismic and Full Tensor Gravity (FTG) which have since increased chances of oil and gas discoveries in the country. Recently the Ministry of Energy announced that it had licensed all the 46 oil and gas exploration blocks in Kenya to foreign O&G (Oil and Gas) prospecting companies save for one, which NOCK is licensed to explore. According to the Ministry, plans are underway to drill an additional five oil wells in five Blocks; two onshore and three offshore between June 2012 and December 2013.

The purpose of this project is to determine whether or not there are economically viable oil deposits in Block 13T, following the oil discovery at Ngamia-1 well in Lokichar, by drilling more exploratory wells. Usually, following the success of the exploratory drilling, this leads to drilling of more appraisal oil wells and subsequent production of the same. If the appraisal wells yield economically viable oil deposits, this will have a significant positive impact in Kenya's energy sector; it will boost the Gross Domestic Product (GDP) and per capita income, and commercial production of the oil, which shall lead to an improvement of the socio-economic well-being of the Turkana County and the country in general.

The envisaged exploration drilling project follows the analysis, identification and delineation of potential hydrocarbon traps based on the seismic data that was acquired during the recently completed seismic survey programme. Exploration drilling is designed to confirm the presence of viable quantifiable hydrocarbons in a prospective formation after the location and extent of a possible hydrocarbon-bearing geological formation has been identified, from seismic and associated surveys like FTG. Following the acquisition of technically high quality data and analysis of the same, TKBV intends to drill exploratory wells within the project area, the first one being the identified Twiga-1 drilling site. Further seismic studies to augment existing information are being carried out to identify the other exploratory drilling sites. The exploratory well at Twiga-1 site will be drilled to a depth of 4500m over a period of up to 120 days, once a licence is granted by the National Environment Management Authority (NEMA). The project is in line with the National Energy Policy (improving access to affordable energy services, enhancing security of supply, promoting development of indigenous energy resources; promoting energy efficiency and conservation; and promoting prudent environmental, health and safety practices), the Economic Recovery for Wealth and Employment Creation Strategy (expanding and improving infrastructure, developing arid and semi-arid lands, and safeguarding environment and natural resources), and Kenya Vision

2030 (enhanced equity and wealth creation for the poor in semi-arid and arid districts, must generate more energy at a lower cost and increase efficiency in energy consumption).

A detailed environmental impact assessment field study was preceded by extensive desktop studies, and was undertaken from 23rd June to 4th July, 2012.The desktop study was conducted to review the available reports, and to design plans and maps in order to compile relevant biophysical and socio-economic information of the project area. The field study (detailed environmental impact assessment, community sensitization, public consultations and social impact assessment, and development of mitigation measures and environmental management plan) was undertaken during this period. Biophysical studies covered environmental aspects such as physiography, climate, hydrology, drainage, soils, geology/hydrogeology, vegetation, wildlife, and aquatic environment. The socio-economic environmental study covered information on issues such as demography, literacy, social amenities (healthcare and schools), land use, land tenure, the social dimensions of well-being and income levels, water supply, sanitation levels and security, along with other pertinent issues. Extensive public consultations created knowledge and awareness about the proposed programme, and also allowed for exchange of views, information and concerns between the communities, the EIA team and the project proponent. The field study also enabled cross-checking of the data compiled during the desktop study. The legislative and regulatory framework has also been extensively explored in this report.

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

- Noise and vibrations from vehicles, equipment and machinery;
- Disturbance to soil, vegetation and fauna due to construction of the campsites and access roads;
- Dust generation and exhaust emissions by vehicles and equipment;
- Waste generation at campsites and drilling rig areas;
- Pollution of soil and water (surface and groundwater) from waste streams generated at the campsites and drilling areas; and
- Workforce influx and associated social and economic issues.

Both the field survey and documentation reveal the following active natural processes that have major and visible impact on the environment: periodic flooding of River Turkwel and ponding of the floodplain and piedmont plain adjacent to the river; high dust loading in the air due to strong winds in the floodplains and the northern part of the block, low vegetation cover and loose surface soils that seal in wet conditions; wind and water erosion; and higher frequency and intensity of droughts and floods due to climate change. Anthropogenic pressures include: high demand for water for domestic and livestock use; land degradation and soil compaction by grazing animals; and pollution of rivers, water pans and shallow groundwater in luggas from humans and livestock. The communities lack adequate provision of basic services such as education, health care, affordable energy, potable water and security. While the communities are fairly stable, their security situation is compromised by sporadic but often deadly cattle rustling. Conflicts also occur from time to time in relation to access to natural resources such as water and grazing lands.

The exploratory oil and gas wells drilling operations are regarded, from an industry standpoint, as being of a small scale in both effort and the time taken to complete them. In addition the majority of operations will be conducted significant distances away from any habitation, town or residential areas so that the inhabitants will be largely insulated. The

short-term duration (3-6 months) of the exploratory drilling programme and its small scale relative to natural processes acting on the environment in the area as well as previous actions undertaken, indicate that the impacts would by and large be temporary and/or transient, rather than long-term and/or permanent. So far, more than 30 exploratory wells have been drilled in Kenya since the 1970s with no adverse impacts reported, and year-by-year industry standards relating to environmental protection for projects of this nature are continually being raised. The measures proposed to mitigate these environmental and social impacts detailed in the Environmental Management Plan within this report are considered more than adequate and effective in safeguarding the environmental and social fabric of the area, and should be strictly adhered to.

The community members and leaders who attended the various public meetings and participated in the questionnaire survey welcomed the proposed project, but appealed for adherence to environmental safeguards and labour legislation. TKBV (as outlined in its EHS [Environmental, Health and Safety] and CSR [Corporate Social Responsibility] Policies) is committed to environmental protection at the highest level, continual engagement of local stakeholders throughout the duration of the project, and to being sensitive to local culture and customs, and would want to be seen as a valued part of the communities in the project area.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

ALRMP	Arid Lands Resource Management Programme
ASAL	Arid and Semi-Arid Lands
BOD	Biological Oxygen Demand
CFC	Chlorofluorocarbon
CLO	Community Liaison Officer
COD	Chemical Oxygen Demand
CSG	County Steering Group
CSR	Corporate Social Responsibility
DHMBS	District Health Management Boards
EA	Environmental Audit
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
EMP	Environmental Management Plan
E & P	Exploration and Production
ERP	Emergency Response Plan
ERS	Economic Recovery Strategy
EPR	Exclusive Prospecting Rights
FTSE 100	Financial Times Stock Exchange 100
FTG	Full Tensor Gravity
GDP	Gross Domestic Product
HDPE	High Density Polyethylene
HSE	Health Safety and Environment
IAEA	International Atomic Energy Agency
LPG	Liquefied Petroleum Gas
KPR	Kenya Police Reserves
KREMU	Kenya Rangeland Ecological Monitoring Unit
KWS	Kenya Wildlife Service
MSDS	Material Safety Data Sheet
NADM	Non-Aqueous Drilling Mud
NEMA	National Environment management Authority
NGOs	Non-Governmental Organisations
NHSSP	National Health Sector Strategic Plan
NOCK	National Oil Corporation of Kenya
OBM	Oil Based Mud

OCPD	Officer Commanding Police Department
OGP	Oil and Gas Producers
OHS	Occupational Health and Safety
PE	Potential Evaporation
PPE	Personal Protective Equipment
PRSP	Poverty Reduction Strategy Paper
PSC	Production Sharing Contract
SCE	Solids Control Equipment
TKBV	Tullow Kenya B.V.
TOR	Terms of Reference
UNEP	United Nations Environment Programme
VOC	Volatile Organic Compounds
WBM	Water Based Mud
WDI	Weatherford Drilling International

LIST OF TABLES

CHAPTER 1

1.1 INTRODUCTION

This Environmental Impact Assessment (EIA) project report presents baseline biophysical and socio-economic information, project mitigation measures, and an environmental management and monitoring plan for the proposed exploratory oil and natural gas wells drilling programme in the National Oil Corporation of Kenya (NOCK, 1987) exploration Block 13T, which straddles four administrative districts, namely, Central Pokot, Turkana Central, Loima and parts of Turkana South Districts (latitudes *ca.* 1.3º to 3ºN and longitudes *ca*. 35º to 35.7ºE) (Figure 1.1). This follows the analysis, identification and delineation of potential hydrocarbon traps based on seismic data that was acquired during the recent seismic survey exploration phase. This project report has been prepared for the project proponent, Tullow Kenya B.V. (TKBV) by Earthview Geoconsultants Ltd. in accordance with the requirements of Kenya's Environmental Management and Coordination Act of 1999 and subsidiary legislation, and in fulfilment of the more general requirement that projects maintain a clean, sustained and healthy environment. This EIA project report has aimed at establishing and mitigating any potential impacts of the proposed oil and natural gas exploration wells drilling operations at the identified site in the project area.

1.2 PURPOSE OF THE REPORT

An EIA project report is a systematic process that predicts and evaluates the potential impacts that the proposed project may have on the biophysical, socio-economic and human environment, and develops mitigation measures that, when incorporated into the project, can eliminate, reduce or minimise the potential effects and where practicable, enhance the benefits that such a project may bring to the communities living within the project area and the government in general if the proposed activities turn out to be successful.

1.3 DEVELOPER IDENTIFICATION

Tullow Oil PLC is one of the world's largest independent oil and gas exploration companies, and is an FTSE100 company. The Group has over 100 licences in more than 22 countries, with operations in Africa, Europe, South Asia and South America. Tullow has been successfully operating in Africa since 1986 where it is already a dominant player following exploration success in Ghana and Uganda.

This EIA was carried out for Tullow Kenya B.V. (Pin P051340553U), a subsidiary company of Tullow Oil PLC, with respect to the proposed exploratory oil and gas wells drilling in the project area.

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

TKBV and its development partner, Africa Oil, will engage an internationally experienced oil and gas well drilling contractor to carry out the drilling operations.

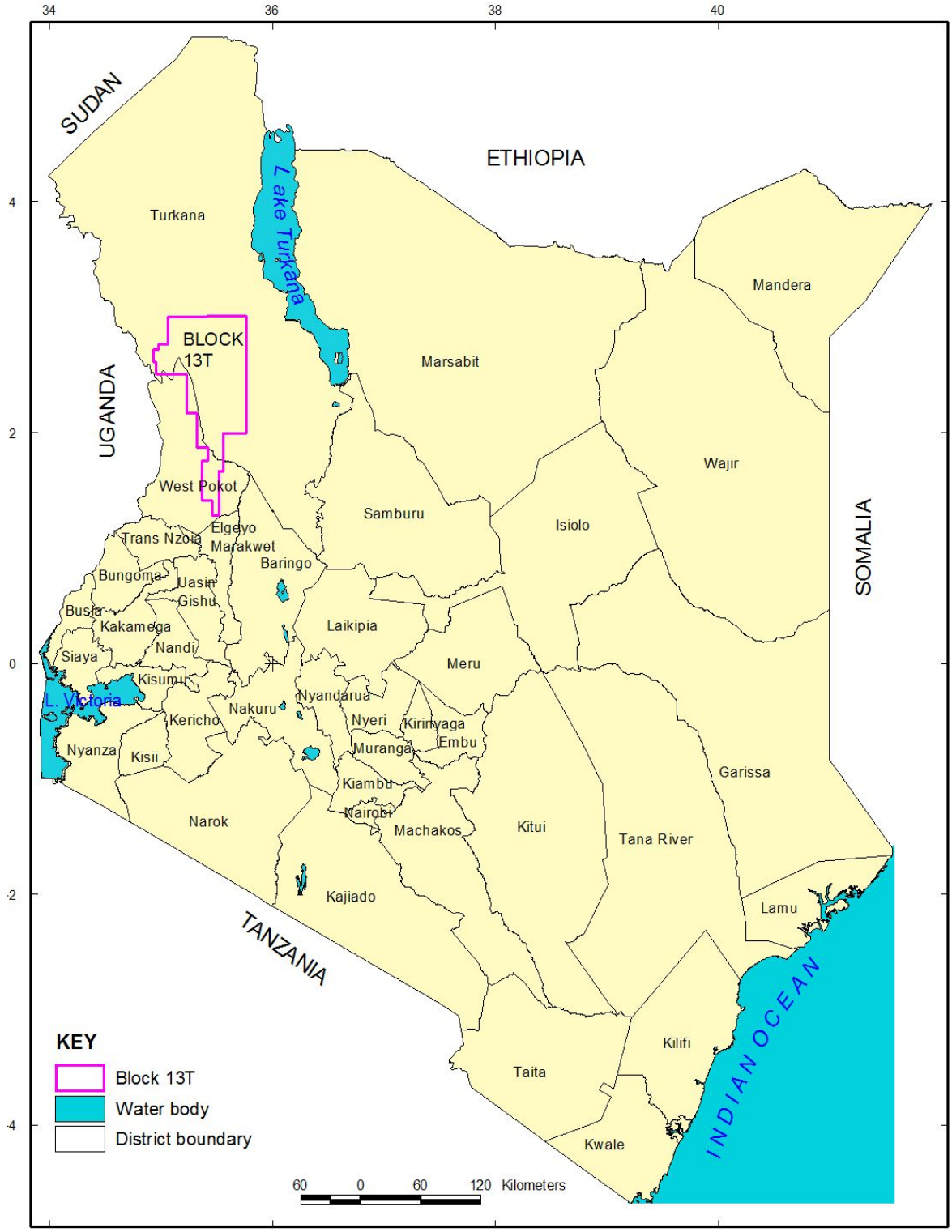


Figure 1.1: Location of the project area

1.4 BRIEF SITE DESCRIPTION

Block 13T is located in Northern Kenya. The block straddles four administrative districts, namely, Central Pokot, Turkana Central, Loima and parts of Turkana South Districts as shown in Figure 1.1.

Geologically, the project area can be divided into three parts (southern, central and northern), moving latitudinally from south to north. The thin southern strip (1.3° to 2°N) is dominated by: metamorphosed sediments of the Basement System; Tertiary rocks represented by plugs and dykes of nephelinites or alkali basalt; and Quaternary rocks that consist of soils, alluvium, scree and ironstone cappings (McCall, 1964). In the central section (2° to 2°30'N), there are mainly superficial deposits of Pleistocene to Recent age that occupy the Turkwel plain, while to the west occur a metamorphic and igneous complex of Pre-Cambrian rocks containing recrystallised sediments and volcanics (Walsh, 1966). The rocks in the northern part (2°30' to 3°N) are folded gneisses, schists, granulites and limestones of the basement system that are cut by acid pegmatites and basic intrusions (Fairburn and Matheson, 1970). In the northwest, the basement system rocks are covered by a thick series of basalt, andesites and rhyolitic ignimbrites. The main river is the Turkwel, and its important tributaries within the project area are the Wei Wei River in the south, Kateruk River in the central part and Nakaton River in the north.

The area, which is arid to semi-arid, receives an average annual rainfall of between 200 and 400mm and temperatures range from 24 to 38°C (Republic of Kenya, 2002). The long rains occur between April and August, while the short rains occur in October and November. The annual rainfall amount ranges between 200 and 400mm (Nicholson, 1980), but is erratic and unreliable (Republic of Kenya, 2002). The area belongs to the Somali-Masai floristic zone (White, 1983). It comprises of semi-arid grassland and thorny shrubland in the lowlands, grading into wooded grassland and bushland as altitude increases, and also towards the south. Along the rivers are riverine forests that are dominated by *Acacia tortillis, Balanites aegyptiaca, Salvadora persica,* and *Hyphaenea compressa. Calotropis procera* and *Prosopis juliflora* are common in disturbed areas.

The population growth in Kenya is estimated to have increased from 2.9% during the last census in 1999 to 3% on the 2009 census (Kenya Population and Housing Census, 2009). The project area is, however, sparsely populated with higher population in the urban centres, which attract higher settlement due to better communication services and availability of schools, health centres, and water. Pastoralism is the predominant economic activity in the lowlands, and agriculture in the highlands. Animals reared are camels, cattle, goats, sheep, donkeys and poultry. In Loima District, crop irrigation is done along River Turkwel, and includes cultivation of sorghum, maize, cowpeas, and green grams. The low and erratic rainfall, high temperatures, prolonged droughts, and El Niño-related floods in the project area have, however, contributed to the high poverty levels through: crop and livestock diseases, collapse of irrigation schemes and harvest failures, as well as livestock deaths (Republic of Kenya, 2002).

The earth roads comprise mainly of a sandy substrate, and are best traversed using four-wheel drive vehicles. Five light aircraft airstrips serve the area and are located at Lokichar,

Lorugumu, Kaputir, Katilu and Kalemyang. The area is covered by both mobile and land line telephone services.

1.5 PROJECT BACKGROUND, OVERVIEW, JUSTIFICATION AND OBJECTIVES

1.5.1 Project Background

The initial Production Sharing Contract (PSC) with the Government of Kenya was awarded to Africa Oil B.V. with the aim of exploring in detail, the assigned project area of 8429 km^2, in accordance with its contractual obligations under the PSC, in order to: (a) delineate potential hydrocarbon prospects, (b) carry out exploratory drilling within the identified potential prospect areas, and (c) carry out well appraisal and production of oil and/or gas if the prospects turn out to be economically viable.

TKBV has since become the operator in the project area and is working in collaboration with its partner, Africa Oil Corporation. TKBV is committed to ensuring that the activities that will be carried out to achieve the stated objectives will be done in a manner that is not detrimental to the natural environment or to the local communities.

1.5.2 Overview of the Project

Exploration drilling is designed to confirm the presence of viable quantities of hydrocarbons in a prospective formation, after the location and extent of a possible hydrocarbon-bearing geological formation has been identified from seismic and associated (e.g. magnetic) surveys. TKBV, having successfully acquired and processed new seismic survey data of a good technical standard in Block 13T, intends to drill a number of exploration wells of various depths within the Project Area of Interest (see Figure 1.2 showing area of interest in Block 13T) once a licence is granted by NEMA. The Project Area of Interest reflects the area where the seismic data was acquired.

Generally, the depth of a well being drilled dictates the size of the drilling rig required, the number of employees, and the duration of the drilling operation (in essence, the drilling duration exponentially increases with well depth). The rig will serve as the drilling platform. A separate camp, located adjacent to the rig, will provide accommodation, kitchen facilities, sewage processing, power generation and storage areas (for fuel oil, bulk mud and cement, fresh/potable water, liquid mud, dry process materials, drilling water and pipe rack storage). It will also provide medical and emergency response facilities and secondary operations such as: welding, painting and machining that will be integral to the rig site.

The total programme will comprise of a number of wells of various depths. The specific project activities will include:

- Site and road preparation;
- Water borehole drilling if necessary;
- Setting up of the camping site near the proposed well site;
- Mobilisation (movement and transport of equipment, personnel and materials);
- Rigging up/positioning the rig;

- Drilling;
- Well and reservoir testing (if necessary);
- Demobilisation;
- Maintenance of wellhead; and
- Decommissioning and abandonment (dependent on the success of the well).

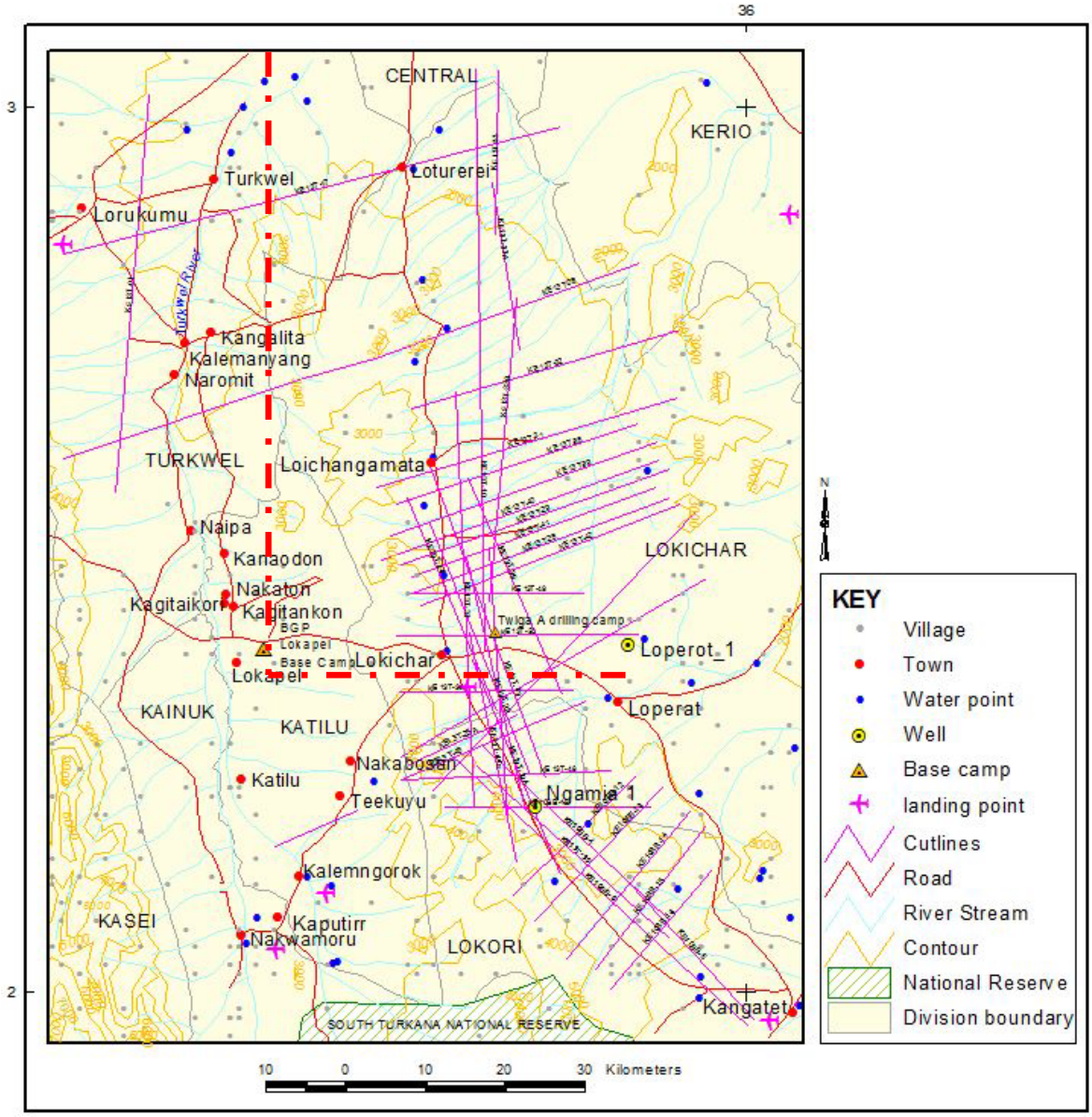


Figure 1.2: Location of the project area of interest (dashed red outline) in Block 13T

The workforce will reside in a base camp that will be constructed by a professional civil and building contractor with experience in setting up such camps. Issues such as camp security, provision of basic services (e.g. accommodation, water, sanitation, lighting, and healthcare), waste management, materials storage areas, etc., shall be incorporated in the camp design. The camp will be sited away from existing settlements, and its location will be determined in consultation with the local community leaders and would normally be located adjacent to the drilling rig. The health and safety of the crew and the general public at large will be ensured by the company complying both with the relevant national legislation, and its own in-house

environmental health and safety (EHS) policies, which embrace the international best practices for such activities. An emergency response plan will be put in place in case of any accidents or incidents. A close working relationship will be fostered with the local communities, and as far as is practicable, unskilled and semi-skilled workers are to be recruited locally.

1.5.3 Project Justification

Following the recent discovery of hydrocarbon deposits in the adjacent block (Block 10BB) by Tullow Oil, exploration efforts have been intensified in the related Mesozoic and Early Tertiary rift basins of Kenya with a view to meeting the global, regional and local demand for energy.

Energy is an important factor in socio-economic development (GVEP Kenya, 2006). The project is in line with the objectives of the National Energy Policy (improving access to affordable energy services, enhancing security of supply, promoting development of indigenous energy resources, promoting energy efficiency and conservation, and promoting prudent environmental, health and safety practices), the Economic Recovery for Wealth and Employment Creation Strategy (expanding and improving infrastructures, developing arid and semi-arid lands, and safeguarding environment and natural resources), and Kenya Vision 2030 (enhanced equity and wealth creation for the poor in semi-arid and arid districts, must generate more energy at a lower cost and increase efficiency in energy consumption).

1.6 PURPOSE OF THE EIA

In Kenya, the primary authority that regulates the environment with relation to oil and gas exploration activities is the National Environment Management Authority (NEMA). Other key national players and regulators in the oil and gas industry are: the Ministry of Environment and Mineral Resources, the Ministry of Energy, and the National Oil Corporation of Kenya. The country is also a signatory to a number of international treaties and conventions related to environmental protection and conservation. The EIA is aimed at providing information that will help the authorities make an informed decision when awarding the licence to TKBV.

1.6.1 Administrative and Legal Framework

Execution of the exploration well drilling in the project area will conform to existing local, national and international standards for environmental protection and management with particular reference to hydrocarbon exploration activities.

These legislative requirements provide for the assessment of the environmental, social and health impacts of the project, establish effects of the proposed activities before any decision is taken, recommend mitigation measures prior to project approval and implementation, promote the implementation of appropriate policies at all levels consistent with all laws and decision-making processes through which sustainable development can be achieved, and encourage the development of procedures/processes for information exchange, notification and consultation amongst stakeholders.

There are several regulations, guidelines and laws that govern the implementation of such projects. These laws are outlined in Chapter 4 of this EIA project report. The country is also a signatory to several treaties and conventions relevant to environmental protection. In Kenya the body mandated with the regulation of the environment and its sustainability is the National Environment Management Authority (NEMA).

1.6.2 The Mandate of NEMA

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

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

1.6.3 Requirements and Scope of Work for the EIA

A project report is defined, in the preliminary section of the EMCA (1999) and the interpretation section of the Environmental (Impact and Audit) Regulations (2003), as a

summarized statement of the likely environmental effects of a proposed development referred to in section 58 of the EMCA, 1999. Section 58 requires that a proponent intending to carry out any undertaking listed in the Second Schedule to the Act must submit a project report to the National Environment Management Authority ('the Authority') in the prescribed form accompanied by the prescribed fee. The exploration drilling of oil and gas falls under Schedule 2, at 6(j) "exploration for the production of petroleum in any form", of the EMCA 1999.

Regulation No.7 of the Environmental (Impact and Audit) Regulations, 2003 lays down the specific issues that the project report must address, which in summary are: the nature, location, activities, and design of the project; the materials that are to be used; the potential environmental, economic and socio-cultural impacts and mitigation measures; plans for the prevention and management of accidents and for ensuring the health and safety of workers and neighbouring communities; and the project budget. These issues are to further address, as outlined in the Second Schedule of the Environmental (Impact Assessment and Audit) Regulations (2003): ecological considerations; sustainable use; ecosystem maintenance; social considerations; landscape and land uses; and water. Within this framework, the collection of relevant baseline data, and consultations with stakeholders and the public are important, and ought also to be included in the report.

The scope of this EIA project report can be summarised as:

- Stakeholder engagement;
- Review of relevant data and ground-truthing;
- Utilising existing baseline data (biophysical, social and health) for the description of the project area;
- Prediction and evaluation of potential impacts;
- Determination of appropriate mitigation measures that can eliminate, reduce/minimise the impacts;
- Development of an Environmental Management Plan (EMP); and
- Report preparation.

1.6.4 The EIA Review and Approval Process

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

sufficient mitigation measures, the Authority will require that the proponent undertake an environmental impact assessment study in accordance with the Regulations.

1.7 THE EIA TEAM

Earthview Geoconsultants (K) Ltd. was appointed by TKBV on 29th May 2012 to undertake the EIA for the proposed exploratory oil and gas wells drilling programme in the project area. Earthview is a well-established consultancy firm based in Nairobi with good capacity in environmental and social impact assessments and audits, geological and hydrogeological studies, geographic information systems, natural resource surveys, and project planning, implementation and management. Earthview is officially registered with the National Environment Management Authority as an Environmental Consultancy Firm. The firm comprises of individuals with many years' experience and knowledge in these and other areas. The firm is conversant with national legislation and regulations that relate to the sectors in which it carries out its activities, including NEMA requirements for environmental and social impact assessments and audits, as well as applicable international best practices and standards.

Table 1.1: The EIA team composition

Name	Role	Qualifications	Experience (years)
Prof. Norbert Opiyo-Akech	Overall coordination/Geological issues	PhD	30
Dr. Daniel Olago	Coordination/Biophysical and Socio-economic issues	PhD	20
Mr. Joseph Nganga	Soil and Waste Management	BSc	20
Mr. Adams Gakuo	Ecology and waste management	MSc	6
Ms. Sheena Adongo Ogutu	Biophysical and Socio-economic issues	BSc	3
Ms. Grace Njeri Murage	Socio-economics, Health and Socio-cultural issues	BSc	2
Mr. Edwin India Omori	Socio-economics, Health and Socio-cultural issues	MSc	10
Mr. Peter Kibe	GIS Expert	MSc	20
Mr. Nicholas Aketch	Logistics/Administration	BSc	8
Ms. Emily Atieno	Policy/Legislation/Regulations	LLB	25

1.8 OBJECTIVES OF THE EIA PROJECT REPORT

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

a) Identify, evaluate and propose suggested mitigation measures for potential environmental impacts of the proposed project on the various biophysical and socio-economic structures of the area;
b) Assess and analyse the environmental costs and benefits associated with the proposed project;
c) Outline environmental management plans and monitoring mechanisms during the project execution phase;

d) Ensure that concerns and aspirations of the local community are addressed in all stages of the project cycle;
e) Ensure that the project activities do not in any way interfere with the environmental sustainability of the area. This is ensured by giving due consideration to:
    - Rare, endangered and endemic flora and fauna and the ecosystems in and around the project area;
    - Local communities and land tenure systems;
    - Sensitive historical, archaeological and cultural sites.

f) Put in place mitigation and monitoring measures that will ensure that any potential negative impacts arising from activities of the project are eliminated or reduced at the earliest opportunity to obviate any harmful effect to the environment;
g) Boost the economy by providing jobs and trading opportunities to the local community in the region.

1.9 TERMS OF REFERENCE (TOR)

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

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

1.10 STRUCTURE OF THE REPORT

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

Table 1.2: Structure of the EIA Project Report

Chapter	Title	Contents
1	Introduction	Introduction to the project area; identification and activities of the project proponent in other regions; project background, objectives and justification; purpose of the EIA and objectives of the report; the EIA team; TOR for the report.

2	Project Description	The technology and processes to be used in the implementation of the project; workforce requirements; the materials to be used in the construction and implementation of the project; the products, by-products and waste generated by the project.
3	Methodology	Methods used in carrying out the assessment; identification of gaps in knowledge and uncertainties, which were encountered in compiling the information.
4	Legal and Regulatory Framework	A concise description of the national environmental, legislative and regulatory framework, and international best practices.
5	Baseline Environmental Parameters of the Project Area	Description of the potentially affected environment within the framework of the proposed EIA; assessment of existing (pre-project) impacts and potential (project and residual) impacts.
6	Analysis of Project Alternatives	Alternative technologies, processes available, and reasons for preferring the chosen technology and processes.
7	Environmental Impact Assessment	Environmental effects of the project including the social, economic and cultural effects and the direct, indirect, cumulative irreversible, short-term and long-term effects anticipated.
8	Environmental Management Plan	Environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the time frame and responsibility to implement the measures; provision of an action plan for the prevention and management of foreseeable accidents and hazardous activities in the course of carrying out activities or major industrial and other development projects; measures to prevent health hazards and to ensure security in the working environment for the employees and for the management of emergencies.
9	Conclusions and Recommendations	Summary of the conclusions and key recommendations from the EIA.
References	References	List of references and websites referred to in the text.
Appendices	1. Minutes of meetings	Minutes of meetings held with communities, community leaders and other stakeholders in the project area.
	2. Copies of laboratory results	Laboratory results for samples collected in the field (water quality, soil chemistry)
	3. Certificates	Certificates of the consultants and the company doing the EIA project report.
	4. Pin Number and VAT certificate	Pin number and VAT certificates of the proponent
	5. Other relevant documents	Relevant copies of the PSC contract with the Government of Kenya and certificate of registration.

CHAPTER 2

PROJECT DESCRIPTION

2.1 INTRODUCTION

TKBV is planning to undertake an exploratory drilling project comprising a number of exploratory wells to verify presence of oil and natural gas in the project area of interest, which lies within Block 13T. The Block covers Central Pokot, Turkana Central, Loima and parts of Turkana South districts.

The objective of the project is to check for the presence of hydrocarbons based on the delineation of potential hydrocarbons traps considered present due to analysis of recently acquired seismic data. Details provided in this report are on project activities, personnel and support requirements. Information on various discharges, emissions and waste likely to be produced from project activities are described as well as management policies put in place to mitigate any impacts that may arise from them.

2.2 PROJECT LOCATION

The project area of interest lies in parts of Central Pokot, Turkana South, Loima and Turkana Central districts (Figure 1.2).

The area has poorly maintained murram and earth roads which are impassable during rainy seasons because they are criss-crossed by luggas or traverse through luggas and river flood plains.

2.3 QUALITY ASSURANCE OF DESIGN

In surface and sub-surface development with large spatial structural variability, such as in the project, certain basic parameters must be reasonably and accurately defined in the overall project specification, and adhered to, to ensure full realisation of the project objectives. TKBV will therefore plan to meet the following quality objectives:

- Compliance with statutory requirements, both locally and internationally;
- The systems must meet the performance requirements;
- Production availability;
- Environmental and safety considerations;
- Operability and maintainability;
- Extendibility; and
- Use of innovative technology.

2.4 OVERVIEW OF EXPLORATORY DRILLING PROGRAMME

Exploratory drilling is undertaken to verify if geological formations have accumulations of hydrocarbons, and if the site can produce enough oil and gas to make it economically viable to proceed with further development. Exploratory drilling is a temporary and short duration activity, taking between 90 to 120 days under normal conditions. Exploratory drilling operations are conducted from a drilling rig.

The depth of the well determines:

- the size of the drilling rig,
- the number of employees, and
- the duration of the drilling operation

The proposed drilling sites, which will measure 450m x 250m, will incorporate: the drilling rig pad, working area, accommodation facilities, waste management facilities, water reservoir (120mx130m), kitchen facilities, power generation facilities, a lay-down area for storage of bulk mud and cement, dry process materials, pipe rack, machinery, and secondary operations such as welding, painting and machining. The site will also include medical and emergency response facilities and security personnel quarters.

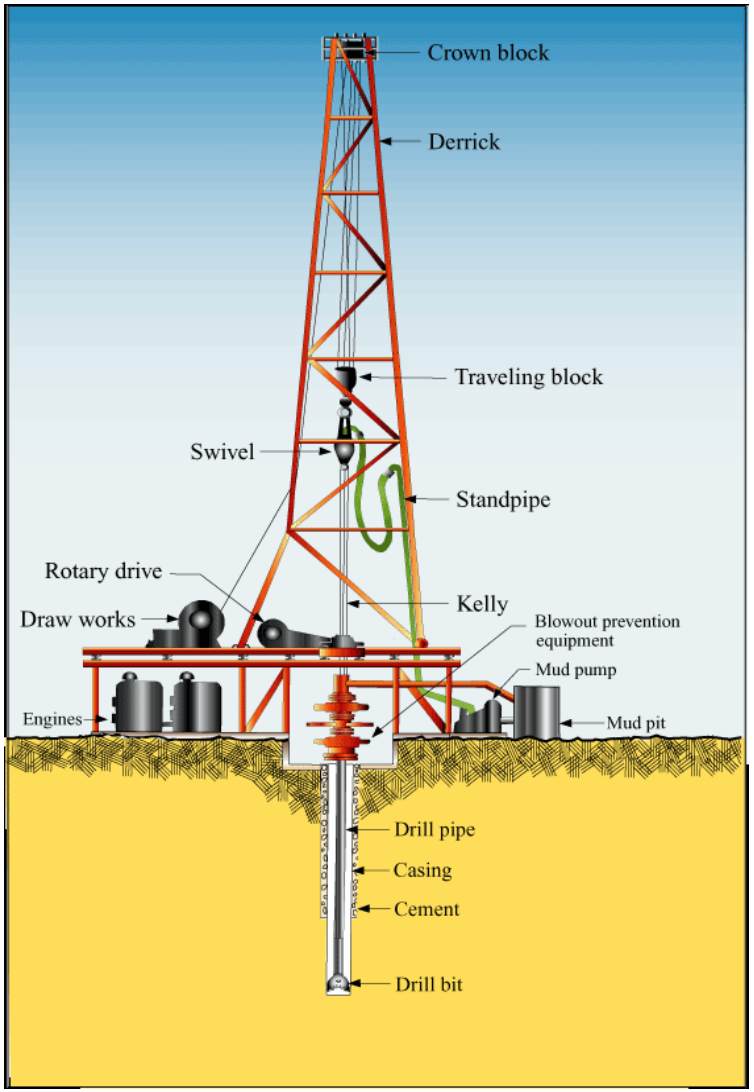


Figure 2.1: Drilling rig showing key components. (Source:*http://www.consrv.ca.gov/dog/picture_a_well/Pages/gh_drill_rig.aspx*)

Table 2.1: Table of drill rig parts

PART	FUNCTION
Crown block	An assembly of sheaves or pulleys mounted on beams at the top of the derrick. The drilling line is run over the sheaves down to the draw works.
Derrick	A large load-bearing structure, usually bolted construction of metal beams. In drilling, the standard derrick has four legs standing at the corners of the substructure and reaching to the crown block. The substructure is an assembly of heavy beams used to elevate the derrick and provide space underneath to install the blowout preventer, casing head, and other equipment.
Travelling block	An arrangement of pulleys or sheaves which moves up or down in the derrick through which the drilling cable is strung to the rotary drive
Swivel	A mechanical device that suspends the weight of the drill pipe, provides for the rotation of the drill pipe beneath it while keeping the upper portion stationary, and permits the flow of drilling mud from the standpipe without leaking
Standpipe	A rigid metal conduit that provides the pathway for drilling mud to travel about one-third of the way up the derrick, where it connects to a flexible hose (kelly` hose), which then connects to the swivel
Kelly	The heavy square or hexagonal steel member suspended from the swivel through the rotary table and connected to the topmost section of drill pipe to turn the drill pipe as the rotary table turns
Rotary drive	The machine used to impart rotational power to the drill string while permitting vertical movement of the pipe for drilling. Modern rotary machines have a special component, the rotary or master bushing, to turn the kelly bushing, which permits up and down movement of the kelly while the drill pipe is turning
Draw works	The hoisting mechanism on a drilling rig. It is a large winch that spools off or takes in the drilling cable or line, which raises or lowers the drill pipe and drill bit
Blowout prevention equipment	The assembly of well control equipment including preventers, spools, valves, and nipples connected to the top of the wellhead to prevent the uncontrolled escape of oil or gas during drilling operations.
Mud pump	A large, high-pressure reciprocating pump used to circulate the mud on a drilling rig
Engines	Any of various types of power units such as a hydraulic, internal combustion, air, or electric motor that develops energy or imparts rotary motion that can be used to power other machines
Mud pit	**O**riginally, an open pit dug in the ground to hold drilling mud or waste materials such as well bore cuttings or mud sediments.
Drill pipe	The heavy seamless steel tubing used to rotate the drill bit and circulate the drilling mud. Each section of drill pipe is about 30 feet long and is fastened together by means of threaded tool joints
Casing	Heavy steel pipe that lines the walls of the hole to prevent the wall of the hole from caving in, to prevent movement of fluids from one formation to another, and to aid in well control
Cement	Used to fill the space between the wall of the hole and the casing. Together with the casing, this prevents caving of the hole, prevents movement of fluids (water, oil, or gas) between rock layers, confines production to the well bore, and provides a means to control pressure
Drill bit	The cutting or boring element used in drilling oil and gas wells. Most bits used in rotary drilling are roller-cone bits. The bit consists of the cutting elements and the circulating element. The circulating element permits the passage of drilling fluid and uses the hydraulic force of the drilling mud to improve drilling rates

The drilling process generally uses drilling bits of different sizes to drill a series of concentric holes from the surface to the planned well depth. A drilling fluid (drilling mud) is circulated within the drill string to the bit. The mud that will be used is water based. The primary function of the drilling mud system is the removal of cuttings from the well and the control of formation pressures. Other functions of the mud system include sealing permeable formation; maintaining well bore stability; cooling, lubricating and supporting the drill bit and assembly; and transmitting hydraulic energy to tools and bit. The drilling fluid is prepared by on site mixing of mud additives and chemicals to the desired concentrations in water. A well is drilled in sections, with the diameter of each section decreasing with increasing depth, as shown in Table 2.2 and Figure 2.2.

Drilling of a well is spudded with a 36" surface hole drilled using water mixed with bentonite, which is pumped at a very high rate down the drill string to force drill cuttings up the annulus and out onto the surface. Once drilled, a 30" conductor is cemented into place to ensure structural integrity of the well. The subsequent sections of the hole are then drilled in a similar manner before cementing in place a further casing strings. This allows installation of a wellhead and the necessary equipment.

Once the wellhead and necessary equipment are installed, the subsequent well sections are drilled with circulating drilling mud and the cuttings returned to the rig for separation of the mud prior to discharge.

As each section is drilled, a casing is run and cemented into place ready for drilling the next smaller diameter section. The drill cuttings are returned to the rig with the circulating mud and passed through a solids control package for separation of the mud from the cuttings.

Table 2.2: Well depths for proposed wells

Hole size (in)	Average depth (m)	Casing Size (in)	Proposed mud system
36	140	30	Water with bentonite
26	140 to 5000	20	Water with bentonite
17½	500 to 1290	$13^{1/2}$	Water based mud
12¼	1290 to 2200	$9^{5/8}$	Water based mud
7	2200 to 3000	7	Water based mud

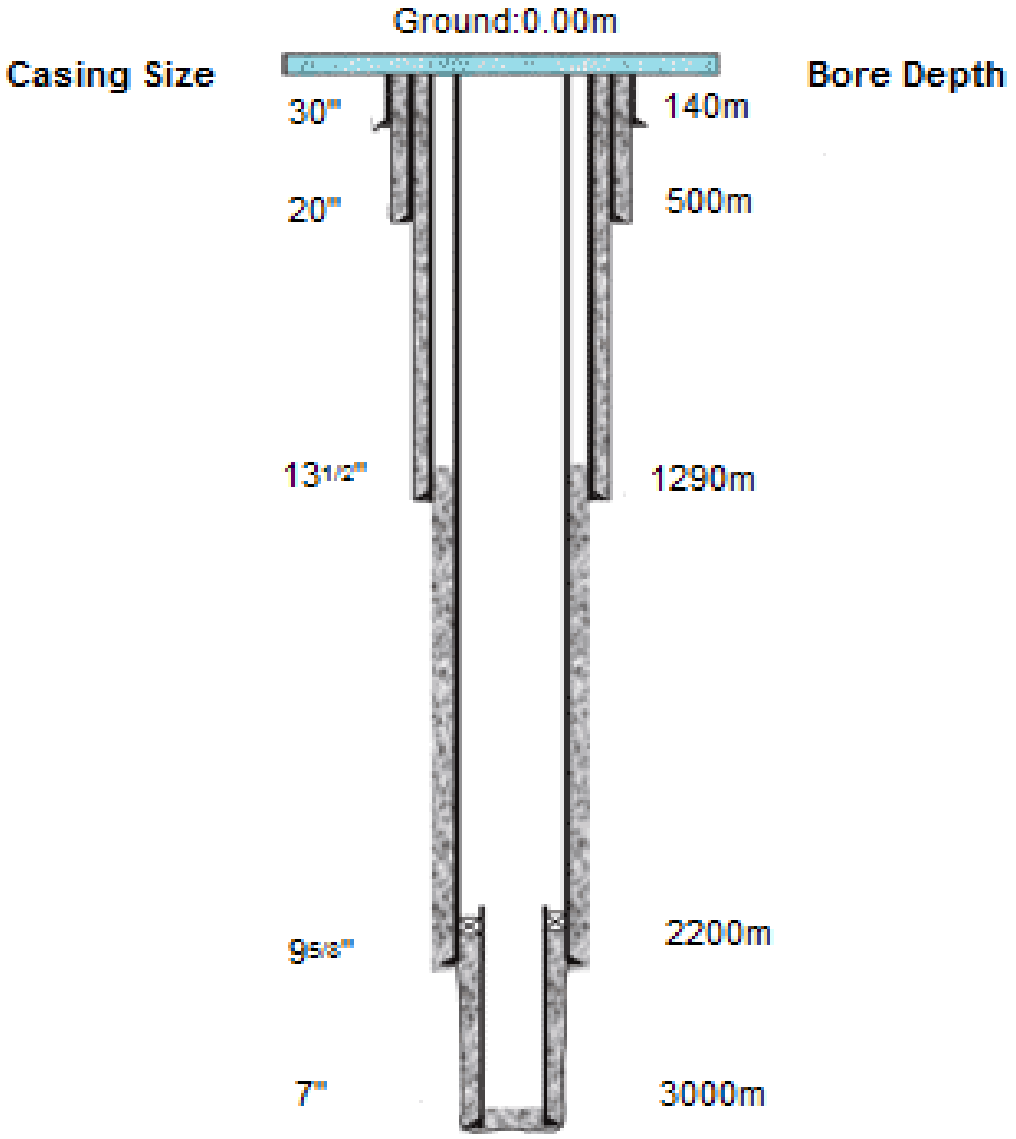


Figure 2.2: Schematic structure of the proposed casing design of exploration wells

The activities undertaken during exploratory oil and gas well drilling are as follows:

2.4.1 Site Preparation

Site preparation activities would consist of clearing the existing access route/cut line and minimal vegetation clearing within the existing Right of Way. A series of civil works will take place during the site preparation stage. A chain-link perimeter fence measuring 1.5 km per site will be erected followed by an earth berm around the drill sites measuring about 1.5 metres in height. Other works will include excavations of the drilling water reservoirs with a capacity of 6,500 M^3 per site and lining of the pits with HDPE lining material. Further works will include excavation of drill cut pits measuring 130m long x 2.4m depth (the bottom sections of the pits will measure 8 m x 13 m) per site; the drilling area foundation that will entail removal of topsoil and murram core placement before damp proofing with a HDP-DPM at 300mm, followed by overlaying murram and compaction. The drill pad will be constructed to specifications using reinforced concrete, around the conductor pipe, accommodation and office facilities, and water reservoir among others. An access road will be built from the existing road to the proposed site.

2.4.2 Drill rig specifications and crew facilities

TKBV has contracted the services of Weatherford Drilling International (WDI) for the duration of the project. They are a reputable service provider in the industry with many years of global experience. WDI will provide the 804 Rig, a medium-duty 1,500 hp rig of the IDM Quicksilver design that can drill to 5,000m. A one-page specification sheet is included for further details about the rig to be used (section 6.2.2). The rig, commissioned in 2008, has been equipped with the latest, modern drilling technology.

Working areas/ offices and accommodation facilities will be sited adjacent to the rig to facilitate operations and accommodation of the personnel working at the drilling site.

2.4.3 Rigging-up

The process involves assembling and erecting the drilling tower (derrick/ mast) and associated equipment. The tower is known as a mast (if tower is part of a tractor-trailer and is jacked up as a unit) or a derrick (if the tower is constructed on site). The towers, constructed of structural steel, sit on a flat steel surface called the drill or derrick floor. Equipment involved is designed for rapid assembly and economy of labour. For this project, equipment will be transported to the site via trucks and offloaded by winch and skid techniques by using cranes. Before the rig is assembled, spudding-in of the starter hole will have been augered.

2.4.4 Drilling Techniques

There are a number of techniques used in oil and gas drilling. Several methods used are as shown in the table below. The bore trajectory could be straight hole/vertical, directional/ horizontal. A well bore is typically drilled in a series of progressively smaller-diameter intervals with the well bore exhibiting the largest diameter at the surface and smallest diameter at the end of the bore (see section 2.4: Overview of Exploratory Drilling Programme).

Table 2.3: Shows various drilling techniques

DRILLING TECHNIQUE		ADVANTAGES	DISADVANTAGES
Cable –Tool Drilling	It is the simplest way to drill and it creates shallow wells in soft beds of rock. A bit held to a long steel cable by an iron rod called a stem is raised and dropped repetitively. The force of the drop drives the bit deeper and deeper into the ground. The jagged bit crushes soil and rock and the drillers must occasionally pull it out to pour water in the opening to flush it out. The bailer, a long pipe, takes out the water and loose rocks and soil	-Low capital investment -Low maintenance and operational costs -Minimal cross-contamination -Water is the only media required for cuttings removal -Large diameter holes can be drilled.	-Drilling is slow in hard formations -Boulders are difficult to drive casing through, often requiring the use of dynamite -Casing penetration rates decrease with depth in a given formation -Casing retrieval is slow -Noise and vibration can be significant and of special concern when drilling in populated areas or near sensitive structures, and can have longer term negative impact on operator hearing -Shortage of experienced cable tool drillers
Auger Drilling	-Method uses a helical screw, which is driven into the ground with rotation; the earth is lifted up the borehole by the blade of the screw. -Method commonly used environmental drilling, geotechnical drilling, soil engineering and geochemistry reconnaissance work in exploration for mineral deposits.	-It is cheap and fast. Requires low operating costs -Has fast penetration rates in suitable formations and no contamination of samples by fluids	-Drilling is restricted to generally soft unconsolidated material or weak weathered rock
Rotary Drilling	Rotary drilling uses a sharp, rotating drill bit to dig down through the earth's crust. The basic rotary drilling system consists of four groups of components. The		

		prime movers, hoisting equipment, rotating equipment, and circulating equipment all combine to make rotary drilling possible.		
	a. Compressed air drilling	Compressed air drilling employs a rotary drilling rig that uses air rather than drilling mud to remove drill cuttings. The drilling rig and operations are identical to those of a rotary drilling rig, except that there is no drilling mud circulating system. Instead of mud, air is pumped down the drill string and out the drill bit, forcing cuttings up and out of the well bore. Compressed air drilling is typically used in low permeability and porosity reservoir intervals where oil or water is not expected to be encountered during drilling. If (or when) natural gas is encountered during drilling, the gas may be safely combusted at the drill site using a flaring device over a waste containment pit.	-Faster rate of penetration (R.O.P) (2-5 times faster than on Mud) -Improved deviation control (light WOB) -Minimal formation damage in Production section -Effective Pressure Control through Lost Circulation Zones -Detection of Low Pressure Zones -Faster return of drilled cuttings (formation evaluation) -Overall Lower Cost per Foot	-High Annular Velocity is required to carry cuttings up the hole -Formation Pressure Control is minimal -Cannot drill when H_2S zones are present -Danger of down-hole fires limited -Applications: geological regions with mature, stable and relatively dry formations (water influx limitations)
	b. Rotary Drilling with Mud	Bentonite and synthetic stabilizers are mixed with water and circulated in the borehole. The resultant fluid commonly referred	-Hole penetration is very fast in some clay, sand and shale formations -No temporary casing is required -Fluid pressure in	Requires mud mixing equipment and dug pits or metal tanks for circulation – Requires significant amounts of water on location to mix initially

		to as mud or drilling mud, is used to cake and stabilize the borehole wall. The mass of the fluid also provides pressure in the hole, which helps to keep it open. The drilling fluid is circulated down the hole through the drill pipe, where it exits through ports in the bit. The drilling mud flushes the cuttings away from the face of the bit and carries them up the annulus to the surface. Reverse circulation with mud is also possible. In either case, once the mud reaches the surface, it feeds into a settling tank where the cuttings are separated from the mud before it is circulated down the hole again.	the hole can help control heaving sands -Low horsepower requirement	and maintain circulation – Requires a fundamental knowledge of bentonite and additives needed to achieve adequate penetration rates and stabilize formations -More difficult to identify water bearing zones, especially in low flow formations -Loss of circulation zones can cause aquifer contamination and dramatically increase bentonite costs -Mud may plug the aquifer and cause decreased production -Driller still bears the risk of hole collapse or swell, resulting in possible loss of drill string or jamming of casing during installation -Disposal of mud after hole is completed can be inconvenient and costly -Freezing temperatures make working with mud more difficult
	c. Foam /Polymer Drilling	Foam drilling is similar to air drilling but mixes detergents with the air and a small volume of water to form foam that is better at removing cuttings and water from the well.	-Foam has excellent cuttings carrying capacity. -During connections (break in circulation) the cuttings will remain suspended in the annulus. -Holding Back Pressure on Annulus can help reduce water influx and/or maintain hole-wall stability.	-Surface requirements (pits) for Foam can become a problem. -Large pits have to be built to contain the Foam and allow time for settling. -Chemical cost to break down Foam can become expensive. -Large influx of Fluids can break down Foam and thus reduce hole cleaning

The rotary drilling with mud method will be used for the project. The well will be straight hole / vertical since the selected project sites are sparsely populated and are not built up which would call for the use of directional/slant/ horizontal drilling. It is also the most efficient and cost-effective manner in which to reach the sub-surface targets.

2.4.5 Casing Operation

Casing or lining of the well is undertaken to ensure the integrity of the wellbore throughout the drilling and production operation stages. Casing consists of a stacked series of metal pipes installed into the new well in order to strengthen the walls of the well hole, to prevent fluids and gases from seeping out of the well as it is brought to the surface, and to prevent other fluids or gases from entering the rock formations through which the well was drilled. A well casing extends from the surface to the bottom of the well and consists typically of a steel pipe. Casing with a diameter slightly smaller than that of the well hole is inserted into the well, and wet cement slurry is pumped between the casing and the sides of the well. Casing is installed as the well is progressively drilled deeper. The top interval of the well, extending from the surface to a depth below the lowermost drinking water zone, is the first to be completed, being cemented from the surface to below the drinking water zone. Next, a smaller diameter hole is drilled to a lower depth, and then that segment is completed. This process may be repeated several times until the final drilling depth is reached.

2.4.6 Well Logging

Logging is a process that deals with performing tests during or after the drilling process to allow geologists and drill operators to conduct the following:

- Monitor drilling process progress in order to gain a clearer picture of subsurface formations;
- Identify specific rock layers, in particular those that represent target zones for further exploration;
- Ensure that the correct drilling equipment, materials, and supplies (such as drilling mud), are being used; and
- Ensure that drilling is not continued if unfavorable surface or subsurface conditions develop.

There are two commonly used types of logging, which are: sample and wireline. Sample logging consists of examining and recording the physical aspects of the rock penetrated by a well by analysing the cuttings returned to the surface by the circulating system. Wireline logging consists of lowering a device used to measure the electrical, acoustic, or radiological properties of the rock layers into the down-hole portion of the well to provide an estimate of the fluid content and characteristics of the various rock layers through which the well passes.

2.4.7 Well Testing

If the results of logging indicate a potential for hydrocarbon-bearing formations the well may be tested. During well tests, formation fluids will be brought to the surface where pressure, temperature and flow rate measurements will be made to evaluate the characteristics of well performance.

Once the required drilling depth is achieved, the following processes may be undertaken: Well completion, well suspension or abandonment.

The well testing objectives will include: establishing productivity of the identified reservoir unit(s); production interference test to assess connectivity of the formations; calibration of sub-surface static and dynamic models; determination of flow barriers/discontinuities, if any; determination of near well-bore properties such as permeability and skin; collection of representative dead oil samples for flow assurance and assay studies; and evaluation of ESP performance. Where well-testing is to occur this will generally not exceed 5 days; well-test fluids will be flared. Produced water will be cleaned to the required standard and discharged offsite.

2.4.8 Flaring

Flaring is the controlled burning of hydrocarbons during a well test. This burning occurs at the end of a flare stack. Flaring disposes of the gas and oil and releases greenhouse gases in to the atmosphere. Flare systems are used throughout the petroleum industry around the world during well testing.

After testing, which includes separating the oil and gas (see section 2.4.7), the hydrocarbons will be sent to the burner boom for disposal by flaring, as this is the only practical handling option for these hydrocarbons. Flaring may be initiated using diesel to ignite the mixture and to give a clean burn. It is intended to use a high efficiency burner to flare the oil during well testing and minimise as far as practical the release of un-burnt hydrocarbons.

A flare is normally visible and generates both noise and heat. During flaring, the burned gas and oil generates mainly water vapour and carbon dioxide. Efficient combustion of the flame depends on achieving good mixing between oil and compressed air from a compressor. The gas will give a clean burn because the heavy-ends will be in the oil phase due to separation in the separator.

2.4.9 Well completion or well suspension

Once the well has been tested and verified to be commercially viable, it can be completed or suspended to allow future production.

2.4.10 Well suspension or abandonment

If little / no hydrocarbons are detected, the well will be plugged and abandoned. Once the wells have been plugged (with cement), the casing will be cut below the ground level and a plate, made of steel, welded to the top of the casing. The top-hole section will be back-filled and a place marker installed on the surface indicating the position of the abandoned well.

If sufficient hydrocarbons are detected and tested, the well will be suspended. During suspension of the wells, bridge-plugs and cement plugs will be placed and tested across any open (perforated) hydrocarbon-bearing formations. This will be accomplished by pumping cement slurry to the desired location within the wellbore. A kill string can be run on with a tubing hanger before a plug is set in the wellhead. (This will allow the contents of the wellbore to circulate out at time of possible future re-entry). The wellhead equipment will remain in place and will be fitted with a purpose-designed flange and pressure gauge assembly that will allow the build-up of any pressure to be monitored.

2.5 DRILLING MUD SYSTEM

Drilling fluids/mud is used extensively in the upstream oil and gas industry, and is critical to ensuring a safe and productive oil or gas well. There are two primary types of drilling fluids/mud used during the drilling process. These are: water based drilling mud (WBM), and non-aqueous drilling mud (NADM) (Neff et al., 2000; OGP, 2003). WBMs have either fresh water or salt water as the primary fluid phase, while NADMs have either refined oil or synthetic materials as the primary fluid phase. Drilling mud is circulated through the inside of the drill string out the bit nozzles, and all the way up from the borehole back to the active mud system for recirculation.

Functions of the drilling mud include:

- Counteracting formation pressure,
- Preventing formation fluids from flooding the well-bore
- Removing cuttings from the borehole
- Cooling and lubricating the drill string and bit.
- Protecting, supporting, and stabilizing the borehole wall.
- Protecting permeable zones from damage

The drilling fluid to be used for this project will be Water Based Mud (WBM) prepared by mixing mud additives and chemicals on site to the desired concentrations in fresh water. The mud will consist of fresh water, weighting agent (barite: BaSO4), bentonite, and various inorganic salts, inert solids, and organic additives to modify the physical properties of the mud so that it functions optimally.

WBM ingredients can be divided into the functional categories shown in the table below:

Table 2.4: Shows the functional categories of materials used in WBM, their functions, and examples of typical chemicals in each category.

Functional Category	Function	Typical Chemicals
Weighting material	Increase density (weight) of mud, balancing formation pressure, preventing a blowout	Barite, hematite, calcite, ilmenite
Viscosifiers	Increase viscosity of mud to suspend cuttings and weighting agent in mud	Bentonite or attapulgite clay, carboxymethyl cellulose and other polymers
Thinners, dispersants, and temperature stability agents	Deflocculate clays to optimize viscosity and gel strength of mud	Tannins, polyphosphates, lignite, lignosulfonates
Flocculants	Increase viscosity and gel strength of clays or clarify or de-water low solids mud.	Inorganic salts, hydrated lime, gypsum, sodium carbonate and bicarbonate, sodium tetraphosphate, acrylamide based polymers
Filtrate reducers	Decrease fluid loss to the formation through the filter	Bentonite clay, lignite, Na-carboxymethyl cellulose,

	cake on the wellbore wall	polyacrylate, pregelatinized starch
Alkalinity, pH control additives	Optimize pH and alkalinity of mud, controlling mud properties	Lime (CaO), caustic soda (NaOH), soda ash (Na_2CO_3), sodium bicarbonate ($NaHCO_3$), and other acids and bases
Lost circulation materials	Plug leaks in the wellbore wall, preventing loss of whole drilling mud to the formation	Nut shells, natural fibrous materials, inorganic solids, and other inert insoluble solids
Lubricants	Reduce torque and drag on the drill sting	Oils, synthetic liquids, graphite, surfactants, glycols, glycerine
Shale control materials	Control hydration of shale that causes swelling and dispersion of shale, collapsing wellbore wall	Soluble calcium and potassium salts other inorganic salts and organics such as glycols
Emulsifiers and surfactants	Facilitate formation of stable dispersion of insoluble liquids in water phase mud	Anionic, cationic, or non-ionic detergents, soaps, organic acids, and water-based detergents
Bactericides	Prevent biodegradation of organic additives	Glutaraldehyde and other aldehydes
Defoamers	Reduce mud foaming	Alcohols, silicones, aluminium stearate ($C_{54}H_{105}AlO_6$), alkyl phosphates
Pipe-freeing agents	Prevent pipe from sticking to wellbore wall or free stuck pipe	Detergents, soaps, oils, surfactants
Calcium reducers	Counteract effects of calcium from seawater, cement, formation anhydrites, and gypsum and mud properties	Sodium carbonate and bicarbonate (Na_2CO_3& $NaHCO_3$), sodium hydroxide (NaOH), polyphosphates
Corrosion inhibitors	Prevent corrosion of drill string by formation acids and acid gases	Amines, phosphates, specialty mixtures
Temperature stability agents	Increase stability of mud dispersions, emulsions and rheological properties at high temperatures	Acrylic or sulfonated polymers or copolymers, lignite, lignosulfonate, tannins

WBM is pumped from the mud tanks on the pad down the hollow drill pipe and exits the drill string through holes in the drill bit. It sweeps cuttings from the drill bit up the space between the drill string and the wall of the well (the annulus) to the platform deck. The mud/cuttings mixture is passed through separation equipment that separates the cuttings from the drilling mud, which is returned to the mud tanks for recirculation down-hole.

When drill cuttings and drilling mud reach the surface during drilling, they are separated by means of Solids Control Equipment (SCE), whose function is to recover useful mud, so it can be re-circulated into the hole. There are several technologies used to remove the solids from the drilling mud.

The separation of WBM and cuttings is mainly based on particle size and relies on shale shakers, hydrocyclones, and a decanting centrifuge.

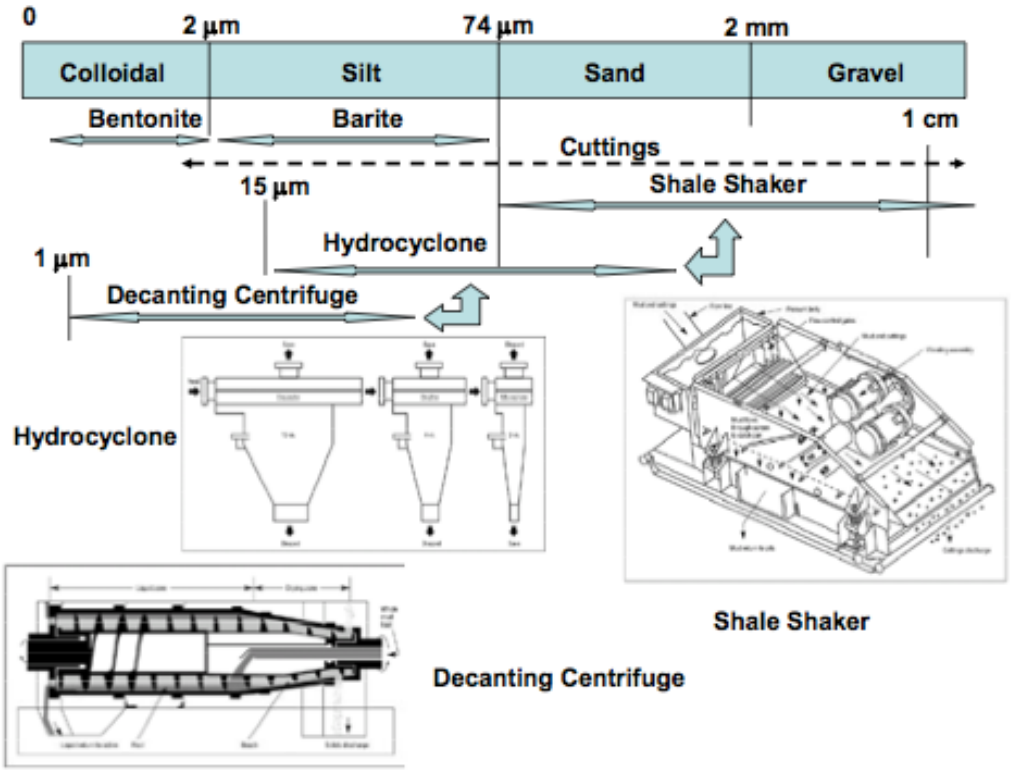


Figure 2.3: illustrates various waste separation stages based on particle sizes (Adapted from Neff, J. M. 2005)

Most cuttings are sand/gravel-sized and are easily recovered on the shale shaker, while silt- and clay- sized cuttings are separated from the barite and bentonite of WBM by use of hydrocyclones and centrifuges due to their sizes. Proper disposal of cuttings and waste fluids has been discussed under waste management.

2.6 WATER SUPPLY

The project area of interest lacks a quality assured water supply network and the water available is sourced from shallow wells, shallow to deep boreholes (at Katilu and Kasuroi), rivers (Turkwel) and luggas. Low and unpredictable rainfall has resulted in scarcity of water in the area. Water will be required for potable use, domestic use and drilling use. TKBV constructed a borehole in Nakukulas area for use in Ngamia 1 drilling operations and it has been proposed that the borehole will supply water to Twiga 1, one of the proposed well sites, that is not far from the area. Drilling will require a lot of water; therefore, TKBV will drill water boreholes at/close to the drilling sites to be the main source of water for the drilling operations. Quality levels for the water will not be critical so long as water is not too saline. Any unforeseen water shortages can be met by having a contingency plan to truck in from other sources water that can be stored on site and used when required.

2.7 EMISSION AND WASTE MANAGEMENT

Drilling of exploratory wells is the only sure way of confirming the presence of hydrocarbons in an identified promising geological structure. During the drilling program, huge quantities of solid (mainly crushed rocks) and liquid (sludge) waste are generated in addition to noise and air emissions. Therefore, the proposed exploratory drilling operation will likely result in the generation of solid waste, liquid waste, noise and air emissions.

2.7.1 Emissions

a) Air Emissions

Air emissions will arise from both direct and indirect sources: Direct emission sources will include rig power generation, vehicles and machinery, and flaring (burning of crude and gas) during well testing (if undertaken). Indirect emissions will include fugitive emissions such as chemical leaks, increased vehicle traffic, manufacturing emissions (necessary mud, chemicals, machinery, etc.).

The principal atmospheric emissions from these sources normally include carbon dioxide (CO_2), methane (CH_4), oxides of nitrogen (NOX), sulphur dioxide (SO_2), carbon monoxide (CO) and volatile organic compounds (VOCs). CO_2 and CH_4 are classified as two of the principal greenhouse gases (GHGs) (see table below).

Table 2.5: Summarises the environmental impacts of different atmospheric releases:

Type of emission	Environmental Impact
Carbon dioxide (CO_2)	A GHG that is believed to contribute to climate change
Methane (CH_4)	Enhances low level ozone production, indirectly contributing to climate change
Carbon monoxide (CO)	Enhances low level ozone production, indirectly contributing to climate change
Sulphur dioxide (SO_2)	Contributes to acid deposition/acid rain and toxic gas
Volatile organic compounds (VOCs)	Hydrocarbons may promote formation of photochemical oxidants. These are also known to be or suspected to be carcinogenic

Flaring emission from possible well test operations will likely produce the greatest levels of non-methane VOCs, as well as CH_4, SO_X, NO_X and CO. The hydrocarbons burned during potential well tests are likely to result in a significant contribution to atmospheric emissions from the operations, although each well test event would be relatively short-lived.

Fugitive (indirect) emissions could arise from loading and unloading, chemical use, spills, leaks from seals and flanges, poor housekeeping practices (for example containers left unsealed) and from small-scale engineering and maintenance operations such as welding. These emissions will be of small volumes and short-lived. They can be minimised by good

maintenance practices, by following operational controls for the loading and unloading of materials and by maintaining good housekeeping on the rig.

To minimise unnecessary emission generation, the proponent will ensure that there is extensive pre-planning to ensure that the required equipment, materials and personnel are available at the right location and at the correct time.

b) Noise emissions

The drilling rig will produce low-frequency noise which will originate from the top drive, draw-works, shale shakers, mud pumps, generators, trucks, forklifts, pipe handling, among others.

2.7.2 Wastes

In Oil and Gas Exploration and Production, the term 'waste' can be defined as any unavoidable material resulting from an up-stream operation for which there is no economic demand and which must be disposed of (Bashat, 2003).

a) Types of wastes

During the exploratory well drilling, several types of wastes will be generated, namely: domestic waste from offices and accommodation area; special waste which is hazardous to health and/or the environment; and industrial waste generated during petroleum activities and which is neither domestic nor special. The waste can be categorised into two main groups, i.e., operational wastes and domestic wastes. Table 2.6 shows the common wastes and their environmentally significant constituents.

Table 2.6: Shows the common wastes and their environmentally significant constituents.

CATEGORY	TYPE OF WASTE	MAIN WASTE COMPONENT	POSSIBLE ENVIRONMENTALLY SIGNIFACNT CONSITITUENTS
Domestic	Domestic sewage	Biodegradable organic matter	BOD, solids, detergents, coliform bacteria
	Domestic refuse	Packing materials, cleaning materials, garbage, garden leftovers, kitchen waste	Plastics, glass, organic waste
Operational	Drainage	Rain water	Hydrocarbons
	Process water	Engine cooling water, brake cooling water, wash water	Hydrocarbons, Detergents
	Gases	Vent gases	H_2S, CO_2, hydrocarbons
		Flare gases	NO_X, SO_2, CO_X, carbon particulate
		Blow down from bulk chemicals	Dust, well fluids
		Vapours	Hydrocarbons
		Fugitive gases	Volatile organic compounds (VOC)
		Exhaust gases from engines	NO_X, SO_2, CO_X, carbon particulate
	Drilling waste (from drilling mud)	Natural clays, natural polymers (starches, carboxyl methyl cellulose)	Inorganic salts, biocides, hydrocarbons, solids/cutting, BOD, organics
	Fire-fighting agents	Powders of sodium bicarbonate, potassium bicarbonate, and/or monoammonium phosphate	Fine dust, CFCs
	Waste lubricants	Lube oil, grease	Heavy metal organics
	Spacers	Mineral oils, detergents, surfactants	Hydrocarbon, alcohol, aromatics
	Cement slurries	Weighting materials	Heavy metals
	Cement mix	Salts, thinner, viscosifiers	Heavy metals
	Spent / contaminated water-based mud	Whole mud, mineral oil, biodegradable matter	Heavy metals, inorganic salts, biocides, hydrocarbons, solids/cutting, BOD, organics
	Spent bulk chemicals	Cement, bentonite, barite, viscosifiers, thinner, fluid loss reducers	Heavy metals, hydrocarbons, organics, solids
	Spent specialty products	H2S Scavengers	Zinc carbonates, iron oxides
		Defoamers	Hydrocarbons, silicon oils,
		Tracers	Potassium salts, radioactive materials
	Industrial refuse	Scrap, cleaning materials, packing material	Heavy metals, metals, plastics
	Energy sources	Batteries/generators	Acid, heavy metals, PCB,

			NO_X, SO_2, CO_X, carbon particulate
	Refrigerants	CFCs	CFCs
	Clean-up process equipment	Formation fines, oils, sludges, biodegradable organic matter	Inorganic salts, heavy metals, solids, organics, BOD, sulphides, corrosion, inhibitors, demulsifiers, wax inhibitors, scale inhibitors, detergents, PCB, hydrocarbons, phenols, PAH
	Industrial refuse	Used steel and plastic pipes, scrap iron wires	Metals, plastics

b) Waste Management and Disposal Methods

Waste (liquid and solid) associated with the exploratory drilling operations includes wastes derived from actual drilling activities (well cuttings, drilling mud, formation water, cement slurry residue, oil cushions etc.), those derived from maintenance of machines and equipment and the wastes derived from life at the rig site.

Management and disposal methods for drilling waste are largely dependent on the waste characteristics and regulatory requirements. Methodologies in use are typically limited by ecological, technical or economic factors. Responsible waste management can be accomplished through a hierarchical application of the practices of source reduction, reuse, recycling, recovery, treatment and responsible disposal (E&P Forum, 1993).

All wastes should be sorted, compacted where practical and stored according to type and disposal route. Hazardous or special waste should be stored in appropriate containers separately from non-hazardous wastes. Any transfer of waste from the rig should be adequately documented.

c) Drilling Waste Management

Where drilling waste treatment processes are undertaken, the process is usually aimed at reducing waste's toxicity and/or hazardous properties through chemical, physical, thermal or biological processes. Several methods exist under each of the mentioned broader treatment methods. Table 2.7 illustrates some of the approaches used for waste treatment.

Table 2.7: Waste management approaches

METHOD	DESCRIPTION AND APPLICATION
Surface discharge	▪ Used for low toxicity aqueous waste streams
Injection	▪ Involves pumping of waste fluids or slurries down a well into suitable underground formations for disposal. Wastes disposed of using this method include: produced water, process water, blowdown liquids, cooling water, and waste drilling fluids. ▪ Injection methods include mainly annular injection and downhole injection
Biotreatment methods	▪ Involves the use of indigenous and/or enhanced bacteria for the remediation/breakdown of contaminants, and applies mostly to organic compounds. Biotreatment methods include land farming, land spreading, compositing, biological treatment in tanks
Thermal treatment methods	▪ Available options include incineration, used as Alternative Fuels and Raw Materials (AFR) in cement kilns, open burning and thermal desorption systems
Solidification, stabilisation and Encapsulation	▪ Involves the mixing of the drilling waste with a cement-based mixture to achieve the immobilisation of the contaminants and/or the chemical stabilisation of the mixture
Landfills	▪ Designed to accommodate burial of large volumes of waste
Pits, and burial	▪ Use of earthen or lined pits for onsite management of drilling solids, evaporation and storage of produced water, workover/ completion fluids and emergency containment of produced fluids ▪ Once the operation concludes, pits are used to dispose of stabilised wastes from drilling and production processes.
Solvent extraction	▪ Use of solvents (CO_2, propane, hexane, triethylamine, methylene chloride, among others) to extract oil from oily solids or sludges

The method of choice for drilling waste management will be physical separation via screens/ shale shakers to remove large particles, and passing through a rotary bowl-decanting centrifuge to remove fine solid particles. Cleaned cuttings will be combined with subsoil and placed in trenches beneath the topsoil layer. Drilling mud cleaned of cuttings will be pumped back into the mud tanks for recirculation and reuse. Due to the scarcity of water in the project area and compliance with environmental/ resource sustainability, water utilized in the drilling process will be treated and recycled.

2.8 DECOMMISSIONING/ABANDONMENT

2.8.1 General activities

The proposed exploratory drilling programme will run for a short duration (approximately 120 days). Upon completion of the drilling and testing, the rig will be decommissioned and mobilised to another well site, then site decommissioning and restoration will be undertaken. The following are some of the activities involved in decommissioning:

- Removal and site clean-up;
- Well casing and disposal of waste according to laid-down guidelines on waste management and disposal

2.8.2 Demolition and site clean-up

If a hydrocarbon-bearing formation is not found or if the structure is not commercially viable, the well may be plugged and abandoned. The well is plugged with mechanical and/or cement plugs, which effectively seal the wellbore. The wellhead equipment will be removed and the drilling rig stripped down for transportation.

As far as abandoning the well site, this will entail removing of all foreign material such as hardcore, plastic liner, piping, fencing, and thereafter the land will be re-instated to its "as-found" state (re-vegetated). All clean-up activities are to be done in accordance with the agreement signed between the government and the proposer. The removal exercise shall be carried out with skill and diligence to avoid spillage of hazardous substances and damage to the environment.

If evaluation and testing shows that the reservoir is capable of commercial exploitation, the well will be temporarily abandoned with a completion string and wellhead in place, allowing later re-entry ready to be linked into the production and export facilities at a future point in time.

2.9 OIL SPILL CONTINGENCY PLANNING

A TKBV Oil Spill Contingency Plan shall be applied to the proposed drilling project. The contingency plan shall be based on the location and volume of potential spill and shall address the possibilities of well blowouts in the drilling emergency plan. The spill contingency plan shall clearly identify the actions necessary in the event of an oil spill, including communication network, the individual responsible for key personnel and the procedure for reporting to the authorities and arranging the logistics of extra labour needed for the clean-up exercise. Finally, the plan should also address the disposal procedure of contaminated wastes generated by a spill.

2.10 SUPPORT OPERATIONS

The drilling rig facility will need support in terms of food, water, fuel, equipment, and material supplies. The supply of these will be coordinated by the drilling contractor. Drilling operations will be coordinated by TKBV from its offices in Nairobi, assisted by their offices in London and Cape Town. Day-to-day drilling activities will be managed at the drilling location by a drilling supervisor based on site. There will be proper segregation of waste: wet food, general waste and metallic wastes derived from operation within the drilling sites. Each waste will be placed in properly labelled and covered containers or in colour-coded containers. The biodegradable waste from the kitchen will be placed in a waste pit covered with a protective net to restrict access by animals. Treatment of the waste will involve the application of lime to aid in degradation before covering the waste with soil.

There will be a clear mechanism for the separation and channelling of grey and black water from the washrooms facilities at the site. Soak pits will be established to cater for grey water from the bathrooms, kitchen and laundry facilities. The site will be fitted with septic tank systems that will collect black water. The septic tank will be emptied, by an approved external contractor, on regular basis and waste removed to an approved site.

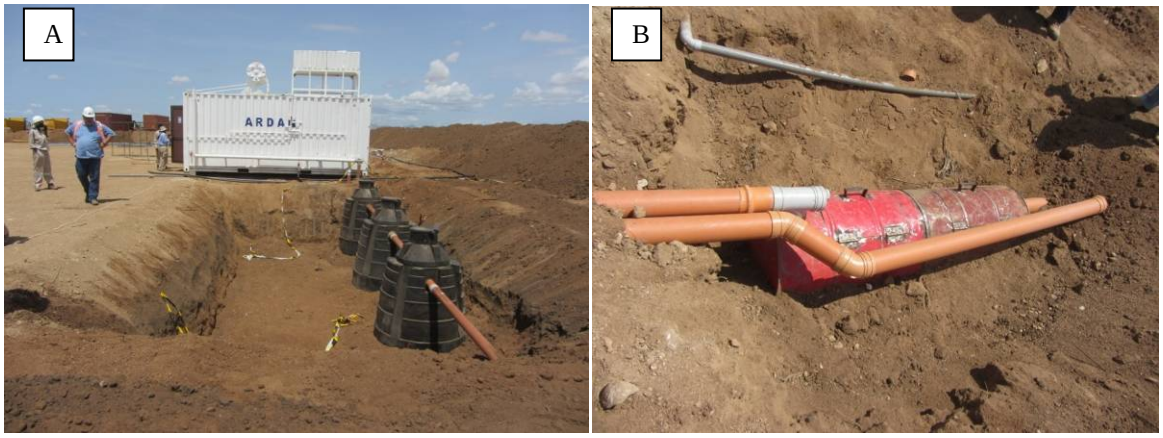


Plate 2.1: Shows on-going works at one of the proposed drilling sites a) Installation of septic systems and b) grease traps.

Grease traps will be installed along the drains leading away from the kitchen area. The grease will be collected and stored in drums for disposal in accordance with the waste management plan.

In addition, there will be a 'BIOBOX' type system, an onsite total waste recycling kit / system, to recycle a mix of grey water from showers, kitchens and laundry and black water from toilets to produce clear odourless and environmentally safe water.

Appropriate medical and transport facilities will be on site in the event of a medical emergency that would require immediate evacuation of personnel and a Medivac procedure will be in place.

CHAPTER 3:

ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

3.1 APPROACH TAKEN FOR THE EIA

The approach taken for the EIA with respect to the proposed exploratory oil and gas wells drilling included the following:

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

3.2 WORK EVALUATION FOR THE EIA

The work evaluation for the EIA was based on the NEMA requirements (section 1.6.2) and customised for the project to be undertaken (outlined in Chapter 2), as per the objectives and terms of reference outlined sections 1.8 and 1.9.

3.3 TOPICS ADDRESSED AND ISSUES CONSIDERED

Table 3.1: Topics addressed and issues considered

Topic or Context	Issues Considered	Rationale	Spatial Scope	Limitations of Methodology and Consequences for the Study Outcomes
Project Design, Technologies, Scale and Extent	• Project components • Equipment and machinery used • Personnel required • Facilities required • Management of fluid and solid wastes • Occupational and public health and safety • Supplies • Decommissioning	• Project components equipment/ machinery used, and facilities will have a number of environmental impacts related to construction, operations and decommissioning • Identification and prioritisation of factors requiring mitigation • Personnel and public safety during operations needs to be ensured	• Proposed drilling sites • Access roads • Selected camp sites, storage, repair and waste disposal and facilities	• None
Legislative and Regulatory Framework	• Legislation and regulations applicable to project design, execution, affected	• Need to ensure that all applicable laws are followed during project execution	• National legislation and regulations and authorities responsible	• None

	parties, and environmental protection	• Need to be conversant with the authorizations required for the regulatory approval of the project • Some legislation, regulations and guidelines have embedded mitigations relevant to the proposed exploratory oil and gas well drilling	• International best practices in Oil and Gas industry • Company EHS, CSR and Code of Conduct	
Geographical Aspects and Boundaries	• Description of the setting of the project area • Identification of key features	• Determination of the context within which the work is to be done • Assessment of the scale and extent of the work	• Project area	• None
Administrative set-up	• Key administrative units and their roles in the project area	• Establishment of jurisdictions • Identification of key administrative contacts • Role in emergency situations (e.g. security threats) and response	• Project area	• None
Communication and Transport	• Road infrastructure • Air transport network • Land, radio and mobile communications network	• These will determine the ease with which the project will be carried out • Identification of areas difficult to access • Inform on types of equipment/ machinery that will be required for the project • Assist in development of contingency/ emergency plans	• Project area	• None
Governmental, Non-Governmental and Community-Based Organisations	• Activities and projects carried out in the area	• Identification of potential local partners particularly with respect to CSR	• Project area	• None
Physiography and Geology	• Physiography and geology • Assessment of terrain ruggedness • Assessment of susceptibility to landslides, earthquakes, subsidence and floods • Active surface processes	• Establishment of baseline conditions • Identification of potentially difficult areas to work in – terrain and accessibility by vehicles • Identification of areas requiring extra safety precautions • Identification of hazard-prone areas	• Project area	• Samples collected are representative of project area
Soils	• Soil condition • Areas subject to wind and water erosion • Soil texture and drainage characteristics • Soil chemical quality • Assessment of rehabilitation	• Drilling rig and campsites construction considerations • Disposal of domestic effluents, drilling mud and drill cuts • Identification and prioritisation of factors requiring mitigation.	• Project area	• Mapping unit A8 was observed and field information collected but not sampled since sufficient data exists in literature and as reported in previous EIA document. All

	potential			other areas, within the project mandate, had representative samples collected and assessed.
Climate	• Temperature • Winds • Precipitation • Climate change	• Establishment of baseline conditions • Information useful for project elements such as cooling of temperature-sensitive equipment and installations • Personnel safety from adverse weather and related conditions e.g. flooding	• Access roads • Selected camp sites and rig and facilities	• No data available for trend analysis.
Air Quality	• Ambient air quality • Generation of dust, smoke, odorous fumes, and other toxic gaseous emissions • Release of gases which contribute to the greenhouse effect or ozone damage • Identification of project components that can lower air quality	• Establishment of baseline conditions • Assessment of project impacts on air quality • Identification and prioritisation of factors requiring mitigation	• Access roads • Selected camp sites and rig facilities	• Lack of air quality data on particulate loading, SO_x and NO_x or any other gaseous compounds in the area. Area is, however, rural and undeveloped so air quality can be assumed to be good and varies mainly due to variations in wind speeds (natural particulate loading).
Surface and Groundwater Resources	• Ground and surface water sources • Ground and surface water use • Planned water use • Changes in quantity • Identification of project components that can affect water use	• Establishment of baseline conditions • Potentially high demand for water by project group in a water scarce region • Planned water uses that affect water quantity may be blamed on the project proponent • Identification and prioritisation of factors requiring mitigation	• Selected camp sites and exploratory well drilling sites and facilities	• Inaccessibility of some areas due lack of roads and security concerns
Water Quality	• Current ground and surface water quantity • Current point and non-point sources of water pollution • Identification of project components that can potentially alter water quality	• Establishment of baseline conditions • Assessment of project impacts (e.g. effluent disposal and accidental spills) on water quality • Domestic effluent discharges • Identification and prioritisation of factors requiring mitigation	• Selected camp sites and exploratory well drilling sites and facilities	• Representative water samples were taken.
Terrestrial	• Vegetation cover	• Establishment of baseline	• Project area	• Old data, but the

Environment (Habitats, Flora and Fauna)	and classes • Habitat conditions • Floral and faunal communities which are uncommon, threatened or endangered • Environmentally sensitive localities • Wildlife corridors • Pastoral areas • Assessment of ecosystem state	conditions • Physical disturbance of terrestrial environment during operations, such as pit excavations, campsite construction and drilling rig operation • Determination of pre-project endangered communities • Assessment of areas requiring special precautions • Avoidance of human-human and human-wildlife conflicts • Identification and prioritisation of factors requiring mitigation		ecosystem structures are resilient to the effects of land degradation and deforestation. Land cover, for example, has become patchier, but the species diversity within the various ecotones remain the same.
Land Resources and National Parks	• Land use and designation • Existing activities in the area • Currently known and exploited mineral resources • Resource inventory	• The land resources are critical resources supporting livelihoods in the area. • Consideration of competing resources	• Project area	• None
Archaeological, Historical and Cultural Sites	• Identification of archaeological, historical, cultural sites	• Establishment of currently known sites • Avoidance of such sites during the drilling operation	• Project area	• None
Visual Aesthetics	• Aesthetic or high scenic value	• Establishment of baseline conditions • Assessment of project impacts such as vegetation clearance along cut lines and at campsites	• Proposed drilling sites • Access roads • Selected camp site and rig facilities	• None
Noise and Vibrations	• Ambient noise and vibration levels in the area • Potential sources of noise and vibrations produced by project operations • Noise impacts on terrestrial fauna	• Establishment of baseline conditions • Noise and vibrations impacts on the project workforce and the neighbouring public • Impacts on nearby structures and facilities	• Proposed drilling sites • Access roads • Selected camp site and rig facilities	• Lack of studies on noise and vibration impacts on fauna
Solid and Liquid Wastes	• Disposal of sewage or domestic wastes • Damage to environment through accidental spills of oil, fuel, cargo, waste or sewage	• Establishment of baseline conditions • Campsites will require to install waste discharge systems	• Campsites • Working areas	• None
Social Characteristics	• Level of services available • Social support information • Identification of key	• Quality of life baseline. • Ability to absorb change	• Project area	• Language barrier in some places • Reluctance to adopt new social practises

	community needs			
Economic Setting	• Area targeted for growth • Labour and employment	• Quality of life baseline • Development level baseline • Willingness to adopt new economic activities	• Project area	• Unwillingness by locals to adopt new economic opportunities
Health Setting	• Status of health facilities • Access to health services • Occupational health and safety hazards • Hazards due to the use, storage, disposal or transportation of flammable, explosive or toxic, substances • Emission of electromagnetic or other radiation which may adversely affect electronic equipment or human health • Traffic hazards	• Determination of the available health facilities in the area • Availability of officials in the available health facilities • Emergency preparedness	• Project area and the surrounding environment	• Inaccessibility of some areas
Security and Public Safety	• Public risks • Crime • Conflicts over resources • Fires	• Need to enhance security in the project area • Emergency preparedness	• Project area and the surroundings	• Some areas are considered as high risk areas in terms of security (inter-tribe conflicts-Turkana vs. Pokot)
Public Consultations	• Awareness creation on the project • Environmental pressures in the area • Expert and indigenous knowledge of the area	• Involvement of all stakeholders • Information gathering on environmental issues and concerns in the project area • Acceptability of the project	• Project area and surrounding environment	• Language barrier
Corporate Social Responsibility	• Community prioritisation of areas/projects for possible CSR assistance	• These were stated during the public consultations	• Project area	• High and sometimes unrealistic expectations
Mitigation Measures	• Mitigation hierarchy	• Avoiding or reducing at source • Abating on-site • Abating off-site • Repair or remedy • Compensate for loss or damage	• Proposed drilling site • Access roads • Selected camp sites and facilities	• None
Environmental Management Plan	• Effective mitigations specified for the topics addressed • Costs • Responsibility • Management	• Least possible interference with the environment • Compliance with principles, policies and legislation relating to conservation of environment • Decommissioning of	• Proposed drilling site • Access roads • Selected camp sites and facilities	• None

	• Relevant legislation and regulations • Decommissioning	campsites		
Environmental Monitoring Plan	• Parameters to be monitored • Personnel required • Training needs	• Ease of monitoring • Effectiveness of monitoring method • Cost of monitoring • Frequency	• Proposed drilling site • Access roads • Selected camp sites and facilities	• None

3.4 COLLECTION OF BASELINE DATA

3.4.1 Overview of Methods

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

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

Prior to the field study, a desktop study was conducted to review the available reports, and to design plans and maps in order to compile relevant biophysical and socio-economic information of the project area. The field study (detailed environmental impact assessment, community sensitization and social impact assessment, and development of mitigation measures and environmental management plan) was carried out from 23 June 2012 to 4 July 2012. Biophysical studies covered environmental aspects such as physiography, climate, hydrology, drainage, soils, geology/hydrogeology, vegetation, wildlife, and aquatic environment. The socio-economic environmental study covered information on issues such as population, literacy, social amenities (healthcare and schools), land use, land tenure, the social dimensions of well-being and income levels, water supply, sanitation levels and security, along with other pertinent issues. The field study also enabled cross-checking of the data compiled during the desktop study.

3.4.2 Physiography and Geology

A literature review and field verification of the physiography, regional geology and geological setting of the project area was undertaken and the potential of related hazards such as subsidence, landslides, earthquakes, soil erosion, etc., were assessed in relation to the proposed exploratory oil and gas wells drilling to be done in the area.

3.4.3 Soils

Primary soil data was obtained using the exploratory soil and agro-climatic zone map and report of Kenya (Sombroek *et al* 1982) and the National Oil Corporation of Kenya oil blocks map for boundary delineation. TKBV provided the geographical locations of the study area which were superimposed in existing base maps. The scale used for maps in this report was 1:50,000. Field data was collected through visual observation of soil units and profile pits descriptions. Profile pits descriptions assisted in classification of the soil units. Parameters assessed included soil texture, colour, structure, porosity, root distribution, drainage and soil depth. Surface conditions like stones and rock outcrops, meso-relief like presence of dunes, and micro-relief like presence of rills were also assessed. The surface physical characteristics were described to determine wind and soil-water erosion hazards, flooding, ponding and water-logging potential and accessibility of the units by equipment and vehicles. Also assessed was the rehabilitation potential of some units due to presence of salts. Surface-water infiltration tests were carried out using the double ring infiltration method. A GPS was used to geo-reference the sampling points. Soil samples were collected for survey, fertility, and soil moisture characteristics laboratory determination. Desktop work included soil map compilation and correlation to assign soil boundaries and harmonize the soil legend.

3.4.4 Climate

Wind and precipitation data was obtained from published literature and reports. In addition, wind data was supplemented by visual observations in the field.

3.4.5 Air Quality

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

3.4.6 Surface and Groundwater Resources

Baseline data for water potential and quality was assessed through literature review and analysis of water samples from boreholes and shallow wells, during the EIA fieldwork. The locations of all sampling points were determined and recorded using a GPS receiver.

3.4.7 Terrestrial Environment

Collection of baseline information for the terrestrial environment including floral and faunal components in the project area was based on field observations and supported by literature review. Considerations included inventories of habitat types and species (including local names, where provided); vegetation cover, classes, and dominance levels; presence of rare and endangered species; presence of ecological reserves, and any critical ecosystem components; assessment of existing habitat or biodiversity decline; and the potential impacts

of the exploratory oil and gas wells drilling project on the existing ecosystems, flora, and fauna. Field guidebooks were used in helping to confirm identified species. Habitats and animal encounters of interest were recorded, and photographs of species of mammals, birds, reptiles, amphibians and arthropods present at the time of observation were taken.

3.4.8 Aquatic Environment

Assessment of the riverine environments (along the perennial River Turkwel) included field-based identification of floral and faunal components and sampling, supported by literature review. River habitat types and species (common, rare, endemic and endangered) were noted.

3.4.9 Land Resources

A detailed desktop literature review was undertaken followed by visits to the proposed project area for primary field observations. Specifically the issues of concern were land use patterns in the area as well as available natural resources and heritage sites (including cultural and archaeological). Also considered was the potential impact of the exploratory well drilling and its infrastructure, particularly paving of access road in the area on land use patterns and their sustainability.

3.4.10 Visual Aesthetics

An assessment of visual aesthetics was done through field observations. The following issues were considered:-

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

3.4.11 Noise and Vibrations

The prevailing noise levels at Ngamia 1, which is the first test well drilling site in the proposed exploratory drilling programme, as well as the camp site and the surrounding areas, were measured using a dosimeter. The potential disturbance caused by noise levels during the exploratory well drilling and associated operation within the study area was taken into consideration during the fieldwork period. The mitigation of noise and vibrations arising from operations at the rig site, and occupational health and safety issues associated with exposure to noise and vibrations were addressed.

3.4.12 Solid and Liquid Wastes

Potential solid and liquid wastes that would be generated, and their possible impact as a result of the operations of the proposed project and the associated support facilities like residential areas and increased use of motor vehicles in the area were assessed, and mitigation measures suggested. An assessment of methods to be employed in solid waste and effluent management in the proposed project was made and implementation suggestions recorded. The current methods of waste management in the project area were also noted.

3.4.13 Public Consultations and Socio-Economics

Extensive public consultations were carried out in diverse parts of the project area (Table 3.2) with the following aims:

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

Table 3.2: Order of meetings held in Block 13T

ORDER OF KEY MEETINGS HELD IN BLOCK 13T				
	DAYS & DATES	**TIME (Start/End)**	**AREAS COVERED**	**DISTRICTS**
1.	SATURDAY 23/06/012	9.00 A.M 1.00 P.M	Lochwaa Location, Lokichar Division	TURKANA SOUTH
2.	SUNDAY 24/06/2012	1:00 P.M 3:00 P.M	Locher-emoit Village, Lochwaa Location, Lokichar Division	TURKANA SOUTH
3.	MONDAY 25/06/2012	10.00AM 12.45 P.M	Lokapel Sub-Location, Katilu Location, Katilu Division	TURKANA SOUTH
4.	MONDAY 25/06/2012	1:00 P.M 2:30 P.M	Kanaodon Sub-Location, Katilu Location, Katilu Division	TURKANA SOUTH
5.	TUESDAY 26/06/2012	10:00 P.M 1:00 P.M	Kalemng'orok Sub location, Kaputir Location, Kainuk Division	TURKANA SOUTH
6.	WEDNESDAY 27/06/2012	9:00 A.M 12:35 P.M	Lokichar Location, Lokichar Division	TURKANA SOUTH

Other social and economic aspects relating to the project area, including livelihoods and cultures, education and health, among others, were also assessed. The methodologies employed include review of available literature, public meetings and consultation with local residents and their leaders as well as and administration of formal questionnaires and interviews with interested parties and at household level.

3.4.14 Health and Public Safety

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

The main issues assessed included:

- Sources of water;
- Types of sewage disposal/facilities;
- Types and quality of housing;
- Refuse disposal;
- The general cleanliness of the environment;
- Availability of health facilities;
- Interaction between environment and health; and

- Potential health impacts related to the project.

3.4.15 Key Informant Interviews

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

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

3.5 DEVELOPMENT OF THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)

3.5.1 The Five- Step Process

The general methodology utilized for impact assessment is a five-step process starting with identification of project activities (Chapter 2 and Table 3.3 below) that may interact with the environment. This is followed by identification of environmental (physical and biological aspects) and social (human aspects) parameters and existing pressures from the environmental baseline study (Chapter 5). The third step involves identification and prediction of any potential positive or negative impact that may result from the defined project activities during its life cycle, based on the impact assessment criteria and rating scales outlined below. In the fourth step, the predicted impacts are then evaluated using the objective significance ranking process. In the fifth step, the cumulative impacts are assessed. This data is then used to develop the Environmental Management Plan.

Table 3.3: Impact assessment criteria and rating scales

CRITERIA	RATING SCALES
Intensity (expected size or magnitude of impact)	**Negligible** **Low** - where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected **Medium** - where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected **High** - where natural, cultural or social functions and processes are altered to the extent that it will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected.
Extent (predicted scale of impact)	**Site-specific** **Local** (immediate surrounding areas) **Regional** **National**
Duration (predicted lifetime of impact)	**Short-term** - 0 to 5 years **Medium term** - 6 to 15 years **Long term** - 16 to 30 years - where the impact will cease after the operational life of the activity either because of natural processes or by human intervention

CRITERIA	RATING SCALES
	Permanent - where mitigation either by natural process or human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability (likelihood of impact occurring)	**Improbable** – where the possibility of the impact materialising is very low. **Probable** – where there is a good possibility (<50% chance) that the impact will occur. **Highly probable** – where it is most likely (50-90% chance) that the impact will occur. **Definite** – where the impact will occur regardless of any prevention measures (>90% chance of occurring).
Status of impact	**Positive** - a "benefit" **Negative** - a "cost" **Neutral**
Degree of confidence (specialist's level of confidence in predictions +/or information on which it is based)	**Low** **Medium** **High**

3.5.2 Assigning Significance Ratings

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

Significance is described as follows:

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

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

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

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

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

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

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

CHAPTER 4

POLICY, LEGAL, AND REGULATORY FRAMEWORK

4.1 THE CONSTITUTION OF KENYA, 2010

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

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

4.2 THE POLICY FRAMEWORK

4.2.1 Environment and Development Policy

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

authority.
It outlines the following principles, goals and objectives:

Principles

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

Overall Goal

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

Specific Goals

a) To incorporate environmental management and economic development as integral aspects of the process of sustainable development.
b) To promote maintenance of a quality environment that permits a life of dignity and well- being for all.
c) To encourage sustainable use of resources and ecosystems for the benefit of the present generations, while ensuring their potential to meet the needs of future generations.
d) To promote maintenance of ecosystems and ecological processes essential for the functioning of the biosphere.
e) To promote the preservation of genetic resources, biological diversity, their cultural values and their natural heritage.
f) To incorporate indigenous knowledge, skills, and interests for effective participation

of local communities in environmental management and sustainable development.

Objectives

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

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

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

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

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

The broad objective of the national energy policy is to ensure adequate, quality, cost-effective and affordable supply of energy to meet development needs, while protecting and conserving the environment. The specific objectives are to:

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

4.2.4 Land Policy (Sessional Paper No. 3 of 2009)

The overall objective of the National Land Policy is to secure land rights and provide for sustainable growth, investment and the reduction of poverty in line with the Government's overall development objectives. Specifically, it seeks to develop a framework of policies and laws designed to ensure the maintenance of a system of land administration and management that will provide all citizens with:

a) The opportunity to access and beneficially occupy and use land;

b) An economically, socially equitable and environmentally sustainable allocation and use of land;

c) Effective and economical operation of the land market;

d) Efficient use of land and land-based resources; and

e) Efficient and transparent land dispute resolution mechanisms.

4.2.5 Mining Policy

The National Mineral Resources and Mining Policy is currently at an advanced stage of being adopted. In tandem with this process, the Government has developed new mining legislation (currently The Mining and Minerals Bill, 2011) 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 proposed new mining legislation has been harmonised with existing environmental legislation. In particular, mining companies will be required to comply with the requirements of the Environmental Management and Co-ordination Act and other applicable environmental legislation and, the new legislation will provide that mining licences may not be granted unless the applicant has obtained an Environmental Impact Assessment ('EIA') Licence.

4.2.6 Health Policy

The Kenya Health Policy Framework (1994) sets out the policy agenda for the health sector up to the year 2010, so this is likely to be reviewed in the near future. The policy includes strengthening of the central public policy role of the Ministry of Health (MoH), adoption of an explicit strategy to reduce the burden of disease, and definition of an essential cost-effective

healthcare package. To operationalise this Health Policy Framework Paper, the National Health Sector Strategic Plan (NHSSP, 1999-2004) was developed in 1994. The strategic plan emphasized the decentralisation of healthcare 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. The ensuing NHSSP II (2005 – 2010) was intended to keep people well and to promote the involvement of communities in their own healthcare. Major players in the health sector include the government represented by the Ministry of Health and the Local Government, private sector and non-governmental organisations (NGOs). The organisation of Kenya's healthcare delivery system revolves around three levels, namely the MoH headquarters, the provinces and the districts. The headquarter sets policies, coordinates the activities of NGOs and manages, monitors and evaluates policy formulation and implementation. The provincial tier acts as an intermediary between the central ministry and the districts. It oversees the implementation of health policy at the district level, maintains quality standards and coordinates and controls all district health activities. In addition, it monitors and supervises district health management boards (DHMBS), which supervise the operations of health activities at the district level.

4.2.7 Economic Recovery for Wealth and Employment Creation Strategy

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

a) Expanding and improving infrastructures;
b) Reforms in Trade and Industry;
c) Reforms in forestry;
d) Affordable shelter and housing;
e) Developing arid and semi-arid lands; and
f) Safeguarding environment and natural resources.

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

4.2.8 Kenya Vision 2030

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

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

The economic, social and political pillars of Kenya Vision 2030 are anchored on macroeconomic stability, continuity in government reforms, enhanced equity and wealth-

creation opportunities for the poor, infrastructure, energy, science, technology and innovation, land reform, human resources development, security, as well as public sector reforms.

The foundations for the Vision are:

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

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

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

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

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

f) **Land Reform**: Land is a vital resource for the socio-economic and political developments set out in the Vision. It is recognized that respect for property rights to land, whether owned by individuals, communities or companies, is key to rapid economic growth (A national land use policy has now been created to enable this growth) (section 4.2.4).

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

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

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

be found through the exploitation of geothermal power, coal, and renewable energy sources.

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

4.3 KENYA LEGISLATION AND REGULATIONS

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

The purpose of this legislation is to regulate the Government's negotiation of petroleum agreements relating to oil exploration, among other things. The Act, its regulations, and the terms and conditions of the petroleum contract, together govern oil operations. The Minister has the power to make regulations for the conservation of petroleum resources, the safety measures to be taken on site, environmental protection and the prevention of pollution, waste and accidents. The contractor[1]is expected to take necessary measures to conserve petroleum and other resources, as well as protect the environment and human life. Should the rights of the owner or occupier be infringed in the course of the petroleum operations, the contractor must pay a fair and reasonable compensation (Sections 4, 6, 9, 10). In our view, precedent cases of compensation under similar conditions, where they exist, should be considered as guidelines to the level of compensation.

4.3.2 The Petroleum (Exploration and Production) Regulations

The existence of a petroleum agreement or the issue of a permit under the parent Act does not authorize the contractor or the grantee to occupy or exercise any rights in a) any burial land in the locality of any church, mosque or other places of worship; b) any area within fifty metres of any building in use, or any reservoir or dam; c) any public road; d) any area within a municipality or township; d) any land within one thousand metres of the boundaries of any aerodrome; e) any land within a thousand metres of the boundary of any aerodrome under the Civil Aviation Act (Cap. 376) and f) any land declared to be a national park or national reserve under the Wildlife (Conservation and Management) Act. However, directional drilling into the subsurface from land adjacent to the mentioned areas is permitted with the consent of the competent authority (Regulation 6).

It relates to interference with sensitive cultural, natural heritage sites, exhaust emissions from vehicles, machines and equipment such as generators, etc., fossil fuel emissions from nuclear power sources, and disturbance of flora and fauna.

4.3.3 The Explosives Act, Cap. 115

There are restrictions on storage and possession of explosives. A permit is required to purchase and use blasting materials as well as to convey explosives within Kenya. An inspector of explosives may prohibit, or restrict the use of explosives in places where

[1] "Contractor" here means the individual(s) or company undertaking the work or project.

blasting may endanger life or property. The use or transport of explosives, in the working of a mine, quarry, excavation or other project is forbidden, unless an explosives manager has been appointed and the inspector notified in writing. The explosives manager is responsible for the safety and security of all explosives used, transported or stored, until they are handed to the blaster for use. He is also responsible for the safety of every person who may be employed on the project, whether under his direct supervision or not (sections 6, 7, 11, 13).

This statute relates to the safety of the project workers in the workplace and the security of property, and covers developmental activities that may result in adverse effects on the environment.

4.3.4 The Energy Act, No. 12 of 2006

Anyone in the petroleum business must comply with the Kenya Standard or other approved standard on environment, health and safety and in conformity with the relevant laws in that regard. A person transporting petroleum by inland waters, pipeline or any other mode must institute measures to ensure that the mode of transportation is safe. Anyone engaged in any licensed undertaking must notify the Energy Commission of any accident or incident causing loss of life, personal injury, explosion, oil spill, fire or any other accident or incident causing significant harm or damage to property or to the environment (Sections 95, 98, 117). All petroleum equipment must conform to the relevant Kenya Standard, and where that does not exist, the relevant international standards approved by the Kenya Bureau of Standards shall apply.

It relates to the health and safety of the project crew and the environment. TKBV will need to conform to the relevant local and/or international standards and comply with the applicable statutes on environmental, health and safety standards.

4.3.5 The Radiation Protection Act, Cap. 243

This is the only legislation in Kenya remotely dealing with nuclear resources. It provides for the protection of the public and radiation workers from the dangers arising from the use of devices or material capable of producing ionizing radiation. Irradiating devices or radioactive material may not be imported without a licence (Section 8). Kenya is a member of the International Atomic Energy Agency (IAEA) and is signatory to a number of international agreements pertaining to the code of conduct in the use of nuclear technology, including the Convention on the Physical Protection of Nuclear Material (2002), the Joint Convention on Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and the Code of Conduct on the Safety and Security of Radioactive Sources. Under the Constitution of Kenya these form part of the law of Kenya. NEMA has the mandate to establish the standards for the setting of acceptable levels of ionising and other radiation in the environment (Section 104, EMCA). The Radiation Safety Bill, 2009, once enacted into law, will incorporate the IAEA's Basic Safety Standards.

This Act relates to the nuclear source that will be used to power the well-logging equipment when drilling the well(s).

4.3.6 The Public Health Act, Cap. 242

This legislation focuses on securing and maintaining health. It is the duty of every local authority to take measures to prevent any pollution dangerous to the health of any supply of water which the public uses for domestic purposes. They must purify the water supply should it become polluted, and take appropriate action against any person polluting any such water supply or any stream so as to cause a nuisance or danger to health (Section 129). They are also obligated to take measures to maintain the locality in clean and sanitary condition and to prevent or remedy any nuisance that may cause injury to health (Section 116). The Minister may make rules (a) as to the standard or standards of purity of any liquid which may be discharged as effluent after treatment, (b) to establish or prohibit trade premises or factories likely to cause offensive smells, or (c) to discharge liquid or other material prone to cause such smells, or to pollute streams, or are likely in any way to be a nuisance or dangerous to health (Section 126).

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

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

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

This covers activities that may be a hazard to the health and safety of the project workers due to accidents caused by, for instance, vehicle collisions, collisions with animals, injury involving equipment, as well as emissions from vehicles and equipment.

4.3.8 The Water Act, Cap. 372

The Minister is mandated to prescribe a system for classifying water resources in order to determine resource quality objectives of each water resource. It is an offence to wilfully obstruct, interfere with, divert or obstruct water from any watercourse or water resource, or to negligently allow such acts, or to throw any dirt, effluent, trade waste or other offensive or

unwholesome matter or thing into or near any water resource in such a way as to cause or be likely to cause pollution of the water resource (Sections 12, 44 and 94).

This relates to waste generation – solids, effluents and oils at camp and work areas – and its safe discharge.

4.3.9 The Water Resources Management Rules, 2007

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

This applies to the safe discharge of waste emanating from camp and worksites.

4.3.10 The Local Government Act, Cap. 265

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

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

4.3.11 The Physical Planning Act, Cap. 286

The statute establishes Physical Planning Liaison Committees to determine development applications relating to industrial location, dumping sites or sewerage treatment, which may have adverse impact on the environment. If a local authority is of the opinion that a proposed

development, dump site, sewerage treatment plant, quarry or other development activity will impact on the environment adversely, it will require the applicant to submit an environmental impact assessment report for consideration (Section 36).

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

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

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

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

4.3.13 The National Museums and Heritage Act, Cap. 216

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

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

4.3.14 The Land Act, 2012

The National Land Commission (established under the National Land Commission Act, 2012) is mandated to take appropriate action to maintain land that has endangered or endemic species of flora and fauna, critical habitats or protected areas. The Commission is required (in consultation with existing conservation bodies) to identify ecologically sensitive

areas that are within public lands, and demarcate or take any action on those areas to prevent environmental degradation and climate change. The Commission may make rules and regulations for sustainably conserving land-based natural resources. These may include: measures to protect critical ecosystems and habitats; incentives for communities and individuals to invest in natural resource conservation programmes that generate income; measures to facilitate the access, use and co-management of forests, water and other resources by communities who hold customary rights to them; procedures on involving stakeholders in managing and utilizing land-based natural resources; and measures to ensure benefit-sharing for the affected communities. Disputes arising from matters provided for under this law may be referred to the Land and Environment Court, which has exclusive jurisdiction to handle them under this statute (Sections 11, 19, 128, 150).

This relates to the project's compliance with the laws and regulations regarding the protection of the environment generally.

4.3.15 The Penal Code, Cap. 63

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

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

This relates to compliance with the law as regards air and water pollution from site activities.

4.4 NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY - ACT AND REGULATIONS

4.4.1 The Environmental Management and Co-ordination Act, 1999

The Environmental Management and Co-ordination Act, 1999, provides for the establishment of an appropriate legal and institutional framework for the purpose of managing the environment and matters connected with it. The National Environment Management Authority (NEMA) is established under section 7 of the Act. Its mandate is to monitor the operations of industries, projects or activities to determine their immediate and long-term effects on the environment. TKBV, being a project whose activities fall within the ambit of the Act, is therefore subject to its provisions. The Act (Part VIII) lays down provisions pertaining to environmental quality standards. It establishes a Standards and Enforcement Review Committee whose broad functions are to (a) advise NEMA on how to establish criteria and procedures to measure water and air quality and (b) issue standards and guidelines for the safe and proper disposal of waste (Sections 70, 71, 78, 86). Where Kenya is a party to an international convention, treaty or agreement on the management of the environment, NEMA must initiate legislative proposals to give effect to them (Section

124).The law does not permit anyone to deposit any substance in a lake, river or wetland or in, on or under its bed, if that substance is likely to cause adverse environmental effects. NEMA may prescribe measures to ensure that the biological resources in place are preserved, issue guidelines to promote the conservation of the various terrestrial and aquatic systems, and protect species, ecosystems and habitats threatened with extinction. Any area of land, lake or river may be declared a protected natural environment in order to promote and preserve specific ecological processes, natural environment systems or species of indigenous wildlife. It is an offence to discharge pollutants into the aquatic environment. No one is permitted to discharge any hazardous substance, chemical, oil or mixture containing any oil into any waters or any other parts of the environment. Noise must not be emitted in excess of the laid-down standards (Sections 42, 43, 51, 54, 71, 72, 93, 102, 108).

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

4.4.2 The EIA Guidelines and Administrative Procedures

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

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

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

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

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

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

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

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

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

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

These Regulations aim to ensure the sustainable use of wetlands for ecological and aesthetic purposes and in addition seek to prevent and control pollution and siltation as well as other activities that may degrade the environment. All wetland resources must be used in a sustainable manner compatible with the continued presence of wetlands and their hydrological, ecological, social and economic functions and services. Some permitted uses of wetlands include cultivation, fishing (subject to the Fisheries Act), small-scale fish farming, domestic consumption, grazing, and hunting (subject to the Wildlife (Conservation and Management) Act). Areas that have national significance may be declared to be protected wetlands due to their biological diversity, ecological importance, natural heritage, aesthetic value or landscape. Environmental Restoration orders may be given to allow a wetland, riverbank or lakeshore that has been degraded to regenerate. Local authorities are mandated to make byelaws to manage solid waste and wastewaters on lakeshores and

riverbanks in accordance with the Public Health Act, Cap. 342 (Regulations 4, 5, 8, 11, 16, 17, 22, 24).

This relates to interference with oases and their ecological structure and function, grazing and other economic activities close to the project area, as well as visual aesthetics and interference with the natural heritage.

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

The Regulations prohibit the making of loud, unreasonable, unnecessary or unusual noise or excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of other people and the environment. There are laid-down permissible noise levels which no one may exceed unless the noise is reasonably necessary to preserve life, health, safety or property. Any person intending to engage in any commercial or industrial activity likely to emit noise or excessive vibrations must carry out that activity within the prescribed levels (Regulations 3-5, 11, 20).

These regulations relate to noise and vibrations from the use of vehicles, machines and equipment such as generators, etc.

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

Every person in Kenya is entitled to a clean and healthy environment and is obligated to safeguard and enhance that environment. Internal combustion engines are subject to inspection and must pass tests to show that they comply with the standards and requirements for the control of air pollution or contamination. It is an offence to operate an internal combustion engine which emits smoke or other pollutant in excess of the emission standards. Fossil fuel emissions are defined in the Regulations as those that cause air pollution “from the use of any fossil fuel where the constituent properties are not properly combusted in an internal combustion engine and are emitted out as toxic carbon gases and particulates matter”. NEMA may approve any substance to be used as a fuel catalyst if it improves fuel economy, enhances combustion and reduces harmful emissions that adversely affect human, animal and plant health and degrade the environment. The cost of clearing the pollution through fuel emission is borne by the polluter (Regulations 4, 7, 12).

This relates to vehicular exhaust emissions that could be potentially harmful to the project crew as well as to other persons in the vicinity. It includes all other equipment that emits fumes. These regulations do not apply to flaring during well testing. Currently Kenya has no legislation or regulations on flare pit construction specifications. TKBV will need to take the best course available to minimize harmful toxic emissions to the environment. This may involve the application of international standards in this regard, as well as consideration of all relevant legislative and regulatory provisions on environmental protection and prevention of pollution - more particularly the Petroleum (Exploration and Production) Act and Regulations, the Energy Act and the Radiation Protection Act.

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

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

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

4.5 INTERNATIONAL PRACTICES, STANDARDS AND CONVENTIONS

4.5.1 International Best Practices

The International Association of Oil & Gas producers (OGP) is a unique global forum in which members identify and share best practices to achieve improvements in every aspect of health, safety, the environment, security, social responsibility, engineering and operations. Industry guidelines, based on information from OGP, International Association of Drilling Contractors, and ISO14001, have become widely accepted as providing a strong basis for preparing regulations, policies and programmes to minimize the impact that these operations have on the environment. The E&P Forum (Oil Industry International Exploration and Production Forum), jointly with UNEP, published a document on the best approaches to achieving high environmental performance and standards worldwide. Within the framework provided, various technical reviews and guidelines already available from other relevant sources can be applied. It developed a common management system to deal with health, safety and environmental (HSE) issues. Its key elements are as follows:

1. Leadership and commitment

It is vital to have a senior management committed to ensuring that the management system is developed and maintained, and that the company's policy and strategic objectives are achieved. Management should ensure that the policy requirements are adhered to during operations and support local initiatives to protect health, safety and the environment. Management commitment will involve delegating responsibility, providing resources and motivation, and ensuring participation and open communication.

2. Policy and strategic objectives

The HSE management system requires that the company's policies and strategic objectives are well defined and documented. The policies must be relevant and consistent and should be on a par with other company policies and objectives. Here also, commitment to carrying out the company's policies towards protecting people's health and safety as well as the environment, is vital, as are responses to community concerns. Partnerships with stakeholders are just as essential. Where relevant legislation and regulations do not exist, the company must commit to apply responsible standards.

3. Organization, resources and documentation

Organization of personnel, resources and documentation make for a sound HSE management system. Roles must be clearly defined from the beginning to the end of the project. Appropriate periodic training and review will enhance competence and effective performance.

4. Evaluation and risk management

Procedures must be in place to identify on a regular basis the dangers and effects of the undertaking. This identification should apply to all the activities from the start to the decommissioning of the project. Environmental impact assessment study becomes a suitable criterion to gauge what is acceptable, particularly in the absence of appropriate legislative control.

5. Planning

Environmental planning and compliance programmes should include ways and means of preventing or minimizing adverse impacts, as well as enhancing the beneficial impacts that may accrue. It is also imperative that internal standards and targets are set for compliance. A detailed decommissioning plan should be considered in the initial planning of the project, and a plan to restore the environment should be developed before the end of the project.

6. Implementation and monitoring

The purpose of monitoring is to ensure that the results forecast at the planning stage are being achieved, and where the contrary is the case, to identify the cause and take action to correct the situation. Managers must strictly adhere to legal and statutory requirements and controls as well as the company's own commitment to responsible management of the environment. Monitoring will indicate whether or not commitments and compliance with legal and corporate requirements are being met. It also provides the basis for audit.

7. Audit and review

This management tool enables the senior management to regularly assess its performance, effectiveness and suitability. It also provides an opportunity to obtain feedback on the effectiveness of the organization and its environmental performance. In addition, it is useful

in verifying compliance with monitoring programmes and ensuring that plans, procedures and standards are working effectively.

Other renowned national and international standards for best practice, particularly the ISO 9000 and 14000 series, also offer management systems models that can be used by companies to enhance their environmental performance.

4.5.2 International Conventions

The Kenya Constitution provides that the general rules of international law shall form part of the laws of Kenya, as shall any treaty or convention that she ratifies (Article 2). Kenya has ratified or subscribed to a number of international conventions that relate to the environment within her borders (Table 4.1).

Table 4.1: International conventions that Kenya has ratified

	Convention	Entry into force	Date of ratification
1.	African Convention for the Conservation of Nature and Natural Resources, Algiers, 1968 Parties must conserve their natural resources – soil, water, flora and fauna – ensuring that they are used and scientifically developed in a manner that will benefit their people.	16 June, 1969	12 May, 1969 (accession)
2.	African Convention on the Conservation of Natural Resources (Revised Version) Maputo, 2003 Parties must ensure that developmental and environmental needs are met in a sustainable, fair and equitable manner.	11 July, 2003	17 December, 2003 (signature)
3.	Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971 It provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	21 December, 1975	5 October, 1990
4.	Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972 It establishes a system of collective protection of cultural and natural heritage of outstanding universal value.	17 December, 1975	1 July, 1983
5.	Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973 It aims at ensuring that international trade in specimens of wild animals and plants does not threaten their survival.	1 July, 1975	13 March, 1979
6.	Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979 It aims to protect those species of wild animals that migrate across or outside of national boundaries. Parties must protect them, conserve and restore their habitat, mitigate obstacles to migration and control other factors that might endanger them.	1 November, 1983	
7.	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Basel, 1989 It aims at protecting human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous wastes.	5 May , 1992	2000 (accession)
8.	Amendments to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Geneva, 1995 The amendment prohibits exports of hazardous wastes destined for final disposal or recycling purposes from Annex VII countries to non-Annex VII countries (Annex VII not yet in force).	5 May, 1992	9 September, 2009 (acceptance)
9.	United Nations Framework Convention on Climatic Change, New York, 1992 It sets an overall framework for intergovernmental efforts to tackle the challenge posed by climatic change, recognizing that the climate system can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.	21 March, 1994	30 August, 1994
10.	Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 1997 It sets binding targets for 37 industrialized countries and the European Community as well as for countries undergoing the process of transition to a market economy in order to reduce greenhouse gas emissions.	16 February, 2005	2005 (accession)
11.	Convention on Biological Diversity, Rio de Janeiro, 1992 It aims at granting the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the use of genetic resources.	29 December, 1993	27 June, 1994
12.	Stockholm Convention on Persistent Organic Pollutants, Stockholm, 2001 It protects human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife. It requires Parties to take measures to eliminate or reduce the release of persistent organic pollutants into the environment.	17 May, 2001	24 September, 2004
13.	Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, Bamako, 1991 It binds Parties to take appropriate legal, administrative and other measures within the area under their jurisdiction to prohibit the import of all hazardous wastes, for any reason, into Africa from non-Contracting Parties.	22 April, 1998	17 December, 2003 (signature)

4.6 TULLOW OIL PLC POLICIES

Think Environment
Think Health
Think Safety
Think Forward

TULLOW Oil plc

Environment, Health and Safety Policy

At Tullow Oil, we expect everyone to *Think* about their role in managing Environmental Health and Safety (EHS) risks that exist in our business and, in particular, within their own area of responsibility and influence.

To help us manage these risks we require everyone connected with our activities to:

- **Respect** our stakeholders and our values
- **Reflect** on lessons learned and their actions
- **Protect** the environment and each other

By following these principles and ***Thinking Forward*** we will ensure that EHS risk management forms an integral part of our day-to-day working practices and alignment with the EHS Vision.

To achieve this, we commit to:

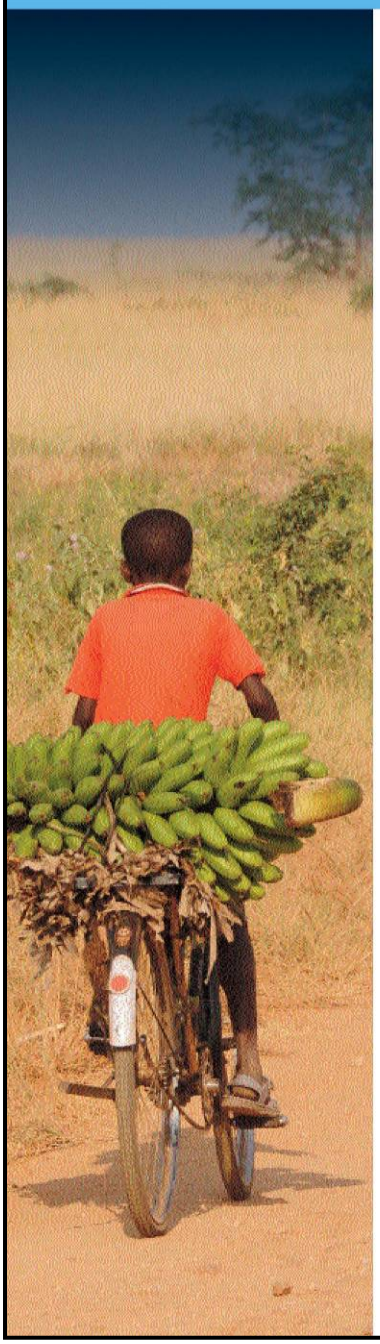
- Proactively manage EHS risks and plan our operations taking those risks into account;
- Comply with the requirements of all applicable EHS laws and regulations, and apply industry best practice where legislation is lacking;
- Invest in building a competent and capable organisation to deliver consistently high levels of operational and EHS performance, supported by strong visible EHS leadership;
- Prevent pollution and minimise other adverse impacts on the environment and the local communities where we operate;
- Maintain a safe working environment by implementing safe systems and taking responsibility for the health and wellbeing of our staff and contractors;
- Ensure those working on our behalf adopt similar high standards of EHS;
- Monitor our progress against strong EHS objectives and targets to continually improve our performance.

In adhering to this Policy, everyone in Tullow or working on our behalf is empowered to stop any activity they regard as irresponsible or unsafe.

Aidan J Heavey
Chief Executive Officer, Tullow Oil plc
May 2012

T-EHS-POL-0001 Rev9

Corporate social responsibility policy



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

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

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

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

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

Aidan J Heavey

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

TO-EHS-POL-001-Rev7

TULLOW OIL plc

CHAPTER 5:

BASELINE ENVIRONMENTAL AND SOCIAL PARAMETERS

5.1 INTRODUCTION

This chapter provides a description of the current environmental and socio-economic situation in the project area (Figure 5.1) against which the potential impacts of the proposed exploratory wells drilling programme in the project area can be assessed, and any future changes monitored and rectified if necessary. It provides details of the desktop studies, field survey, and results from laboratory analyses of samples collected in the field which are based on the methods applied as outlined in Chapter 3, in relation to the possible exploratory well sites and the surrounding areas which may be directly or indirectly impacted upon by the proposed project and the associated activities.

5.1.1 Project Location and Layout of the Chapter

Block 13T is located in Northern Kenya and straddles four administrative districts, namely, Central Pokot, Turkana Central, Loima and parts of Turkana South Districts. A detailed description of the project location is provided in Chapter 1, Section 1.4.

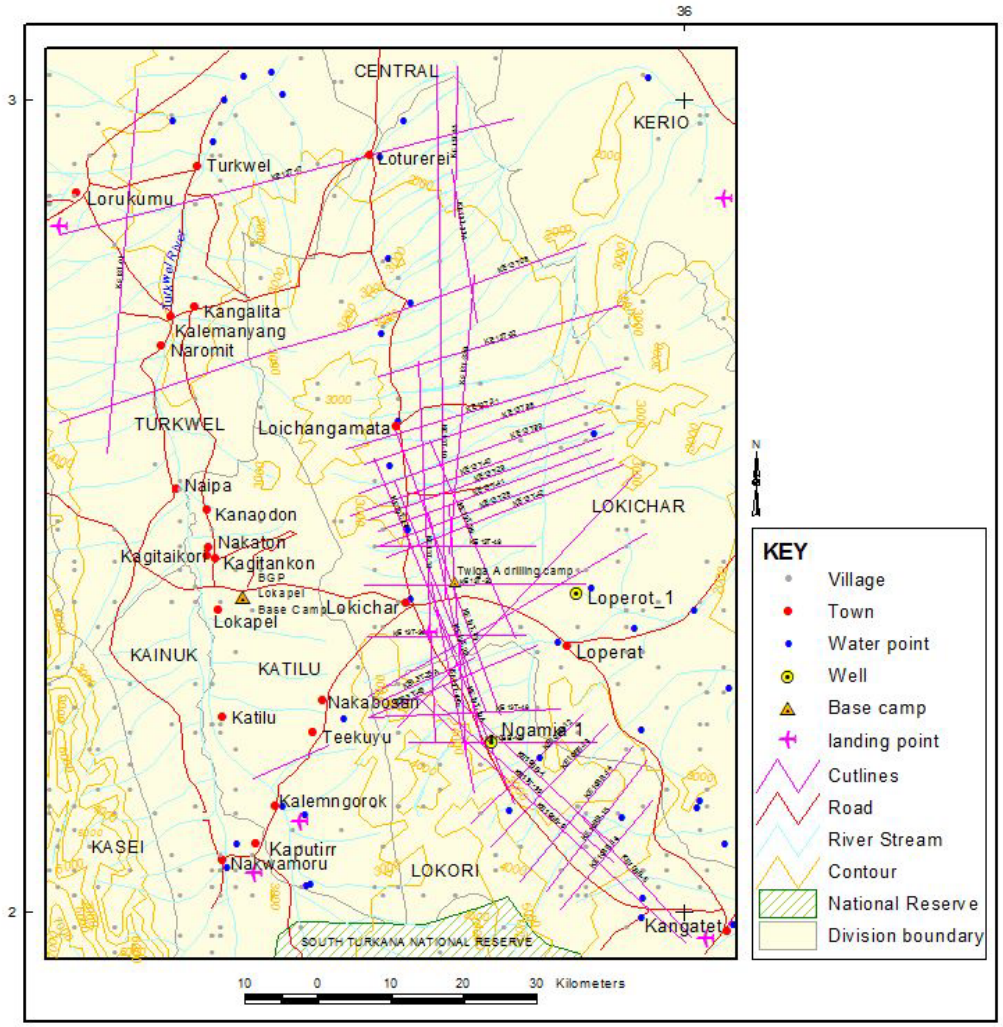


Figure 5.1: Location of the project area.

The baseline draws from both primary and secondary data sources. Primary data sources involved the visit to the project area and undertaking a baseline survey (Table 5.1), while secondary sources of data include various research papers and published literature including social and economic data from Government reports. It should be noted that some of the information in this chapter might be limited due to lack of previous published research on the biophysical and socio-economic aspects of the project area.

Table 5.1: Chapter layout

Major Sections in this Chapter	Issues Addressed
Introduction	• Project Location and Layout of the Chapter • Geographical Aspects and Boundaries • Administrative Set-up • Communications and Transport • Government, Non-Governmental and Community-Based Organisations
Environmental Baseline Survey	• Physiography and Geology • Soils • Climate • Air Quality • Surface and Groundwater Resources • Water Quality • Terrestrial Environment • Aquatic Environment • Land Resources and Parks • Archaeological, Historical and Cultural Sites • Visual Aesthetics • Noise and Vibrations Solid and Liquid Wastes
Environment-related Social and Economic Baseline	• Demography • Education • Housing • Energy Sources • Land Tenure Systems • Labour Force • Livestock and Crop Production • Trade, Commerce and Industry • Health Settings • Security and Public Safety • Community Views and Concerns • Corporate Social Responsibility

5.1.2 Geographical Aspects and Boundaries

The project area lies in the north-western part of Kenya (Figure 5.1), with its most prominent features being the Turkwel River that runs south to north, dissecting the project area into two halves, and the associated hills and ranges that run parallel to the river on either side, marking the western and eastern boundaries of the watershed of the Turkwel River, as well as those of the project area to the west.

5.1.3 Administrative Structure

The proposed exploratory wells drilling sites in Block 13T will be undertaken largely in Turkana South District and areas in east of Turkwel River in Turkana County. Counties are the newly created second tier of governance after the national government. The Counties will be fully operational after the next general election scheduled for March 2013. The

proposed project sites are within Turkana South Constituency and falls in the local government authority of Turkana County Council.

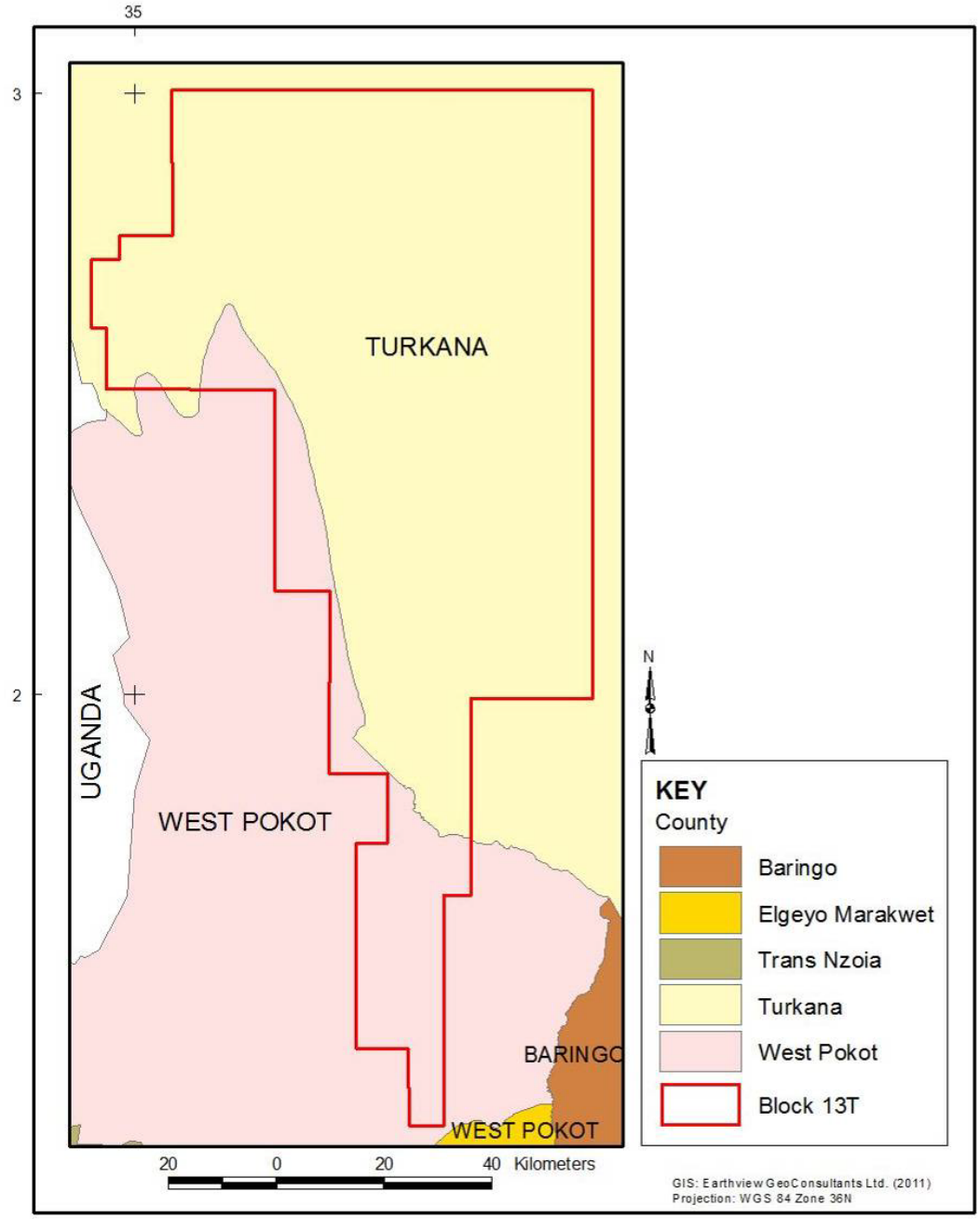


Figure 5.2: Administrative boundaries in the project area: Block 13T

5.1.4 Communications and Transport

The proposed exploratory wells project area can be accessed from Nairobi by road as well as air transport. The main road leading to the project area is a class “A” road (Nairobi-Kitale-Lodwar-Juba highway). Parts of the road from Kapenguria town are in a sorry state of disrepair and need urgent fixing. The exploratory well drilling sites can be accessed by use of internal earth roads. The proponent has undertaken to gravel some of the access earth roads leading to the project sites to murram standard. Most of the terrain in the project area comprises of soft sand and pass through riverbeds, and for this reason, the commonly used mode of transport are four-wheel drive vehicles. During rainy season the

internal roads may be rendered impassable. The project area has several airstrips and the nearest to the project area is the Lokichar Airstrip. Postal and telecommunication services through mobile telephony and Internet cover the area.

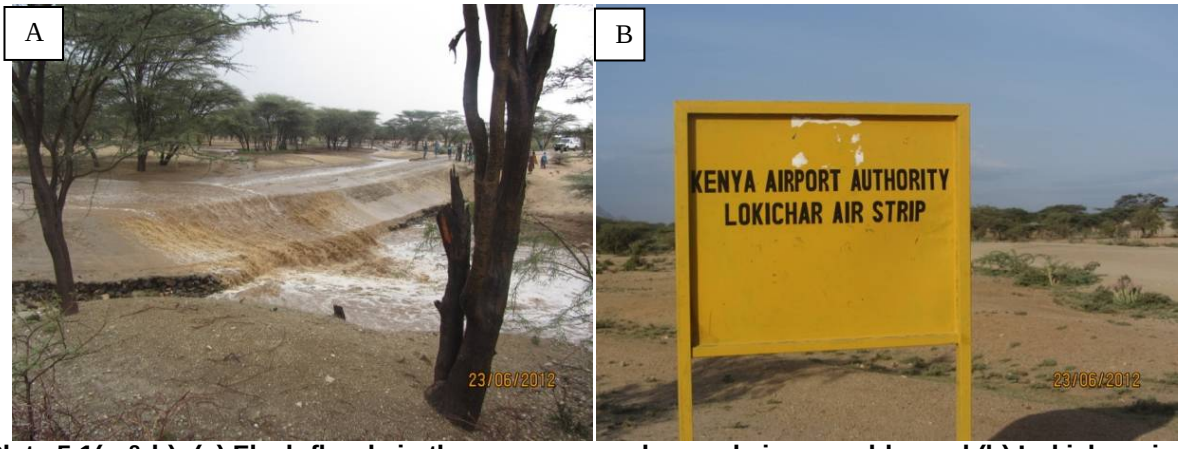


Plate 5.1(a & b): (a) Flash floods in the area can render roads impassable, and (b) Lokichar air strip

5.1.5 Government, Non-Governmental and Community-Based Organizations

The project area is an ASAL region and has several non-governmental organizations (NGOs) and government agencies, with different mandates, operating from bases in Lokichar and Lodwar towns. The overall objective of most of these NGOs is to assist the communities minimize the adverse impacts of climatic shocks and to provide relief efforts and social welfare. 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 County Steering Group (CSG) in-charge of coordinating inter-sectoral ASAL initiatives. NGOs include World Vision, World Food Program, Merlin and Christian Children's Fund. The NGOs work largely in association with the many CBOs and local women and youth groups that the communities have established.

5.2 ENVIRONMENTAL BASELINE SURVEY

5.2.1 Physiography and Geology

5.2.1.1 Physiography

The southern tip of the block is bordered by the foot slopes of Mount Elgon to the southwest and the Cherangani Hills to the southeast (Figure 5.1) in the Block 13T. The Turkwel River, which has its source in Mount Elgon, enters the block in the south-western area and then runs south to north, dissecting the block into two almost equal halves, and is the major drainage system (Figure 5.2). Its three major tributaries are the Wei Wei River in the south, Kateruk River in the central part and the Nakaton River in the north-western part of the block.

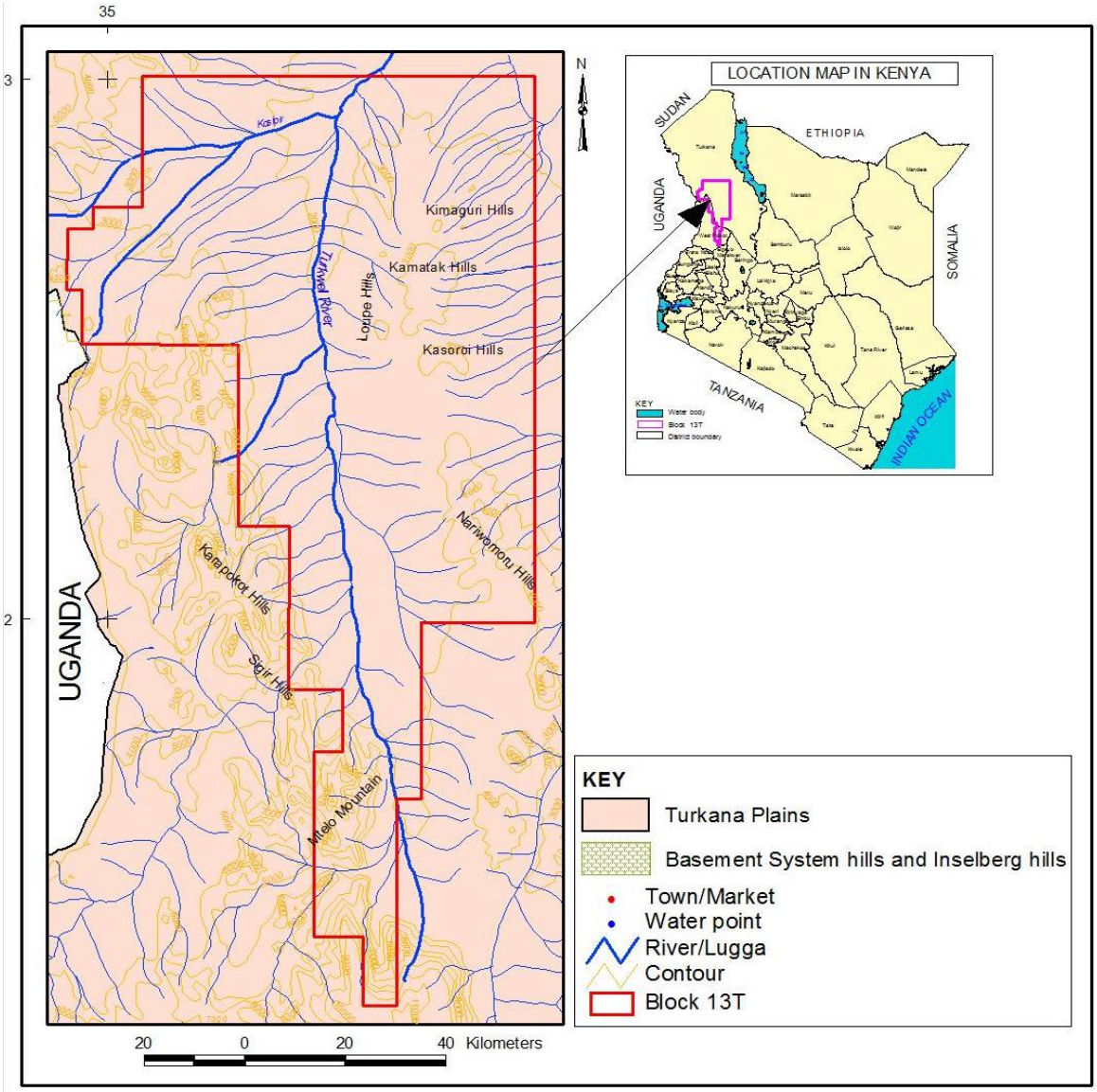


Figure 5.3: Physiography of the project area.

From 2˚ to 3˚N the watershed of the Turkwel River basin is bounded by the Nariwomoru, Kasuroi, Kamatak and Kimaguru hills to the east (these hills are fully within the project area), and the Karapokot, Loropokot, Kobaroch and Moruangiliok hills to the west (with their peaks just outside the western border of the project area) (Figure 5.3). Numerous small and

ephemeral streams arise from the hills and are oriented east-west, flowing into the Turkwel River (Figure 5.3). Those arising from the Nariwomoru, Kasuroi, Kamatak and Kimaguru hills also flow eastwards from the east-facing slopes into the Kerio River (which lies outside the project area to the east) and eventually to Lake Turkana.

The Turkwel River is as much as a kilometre wide in places and is bordered along most of its length by a belt of alluvium which in some places is over 2 kilometres wide (Plate 5.2). The Turkana Plain, which covers an expansive part of the northern section of the project area, is well-smoothed, dipping gently at about 3 metres per kilometre from the foot of the escarpment on the western part of the region (Uganda escarpment) at about 900 metres above sea level, to Lake Turkana which lies at about 375m above sea level (Figure 5.3) (Fairburn and Matheson, 1970).

Plate 5.2: showing Turkwel River floodplain at Katilu Irrigation Scheme in Katilu (southern part of the block).

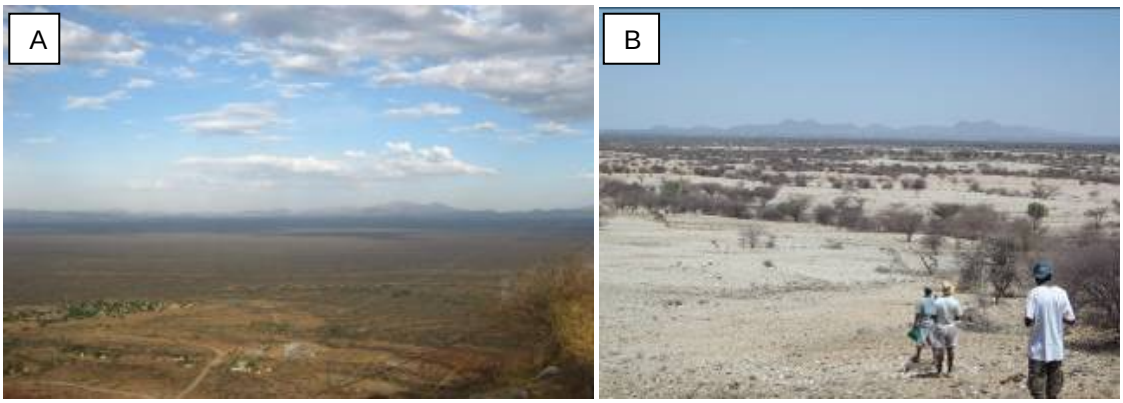


Plate 5.3: Physiography of the project area: a) Floodplain of the Turkwel River, photo taken from Sigir Hills; and b) Turkana Plain in the northern part of the block, photo taken from Kunyupat Hill, Lorugumu area.

The Sigir Hills and Kunyupat Hills comprise mainly of Basement System rocks, becoming smaller in stature and extent northwards, eventually forming only horsts. The Basement System hills in the western part of the area form steep fault and erosional scarps with deep gullies (Plate 5.4).

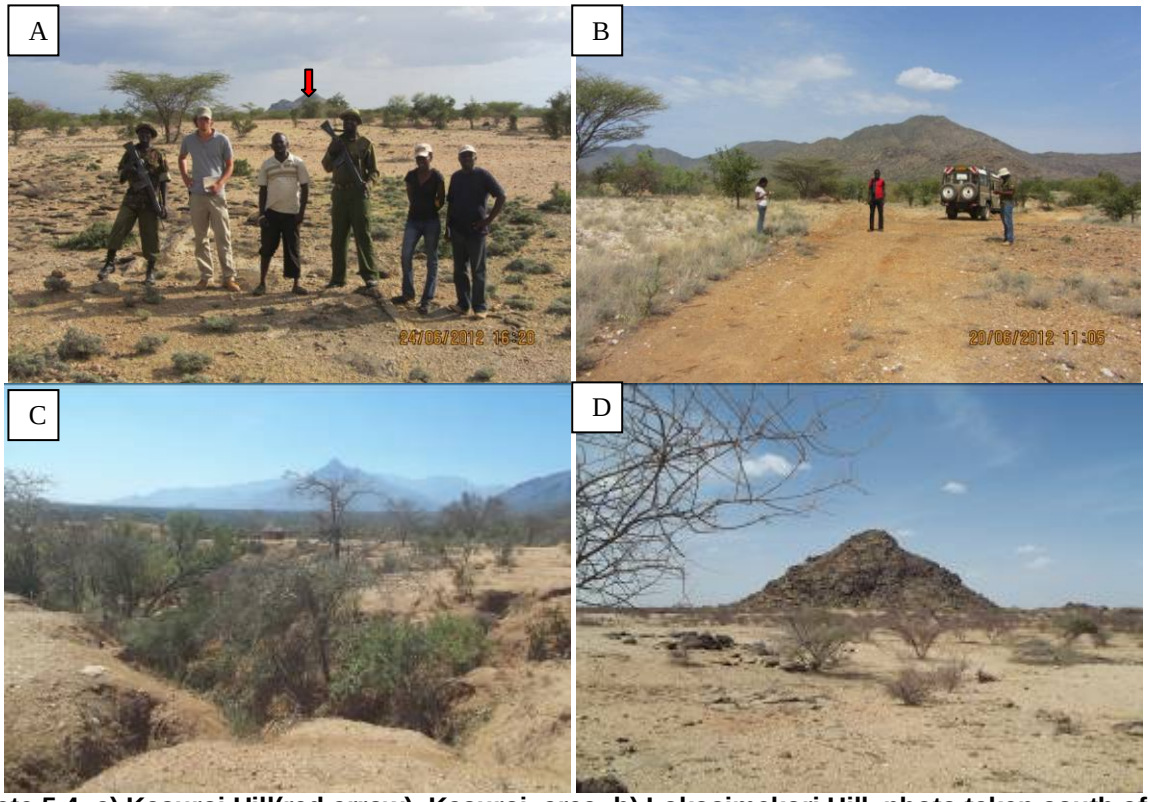


Plate 5.4: a) Kasuroi Hill(red arrow), Kasuroi area; b) Lokosimekori Hill, photo taken south of Ngamia camp; c) Kohu Hills in the background - note the gully erosion in the foreground and plain in the middle ground; and d) Kobroich inselberg hill, Logogo area.

A distinctive feature in the project area is the large number of dry lugga channels that flow for only a few hours or days following heavy rains. Often, gullies with high banks occur in grounds that are slightly more elevated than their immediate surroundings (Plates 5.4 and 5.5).

Plate 5.5: Gully erosion on the higher ground, Marich area.

5.2.1.2 Geology

5.2.1.2.1 Geological Setting

Geologically, the project area can be divided into three parts (southern, central and northern), moving latitudinally from south to north. The thin southern strip (1.3° to 2°N) is dominated by: metamorphosed sediments of the Basement System; Tertiary rocks represented by plugs and dykes of nephelinites or alkali basalt; and Quaternary rocks that consist of soils, alluvium, scree and ironstone cappings (Figure 5.4) (McCall, 1964). In the central section (2° to 2°30'N), there are mainly superficial deposits of Pleistocene to Recent age that occupy the Turkwel plain, while to the west occur a metamorphic and igneous complex of Pre-Cambrian rocks containing recrystallised sediments and volcanics (Walsh, 1966). The rocks in the northern part (2°30' to 3°N) are folded gneisses, schists, granulites and limestones of the basement system that are cut by acid pegmatites and basic intrusions (Figure 5.4) (Fairburn and Matheson, 1970). In the northwest, the basement system rocks are covered by a thick series of basalt, andesites and rhyolitic ignimbrites (Figure 5.4).

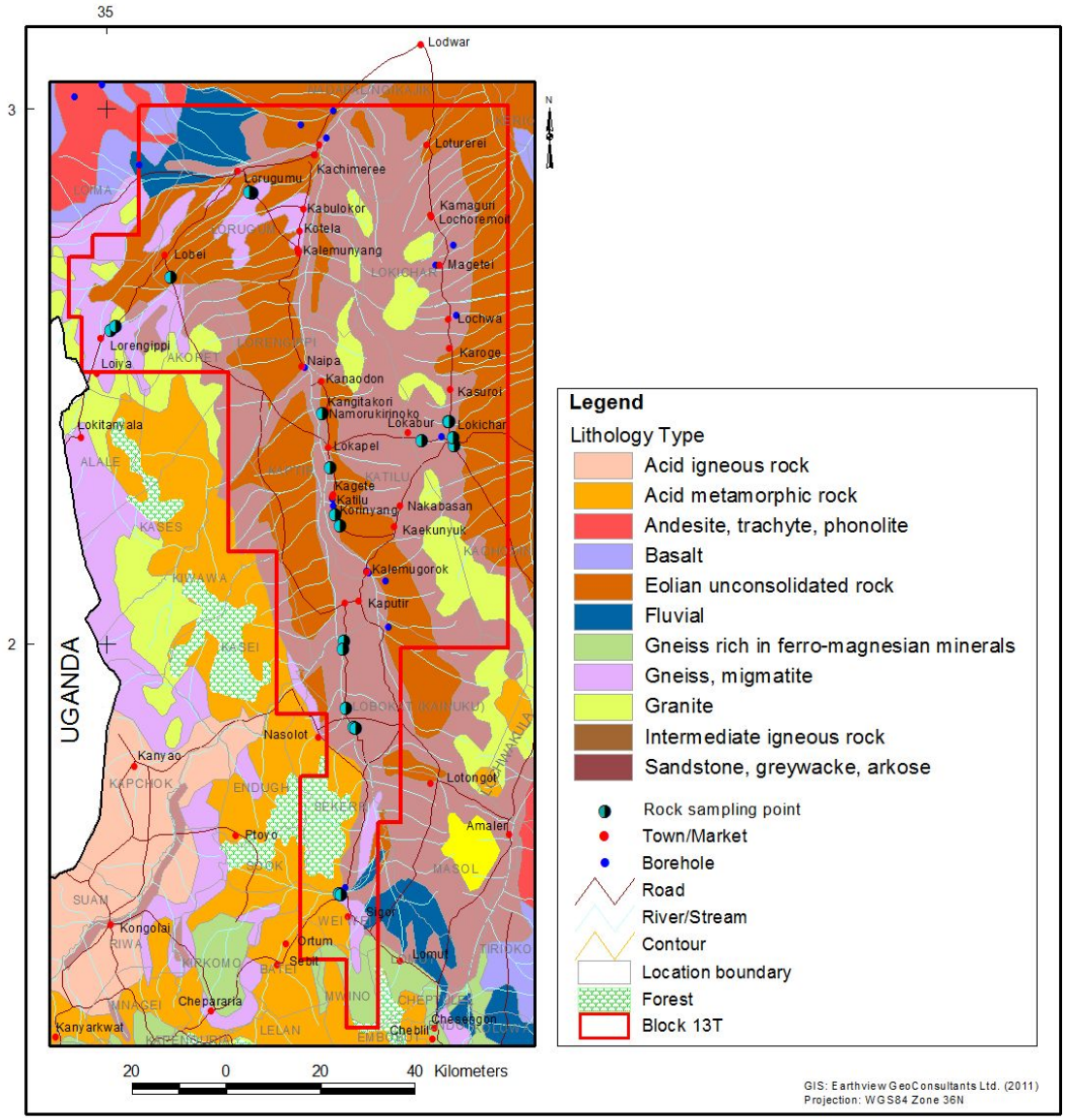


Figure 5.4: Geology of the project area

5.2.1.2.2 Surface Geology

This section describes the geology of the area that was observed in the field (Table 5.2), focusing on those rock-types and geological processes and hazards that are of significance or relevant with respect to the proposed test wells drilling programme in the project area, based on field evaluations. The main rock exposures are quartzo-feldspathic gneisses, as well as biotite schists and metamorphosed basalts (Figure 5.4) that are to be found around Lochwa and Kaaroge parts of the study area. Other minor rock units include: amphibolites schists that occur within the gneisses around Lochwaa, recrystallized sedimentary unit with quartz and feldspar (felsic) veins; and feldspar pegmatite veins near Kasuroi Hill and south west of cutline 44 (Figure 5.4) in the project area.

Plate 5.6: Rugged terrain near Lochwaa where cutline 44 has been excavated

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

Type of Rock	Locality	Brief Description	Natural Hazards	Implications for the Project and EMP
Quartzo-feldspathic gneiss	Covers areas such as Lokichar, Lochwaa and Kaaroge.	The exposures comprising of a succession of conglomerates, arkoses, quartzites and sandstones form steep-sided ridges and rugged land surfaces in the area; there are loose boulders on the surface (Plate 5.7).	• Potential rock falls or topples	• Cut lines and access-ways have left long-lasting residual impacts • Rugged terrain with interfluves and gulleys • Occupational safety relating to rock falls and topples
Basaltic plugs	Covers areas such Lokichar , Lokapel and Lochwa	Have highly rugged topography. with some loose boulders on the surface (Plate 5.9)	• Potential rock falls or topples	• Cut lines and access-ways have left lasting residual impact • Rugged terrain a challenge for access roads and cut lines. • Occupational safety relating to rock falls and topples

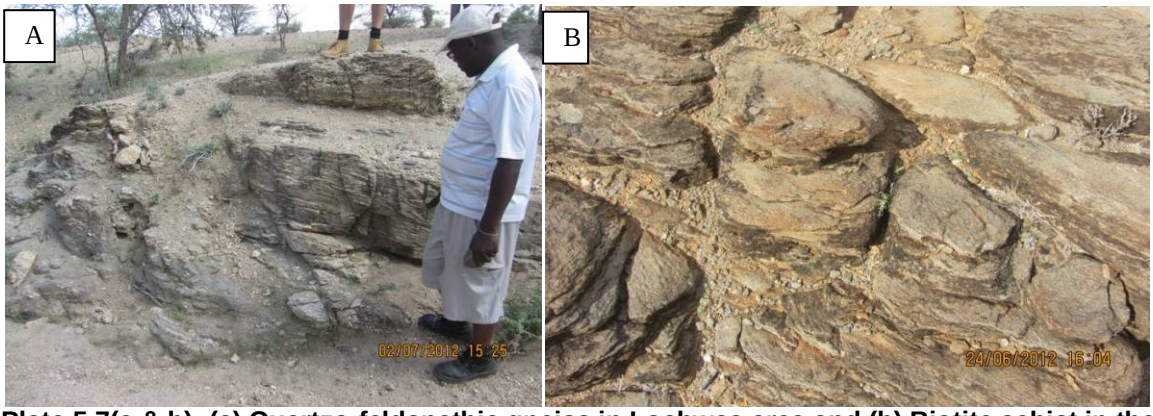


Plate 5.7(a & b): (a) Quartzo-feldspathic gneiss in Lochwaa area and (b) Biotite schist in the Kasuroi area

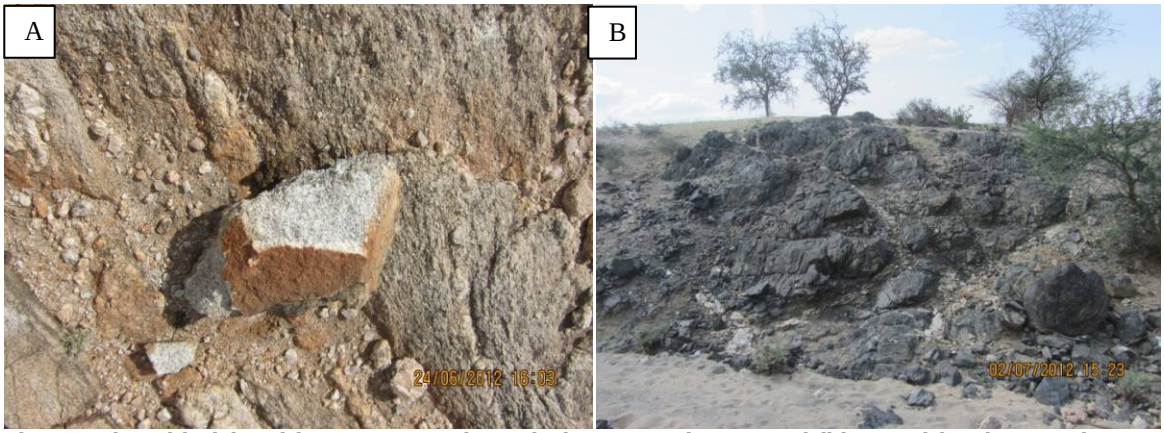


Plate 5.8(a & b): (a) Feldspar-pegmatite vein in Kasuroi area and (b) Basaltic plug on the southeast of Lochwaa

5.2.2 Soils

5.2.2.1 Soil Mapping Units

The test well drilling sites are found in piedmont plains (Mapping unit Y10), Uplands (Ux10) and sedimentary plains (Ps28). The sites are yet to be named though one soil mapping unit (Y10) hosts the Ngamia-1 test well drilling site where drilling has been completed and the new Twiga-1 test well drilling site (Figure 5.5). The mapping units within the test drilling sites project area are summarised below. The soil classification process follows the FAO-UNESCO legend that accommodates the worlds' soils in order to overcome gaps in national classification systems and to provide a common basis for soil correlation. The identification of soils is based on the presence of diagnostic horizons and diagnostic properties which are defined by measurable morphological, physical and chemical criteria related to soil characteristics that are the result of soil formation. There are 26 soil units recognized by the FAO- UNESCO legend of which Kenya has 23. The soil mapping unit description refers mainly to the characteristics of the subsoil usually 'B' horizon, to a depth of 100cm (less if impenetrable material such as bedrock occurs at a shallower depth). Among the parameters described is: drainage condition, effective soil depth, colour (moist condition), mottling (if present), consistence (moist condition), calcareousness (if present), salinity, sodicity (if present), rockiness (if present), stoniness (if present), cracking (if present), texture, additional information on special topsoil or subsoil features, landform, geology, inclusions of other soils, etc (Sombroek *et al.,* 1982). For mapping units the first letter represents the landform while the second letter represents the geology of the unit. Details on the physico-chemical parameters and infiltration tests on the soils are outlined in Appendix 3.

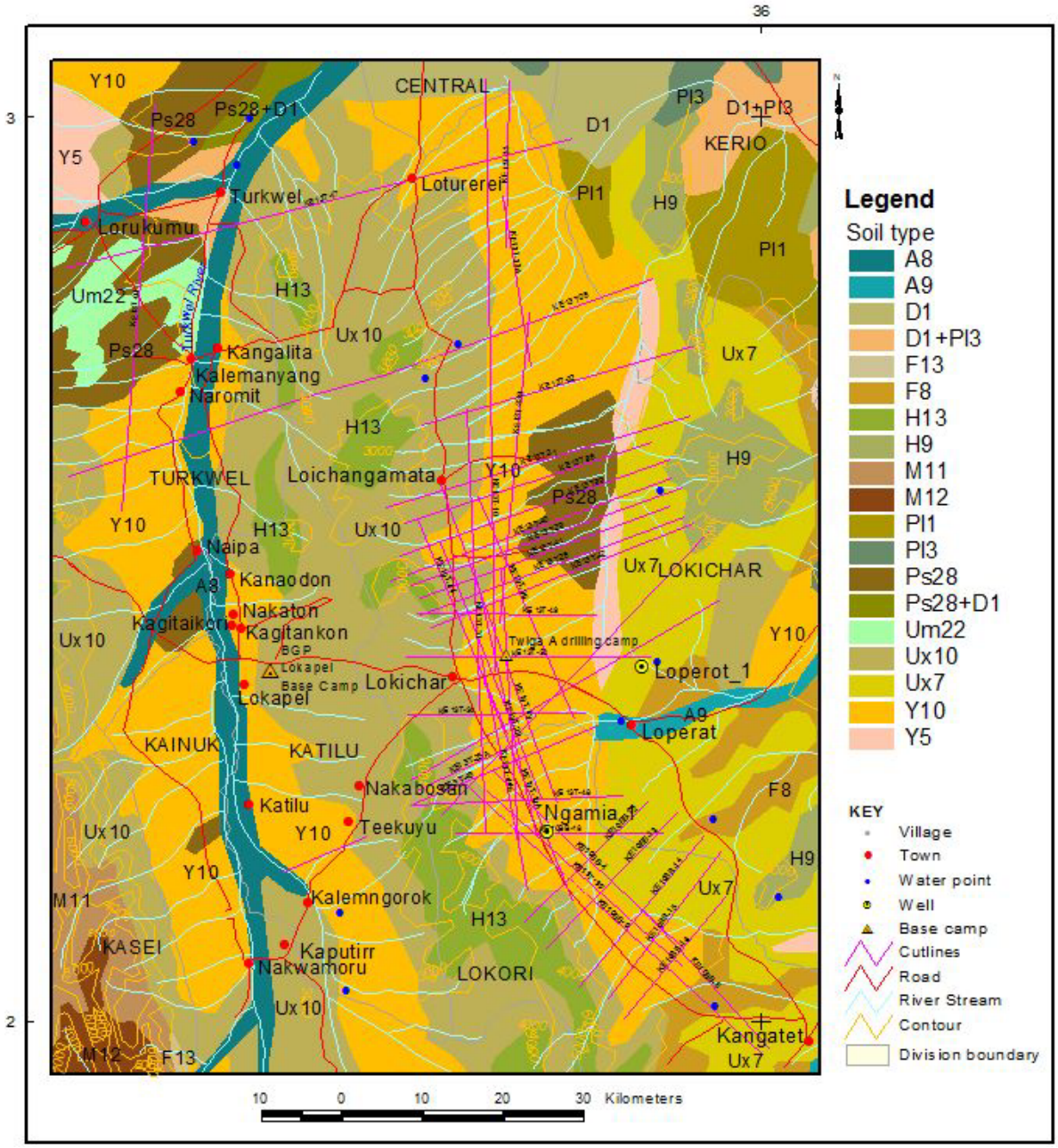


Figure 5.5: Soil map of the project area showing the exploratory drilling sites.

Mapping unit Y10

This unit is found to the eastern part of Block 13T from the northern border at Loturerei, traversing southwards to Katamanak Hills and along the River Turkwel floodplain from Kangalita in the north, traversing southwards past Kaputir. Y10 unit also covers the exploratory drill site of Ngamia-1 and the proposed Twiga-1 site. The profile pit for soil classification was excavated about 80m from Twiga-1 test well drilling site based in Kapese Location, Lokichar Division Turkana South (Figure 5.5, Plate 5.9). Its geology is alluvium from undifferentiated basement system rocks, mainly gneisses. The landform/topography is piedmont plain, consisting of nearly level to gently undulating slopes (0-3%) that are dissected by narrow rills tending south-north direction. The meso-relief consists of common small dunes (<1m) that are stabilized by *Indigofera spinosa* dwarf shrubs and *Grass spp*. The soils are moderately well drained, deep, dark yellowish brown to dark brown, sandy

loam to gravely clay, moderately saline and strongly sodic. The surface consists of sealed and crusted sandy clay loam to sandy clay textured soils with low soil organic matter content, overlain by quartzite surface pebbles. The soils classify as *mollic Solonetz.* The vegetation of the area is a moderately dense Acacia shrubland dominated by *Acacia tortilis.* There are also shrubs of *Luqata sigmama* and *Indigofera spinosa* dwarf shrubs. The noxious invader shrub *Juliflora procera* is also present. The area serves as grazing grounds with goats being predominant. Trampling by grazing animals abets the degraded soils condition making the soil-mapping unit where the exploratory well is sited, fragile.

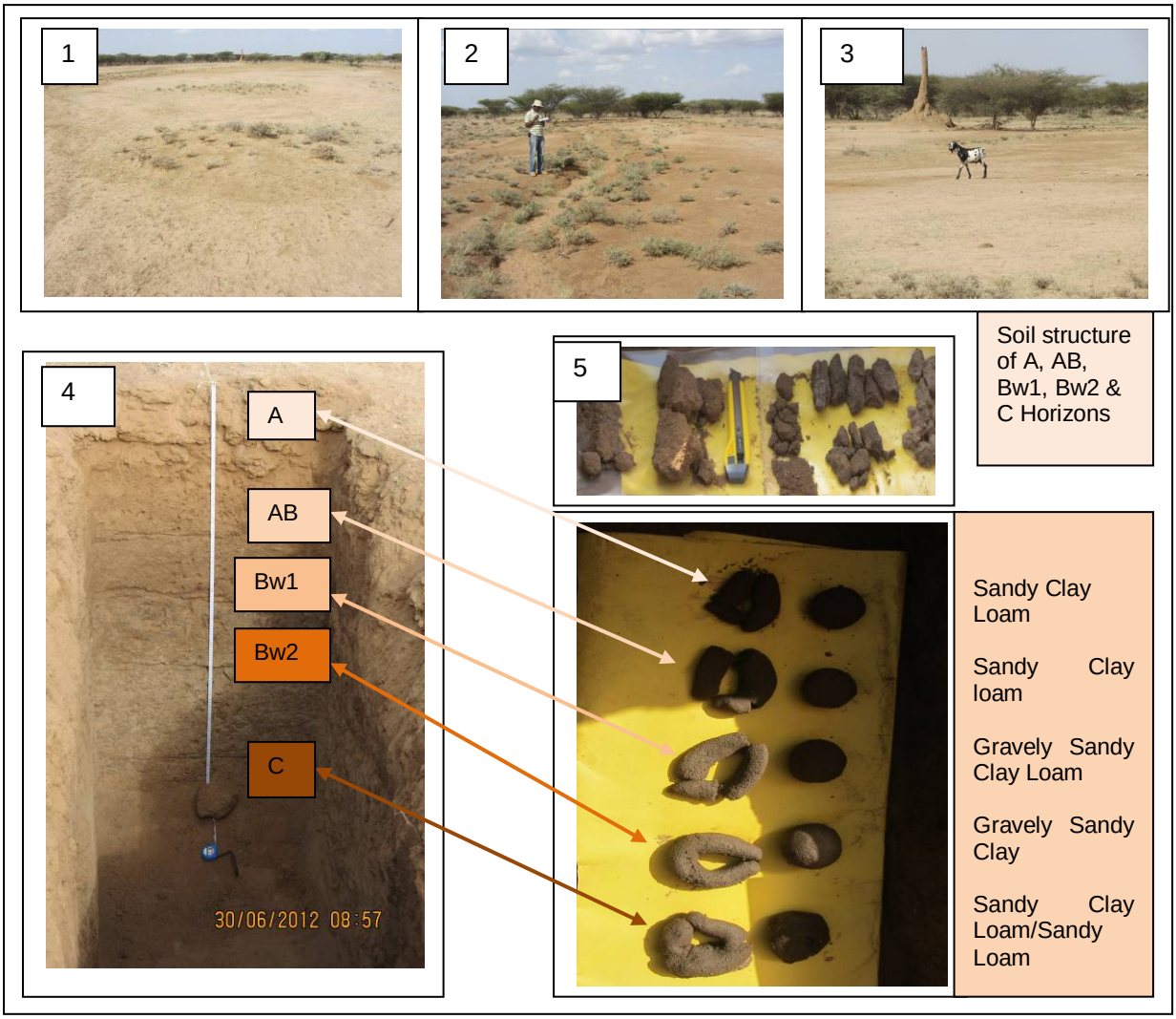


Plate 5.9 (1-5): (1) Piedmont plain showing dunes, meso-relief stabilized by dwarf shrubs (2) Same unit that is gently undulating and bisected by common narrow rills that support vegetation and with sandy sealing soils (3) Y10 unit supports livestock grazing (4) profile pit in the unit showing soil horizons and (5) soil structure of the profile, the 5th horizon (Bw2) showing prismatic structure connotative of *Natric B (*diagnostic horizon) and soil texture matrix for the profile pit.

Mapping unit Ps28

This mapping unit is found to the north west of Kasuroi and West of Lochwaa. It is also found east of the Turkwel River floodplain to the northeast of Block 13T. The profile pit for soil classification was excavated between Kasuroi and Kaaroge townships in Kasuroi Location Turkana South (Figure 5.5, Plate 5.10). Its geology is cover sands. The landform/topography

is sedimentary plain that is nearly level to gently undulating slopes (0-4%). The plain is dissected by narrow (<2m wide) and shallow luggas tending northeast to southwest direction. There are rills and potential gullies forming in the unit where the luggas cross the land sloping perpendicularly to the drainage pattern. The meso relief consists of elevated surface (<1m) that is gently undulating due to erosion processes. The soils are well-drained, very deep, strong brown, friable, moderately calcareous, moderately sodic sandy loam to sandy clay loam. The surface exhibits sheet wash and rill erosion that has resulted in a rugged surface with undulations and depressions. The subsoils are compact and though the surface soils are porous, they exhibit some sealing in places and thin crusts with sandy loam to sandy clay loam texture. The topsoils are also low in soil organic matter and due to the sealing; there is increased soil erosion as runoff is abetted with flow movement from upper to low-lying land. The soils classify as *ferralic Cambisols*. The vegetation of the area is an open grassed shrubland dominated by *Acacia tortilis, A. reficiens* and *Indigofera spinosa* dwarf shrubs and *grass spp* forming the undergrowth. The area serves also as grazing grounds with goats and camels being predominant. Trampling by grazing animals abets the degrading soils condition making the soil-mapping unit tending to be fragile.

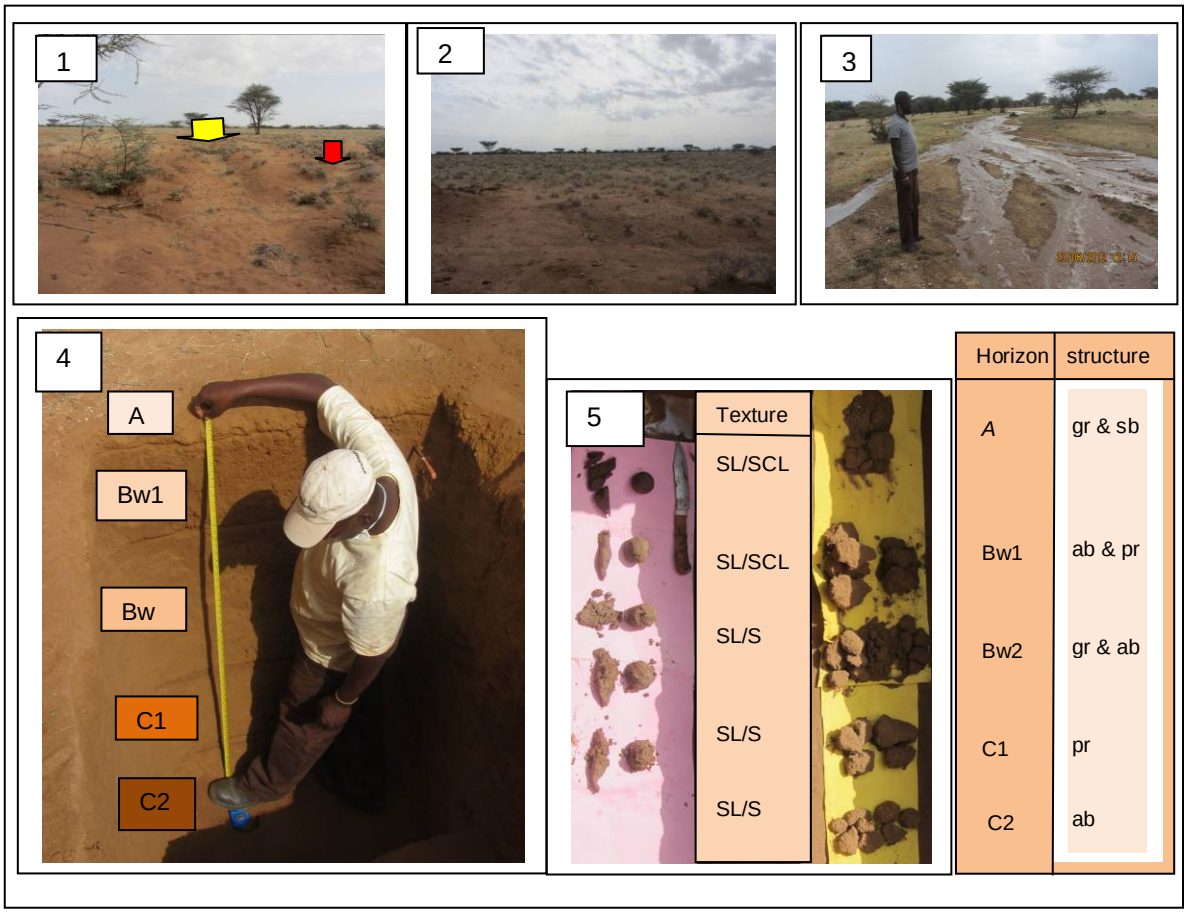


Plate 5.10: (1) Ps28 unit showing typical lugga flowing NE/SW direction in the unit--that support vegetation (yellow arrow) and gulley forming (red arrow) and (2) The unit showing undulating meso-relief stabilized by *Indigofera spinosa*, (3) Surface Ponding in Ps28 line 37 &40 junction, that occurred after some flash floods earlier and (4) profile pit showing soil horizons and (5) profile pit soil texture and soil structure representing all the horizons sampled. The texture in each horizon respectively is as follows: A-Sandy Loam to Sandy Clay Loam, Bw1- Sandy Loam to Sandy Clay Loam, Bw2- Sandy Loam to Sand, C1-Sandy Loam to Sand and C2-Sandy Loam to Sand. The structure in each horizon respectively is as follows: A-granular and sub-angular blocky, Bw1-angular blocky and prismatic, Bw2-granular and angular blocky, C1-prismatic and C2- angular blocky.

Mapping unit Ux10

This mapping unit is extensive and covers nearly half of Block 13T. It is found to the northern border of Block 13T and to the west of River Turkwel floodplain, stretching to Nasolot in the southern end of the block. The same unit is found East of River Turkwel floodplain south of mapping unit Ps28 and stretching southwards to Nasolot (Figure 5.5, Plate 5.11). The unit was described about 3 km northeast of Kaaroge Township, Turkana South. The geology of the area is undifferentiated basement systems, rocks predominantly gneisses. The physiographic unit is uplands at differentiated levels consisting of rolling topography and base level variables. At the sampling site, the unit is intensely dissected with narrow and moderately deep interfluves and the macro relief is rolling uplands. The soils are well-drained, shallow, yellowish brown, friable, strongly calcareous, moderately to strongly sodic and saline, gravely, sandy clay with a gravel surface. There are surface stones and rock outcrops in the unit. The unit also has common quartz-feldspar-gneiss veins. The soils classify as *Calcaric Regosols.* This soil-mapping unit supports an open and scattered *Acacia reficiens, A. tortils, A. Senegal, Balanities aegyptiaca and Delonix elata* vegetation. The undergrowth is sparse *Indigofera spinosa*. The plant life is found in the interfluves where there is water.

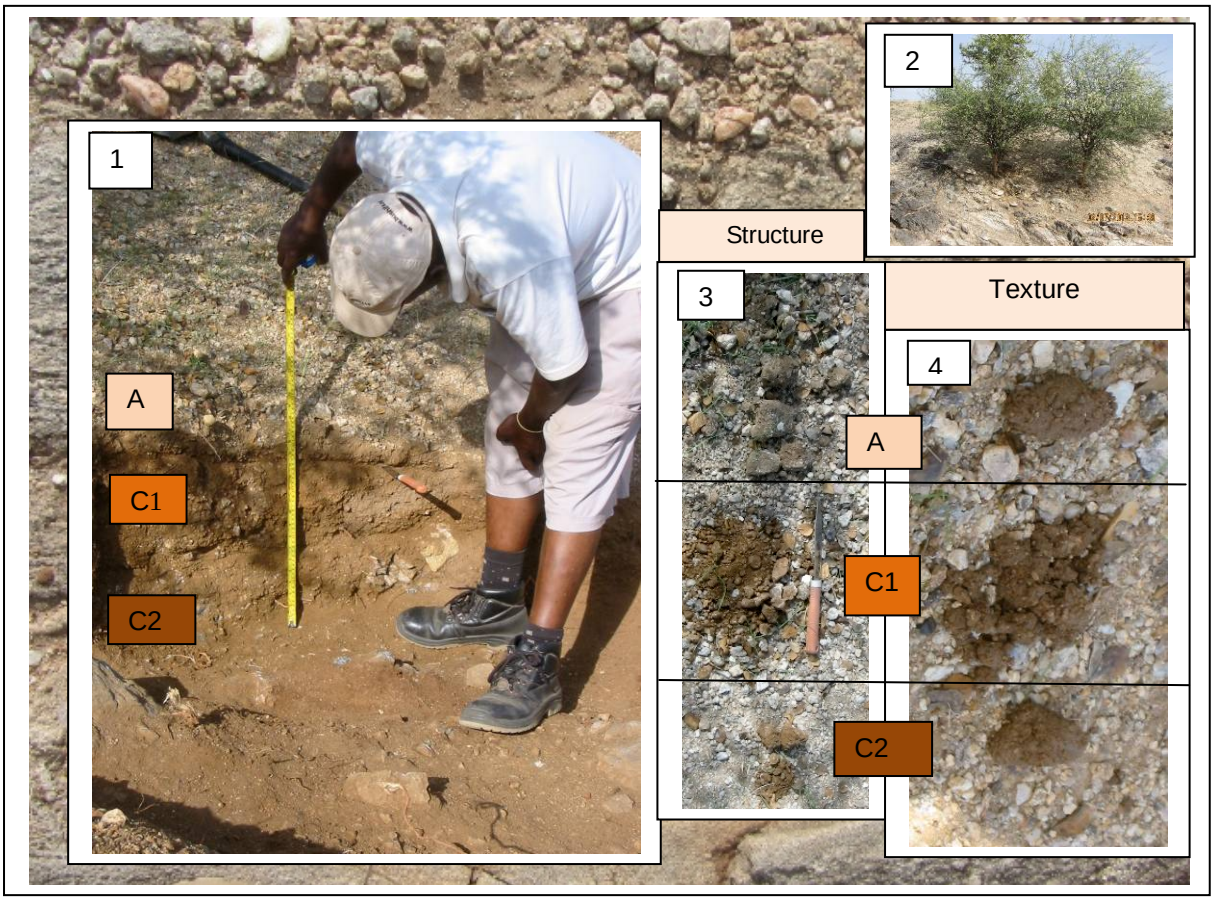


Plate 5.11(1-4): (1) Ux10 unit showing lugga-cut profile horizons, the background being quartz-feldspar gneiss vein, (2) The shallow (in places moderately deep) soils support poorly anchored Acacia Senegal vegetation (3) Soil structure showing A-horizon: prismatic and platy structure, C1-horizon: fine granular and sub-angular blocky structure, in C2- horizon: granular and sub-angular structure and (4) profile soil texture: A-horizon: gravely Sandy Clay Loam to Sandy Clay, C1-horizon: gravelly Sandy Clay Loam, C2-horizon: gravelly Sandy Clay.

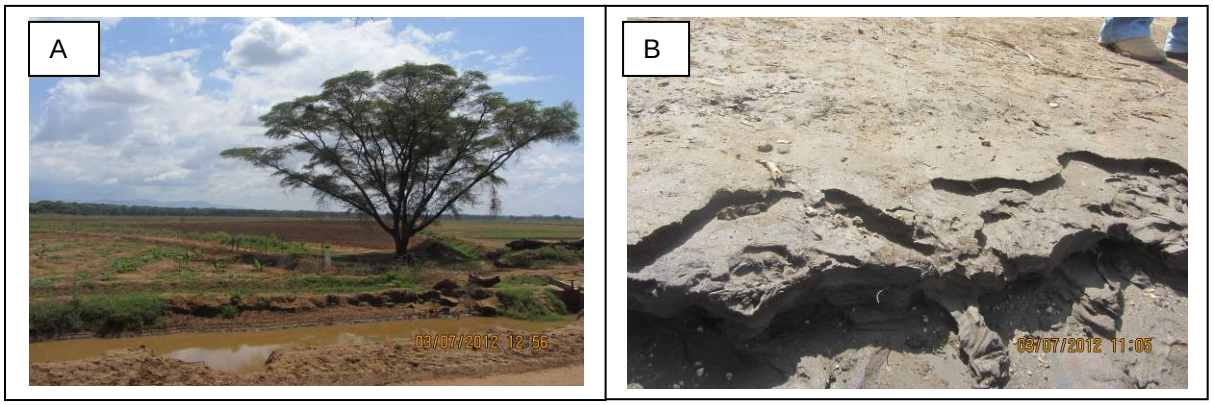


Plate 5.12 (a & b): (a) Mapping unit A8 showing River Turkwel floodplain under irrigation at Katilu and (b) stratified *fluvisol* topsoil at the riverbank.

Table 5.3: Soil description within specified soil mapping units observed during the field surveys that are significant for project logistics and EMP.

Unit	Locality	Brief Description	(*)Natural Hazards	Implications for the Project and EMP
Piedmont Plain Y10	Found to the eastern part of Block 13T from the northern border at Loturerei, traversing southwards to Katamanak Hills and along the River Turkwel floodplain from Kangalita in the north traversing southwards past Kaputir.	The soils are moderately well-drained, deep, dark yellowish brown to dark brown, sandy loam to gravely clay, moderately saline and strongly sodic. They classify as mollic *Solonetz*, [*Sombroek et al. (1982)]*	• Sealing and crusting soils • Wind erosion • common bare patches/denude of vegetation • Surface runoff and ponding • Compact-B soil horizon	• Mechanical excavation of soil may expose the soil and encourage wind erosion and further degrade the unit • Ponding potential may impede certain activities to be carried out during the rains • Campsites may be placed on bare patches without disrupting vegetation • Compact subsurface layer may require hardened tools/equipment or blasting with dynamite if pits are to be excavated
Sedimentary plain (Mapping unit Ps28)	This mapping unit is found to the northwest of Kasuroi and west of Lochwar. It is also found east of the Turkwel River floodplain to the northeast of Block 13T	The soils are well-drained, very deep, strong brown, friable, moderately calcareous, moderately sodic sandy loam to sandy clay loam. (The soil classifies as *ferralic Cambisols* (*Sombroek et al., 1982)*.	• Sealing and crusting soils • Sheet wash and rill erosion • Surface runoff and ponding on depressions and roadways • Compact B-soil horizon	• Mechanical excavation of soil may expose the soil and encourage gulley erosion especially where access ways cross luggas and further degrade the unit. • Runoff and ponding potential may impede certain activities to be carried out during the rains. • Common elevated ground may require levelling/removal if campsites are to be established where applicable. • Compact subsurface layer may require hardened tools/equipment if pits are to be excavated.

Uplands (Mapping unit Ux10)	Found to the northern border of Block 13T and to the west of River Turkwel floodplain stretching to Nasolot in the southern end of the block. The same unit is found east of River Turkwel floodplain, south of mapping unit Ps28 and stretching southwards to Nasolot	The soils are well-drained, shallow, yellowish brown, friable, strongly calcareous, moderately to strongly sodic and saline, gravely, sandy clay (The soil classifies as *Calcaric Regosols* (*Sombroek et al., 1982)*.	• Potential landslips/ rock fall due to topography and surface stones/boulders and rock-outcrops • Potential vegetation-fall due to poor anchorage of plants caused by shallow and sodic soils • Sparse vegetation found in interfluves	• Movement/vibration of machinery/equipment may trigger rock falls • Mechanical excavation of soil may expose the soil and encourage windblown erosion • Movement of machinery and equipment may be hindered due to topography unless access-ways are opened up • Shallow soil and presence of near surface parent material would require hardened tools/equipment or blasting with dynamite if pits are to be excavated • Further surface disruption may denude the existing scanty and sparse vegetation
Floodplains (Mapping unit A8)	This unit bisects Block 13T into two from the north at Turkwel town to the south at Nasolot.	The soils are well-drained, to imperfectly drained , very deep, dark brown to yellowish brown , stratified , micaceous, strongly calcareous, predominantly loamy soils (The soil classifies as *Calcaric Fluvisols* (*Sombroek et al., 1982)*.	• Seasonal flooding and ponding • Windblown dust	• Vehicles and equipment movement would be impeded during wet seasons. • Compaction by vehicles and equipment • Windblown dust may affect equipment • Occupational safety relating to dust generation during dry seasons

5.2.3 Climate

The proposed project area, which is arid to semi-arid, receives an average annual rainfall of between 200 and 400mm and average temperatures range from 24 to 38°C (Republic of Kenya, 2002). During the dry seasons, which are between August-February, temperatures vary between 26 and 40ºC, while in the rainy seasons between March-July, the range is from 20 to 25ºC. The lowest temperatures are experienced in the months of November and December, and the highest in the months of January, March and August, and may exceed 37ºC especially in the afternoons. The long rains occur between April and August, while the short rains occur in October and November. The annual rainfall amount is between 200 and 400mm (Nicholson, 1980), and is erratic and unreliable (Republic of Kenya, 2002). Rainfall is distributed on an east-west gradient with more rainfall in the western parts and other areas of higher elevation (Republic of Kenya, 2002), and is higher in the southern sector than in the northern sector of the project area. Rain falls in brief violent storms resulting in flash floods, particularly in the northern sector. The high temperatures and low rainfall causes high rates of evapo-transpiration that result in deposition of salt in the soil and capping on the surface (Republic of Kenya, 2002).

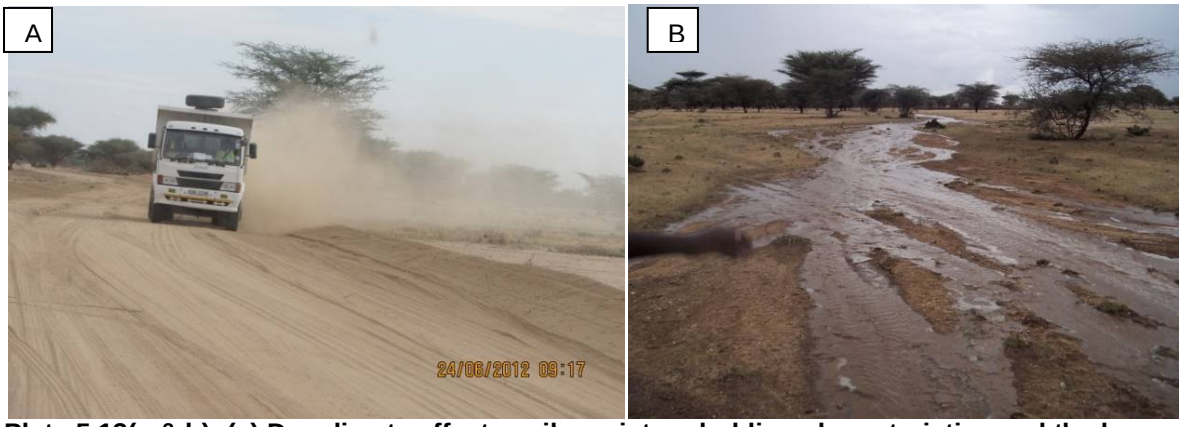


Plate 5.13(a & b): (a) Dry climate affects soils moisture holding characteristics and the loose and often pulverized soil is easily windblown and (b) Flash floods that can occur suddenly characterize the study area

Relationship to Project and EMP

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

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

The project operations will not affect any climate parameter.

5.2.4 Air Quality

The project area is rural, sparsely populated, undeveloped and reasonably removed from major towns, cities, agricultural and industrial centres that are the major contributors to air pollution. In the arid to semi-arid northern sector of the project area, strong winds often generate dust storms. This is the significant contributor of natural particulate air pollution in the area. Minimal and transient air pollution occurs as a result of vehicles traversing the area and raising dust, as well as releasing exhaust fumes. Herds of grazing animals also cumulatively contribute to dust pollution in the course of movement from one area to another.

Relationship to Project and EMP

The ambient air quality in the region is good, but frequent dust storms (particularly in the low-lying northern sector) and generally high levels of dust resulting from the strong winds may affect the working conditions. Care is, therefore, needed to shield the workers and sensitive equipment from dust effects. The project operations are only likely to affect air quality locally in work areas, during transportation of the workforce and equipment from one area to another, and during operation of machinery. An assessment of this impact is presented in Chapter 7 and mitigations recommended in Chapter 8.

5.2.5 Surface and Groundwater Resources

5.2.5.1 Surface Water Resources

The surface water potential is extremely low in the project area. The local communities are adapted to this situation, but persistently long droughts or successive seasonal droughts sometimes put at risk their lives and livelihoods, including frequent loss of livestock. The Turkwel is the main surface water body in the area. The perennial Wei Wei River, a tributary of the Turkwel River, is important in the southern part of the project area. Other sources of surface water are seasonal rivers (luggas) and water pans. There are very few water pans and earth dams in the project area. The construction of some of the existing water pans was sponsored by the World Vision Kenya, particularly in the eastern part of the project area. The pans found during the study area were unable to hold water throughout an entire dry season.

Plate 5.14 (a & b) :(a) Turkwel River in Katilu area, Note the people crossing at a shallow place (b) Earth dam being excavated south of Ngamia camp.

The Turkwel River has been dammed for hydroelectric power generation at Turkwel Gorge, and this dam contributes about 40% of the total power consumed in Kenya and is the third

largest dam in the country (Plate 5.14). The river's contribution to the improved agricultural activities in the area through providing water for irrigation schemes has been the most paramount and pronounced benefit to the local community. Some of the irrigation schemes that use water from the Turkwel River are: Kaputiro Irrigation Scheme in Loyapat area (funded by World Vision); Arumoru Irrigation Scheme in Kanaodon area (supported by the Turkana Rehabilitation Programme); Turkwel Irrigation Scheme in Turkwel area and Katilu irrigation scheme in Katilu (supported by the Government of Kenya). The waters of this river are highly turbid and not suitable for domestic and/or industrial uses.

5.2.5.2 Groundwater Resources

The numerous dry (ephemeral/seasonal) sandy river beds, locally known as *luggas*, are sources of shallow and potable groundwater. The shallow hand-dug wells may, in a few cases, be equipped with hand pumps. There are also some deep boreholes. Groundwater is the major source of potable water supply for both humans and livestock in the project area (Plate: 5.15). The water quality is variable, ranging from clean and potable to turbid.

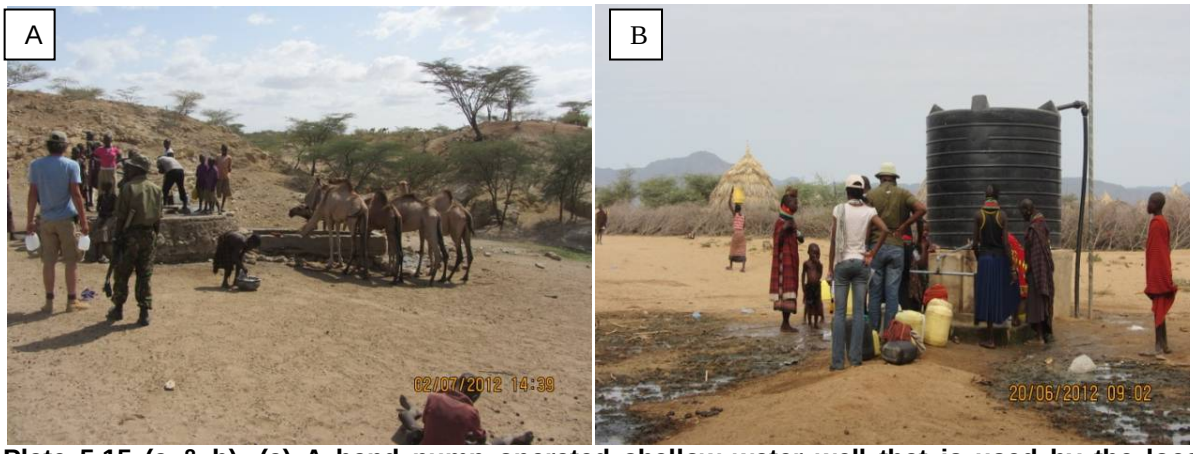


Plate 5.15 (a & b): (a) A hand pump operated shallow water well that is used by the local communities and their livestock at Kasuroi, (b) Nakukulas borehole donated to the local community by TKBV used by local communities and their livestock.

Plate 5.16(a & b):(a) A hand pump operated at a shallow water well at Katilu Centre adjacent to the Turkwel River floodplain and (b) a hand pump operated at a shallow water well at Kanaodon.

Some boreholes have dried up due to lack of recharge (e.g. at Lokichar and Loturerei area). Efforts by TKBV to drill water boreholes have yielded no water near Twiga. Others have slightly saline water, particularly those that are located far from the luggas, such as the borehole in Kalemung'orok centre.

Relationship to Project and EMP

Due to the scarcity of water resources, TKBV would have to find its own water supply (e.g. drill boreholes) for the personnel that would be residing in the camp and working within the project area, rather than share an already existing resource with the neighbouring community as this can cause problems particularly if the water is in short supply. Such boreholes could be handed over to the neighbouring communities at the end of the project.

5.2.6 Water Quality

Potential ground and surface water pollution will need to be considered in the context of drilling fluid waste, sanitation and domestic waste discharge facilities and systems that will be installed at the drilling rig sites (see Chapter 2) as well as unplanned leakages of oils and/or chemicals at the drilling rig sites. Baseline water samples were collected for physico-chemical analysis (Table 5.4) at the locality indicated. Microbiological analysis of the water samples was not undertaken due to technical logistics relating to sample preservation time (only six hours maximum before they are analysed from collection) and lack of analytical water laboratories in the project area; therefore, only physico-chemical analysis was carried out.

Table 5.4: Water quality in the project area (SW – Shallow Well; BH – Borehole). WHO limits are for drinking water quality: grey shaded boxes show the limits are exceeded.

PARAMETERS	Water sample from previous EIA for seismic acquisition of project area				Water samples collected during the EIA for test well drilling							
Lab Sample Nos.	2562	2559	2558	2561		0062	0063	0066	0064	0065		WHO limits
	Turkwel River	Lokichar SW	Katilu SW	Kalemung'orok SW		Lokichar	Nakukulas	Kasuroi	Katilu	Kanaodon		
pH	8.14	8.26	8.5	8.66		8.17	8.37	8.24	8.03	8.11		6.5-8.5
Colour (mgPt/l)	60	5	5	5		<5	<5	<5	<5	<5		15
Turbidity (NTU)	102	3	4	Nil		0.0	0.1	0.3	0.5	0.2		5
PV (mgO_2/l)	7.9	0.79	0.79	< 0.4		-	-	-	-	-		<100
Conductivity (25°C) (µS/l)	208	634	11801	1303		632	1159	1240	2600	887		
Fe (mg/l)	0.91	0.01	0.91	< 0.01		<0.01	<0.01	<0.01	<0.01	<0.01		0.3
Mn (mg/l)	< 0.01	< 0.01	< 0.01	< 0.01		<0.01	<0.01	<0.01	<0.01	<0.01		0.1
Ca (mg/l)	22.4	31.2	23.2	6.4		37.6	8	20.8	76	45.6		<100
Mg (mg/l)	6.82	18.97	25.3	28		37.45	8.37	38.4	80.22	35.5		
Na (mg/l)	8.8	73.4	195.9	238		28	240	182	356	77.6		200
K (mg/l)	0.4	0.4	0.6	1.2		3.9	1.9	9.6	1.6	10.1		<10
Total Hardness ($mgCaCO_3/l$)	84	1.56	162	132		248	56	210	520	260		500
Total Alkalinity ($mgCaCO_3/l$)	98	288	412	574		270	500	392	760	356		<500
Cl (mg/l)	2	5	100	25		9	26	40	325	35		250
F (mg/l)	0.35	3	2.2	1.0		1.17	1.34	4.17	1.66	0.95		1.5
Nitrate (mg/l)	0.23	0.22	0.45	0.54		0.97	7.14	8.18	12.72	2.72		10
Nitrite (mg/l)	< 0.01	< 0.01	< 0.01	< 0.01		<0.01	0.05	0.06	0.09	<0.01		
Sulphate (mg/l)	-	-	-	-		26.7	14.6	127.1	28.5	28.7		400
Free Carbon Dioxide (mg/l)	-	-	-	-		40	Nil	36	76	66		
Total Dissolved Solids (mg/l)	< 0.3	12.9	67	35.71		391.8	718.6	768.8	1612	5		1000

The ground water in the area is suitable for human consumption except for water obtained from Kasuroi borehole due to presence of fluoride in higher concentration than the recommended level of 1.5mg/l.

5.2.7 Terrestrial Environment

According to the Kenya Rangeland Ecological Monitoring Unit (KREMU), the country's rangelands can be divided into 44 eco-units based factors such as soil types, rainfall, soil moisture, vegetation types and land use types. Based on the above, the study area is classified as the *Lokichar Eco-Unit,* which encompasses arid and semi arid areas of the lower parts of Turkana area.

Arid and semi-arid lands are marginal areas with climates that are largely unsuitable for rain-fed agriculture (Pratt and Gwynne, 1977). Semi-arid lands are primarily dry thorn shrublands, while the very arid lands consist of dwarf shrubs interspersed with grassland in certain sites. Temperatures are continuously warm to hot and little variation occurs throughout the year with Potential Evapotranspiration (PE) rates being in excess of 2,500mm/yr. Rainfall is bimodal with rainfall averaging from less than 150mm to 400mm or more at higher elevations. Long rainfall peaks occur in April and May while the short rains that occur between November and December are extremely minimal because of the prevailing wind that blows from Lake Turkana to the western border from August through December.

Under the Lokichar Eco-Unit, several heterogeneous and highly variable habitat conditions exist, namely (Figure 5.6): Dwarf shrubland; Riverine forest; Shrubland; Grassed shrubland; and Near barren.

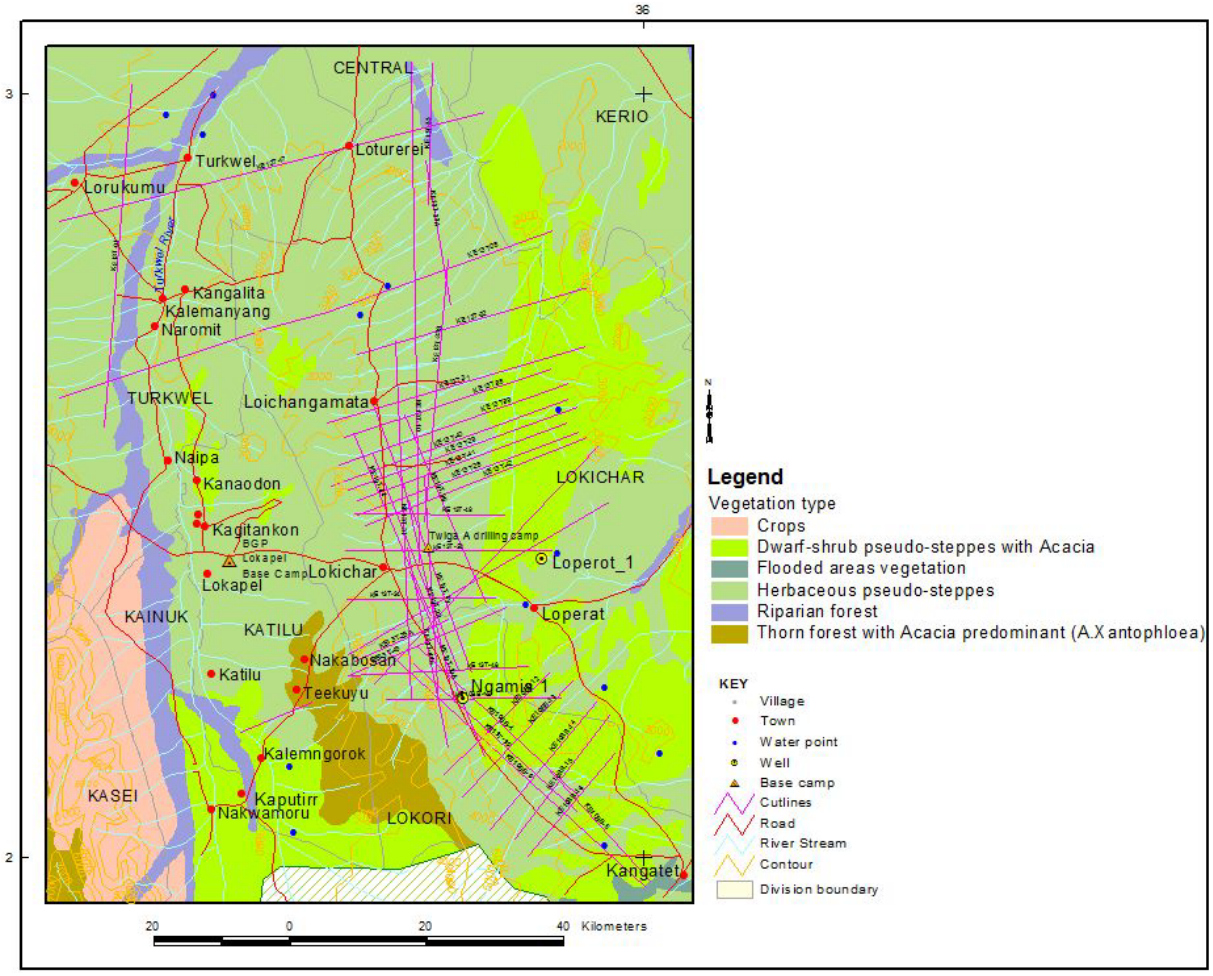


Figure 5.6: Vegetation types in the proposed project area

Dwarf Shrubland

Pockets of this habitat type were encountered along cut line 44. Dwarf shrubland is a habitat type dominated by woody plants that are not more than 1m in height. Development of this habitat type is linked to the shallow soil conditions on site. Species encountered included *Acacia reficiens, Indigofera spinosa* and *Cadaba farinosa.* These species are a key source of browse for goats and sheep.

Plate 5.17: Dwarf shrubland on the southeastern part of line 36

Riverine Forest

Several hills exist within the study area. The common hills are Lomokamar, Natudao and Kasoroi. The foot ridges and slopes of these hills are dissected with interfluves of varying degrees of width and depths. Due to the presence of water and silt, vegetation establishment and growth is highly pronounced (with trees above 8 meters in height) with *Acacia tortilis* dominating the riverine forests. Other species present include *Acacia reficiens, Salvadora persica, Ziziphus mucronata, Delonix elata* and *Calotropis procera.*

Plate 5.18: A riverine forest on the northwestern part of cutline 40

Shrubland

This is the most dominant habitat type in the project area. It was encountered along cut lines 10, 36, 37, 39, 40, and 44. Shrublands habitats comprises of woody plants that are less than 8 meters in height and usually with many stems arising at or near the base. This particular habitat types develops in areas with moderately well developed soils. There are several variants of this habitat type depending primarily on the amount of crown cover. Dominant species includes *Acacia reficiens, Acacia tortilis, Calotropis procera* and single stands of *Boscia spp.*

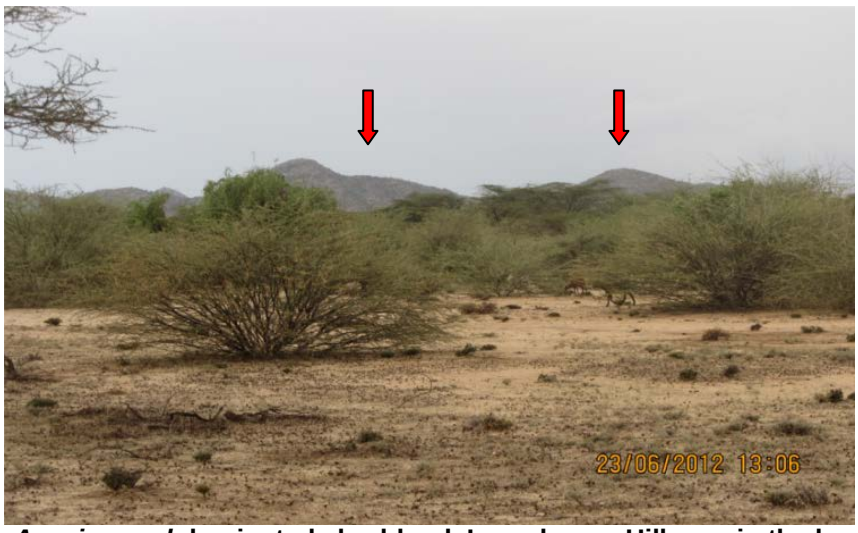


Plate 5.19: An *Acacia seyal* dominated shrubland. Lomokamar Hills are in the background (red arrows) along the northwestern part of line 39

Plate 5.20: Shrubland dominated by *Acacia spp, Indigofera spinosa and Calotropis procera* around the proposed Twiga 1 drilling site

Grassed Shrubland

This habitat type was encountered along cut line 40. Shrub-grassland is an ecotype between grassland and bush shrub grassland. Grasses are the dominant vegetal cover while

herbaceous and woody cover is usually around 6 - 20%. Common grass species include *Eragrostis cilianensis, E. racemosa* and *Chloris virgata. Acacia reficiens, Cadaba farinosa* and *Indigofera spinosa* dominate woody species. Grassed shrublands are a key source of forage for goats and sheep.

Plate 5.21: Grassed shrubland along the Lokichar- Loperot road

Plate 5.22: Grassed shrubland on the southern part of line 10

Near Barren

This habitat type was encountered on the northwestern part of lines 38, 39, 40, 41, 42, 43 and 44 within the Ux10 mapping unit. A near- barren habitat is described as one where woody vegetation contributes less than 2% of ground cover (Pratt and Gwynne, 1977). The

dominant species are *Acacia Senegal, Acacia reficiens* and *Balanites aegyptica.* Sites with interfluves have a high concentration of plant growth due to the presence of water and silt.

Plate 5.23: Near barren habitat along cut line 44. Notice the high concentration of plants along the interfluves and bare ground in between the interfluves.

Relationship to Project and EMP

The identified drilling sites within 13T are located in areas of relatively less dense vegetation, with a majority of the vegetation being not more than 5m in height. This vegetation supports both domestic as well as wild animals and therefore TKBV should avoid clearing vegetation unnecessarily. Sites for construction of camps and any other facilities should be carefully sited, preferably on bare patches to minimize vegetation clearance.

The activities of TKBV are not expected to significantly alter the flora of the region and the impacts are expected to be short to medium-term. The area has sound ecosystem integrity, and species diversity, and is capable of regenerating itself once drilling activities are complete. Where impacts are likely to be severe, it is recommended that TKBV reclaims the land by levelling it and re-planting indigenous trees.

Fauna

The study area has a very low mammal count, with only the presence of the following species being observed: Ground squirrel, Dwarf mongoose, Black-backed jackal, Cape hare, and Dik-dik. However, the study area has a very rich avian diversity. Species identified include: Chestnut bellied sand grouse, Red billed hornbill, White browed sparrow weaver, Black headed Plover, Black bellied go-away bird, Crested hoopoe, Eastern pale chanting goshawk, White headed Buffalo weaver, Superb starling, Fork tailed drongo, Brown necked raven, red and Yellow barbet, Abyssinian roller, White throated bee-eater, among others. The presence of a varied diversity of insect-eating birds indicates that there is a very high diversity of ants. Reptiles such as snakes and lizards are also present.

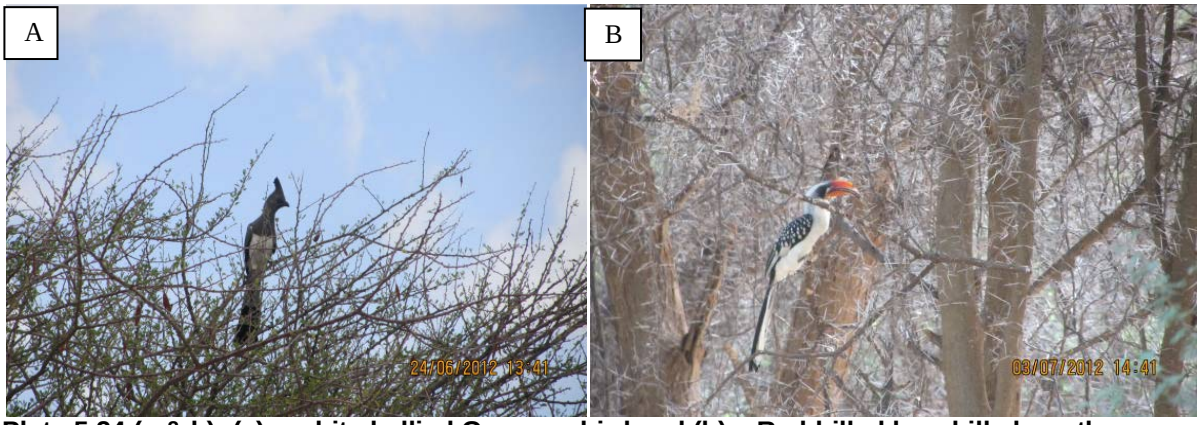


Plate 5.24 (a & b): (a) a white bellied Go-away bird and (b) a Red-billed hornbill along the Turkwel riverine forest

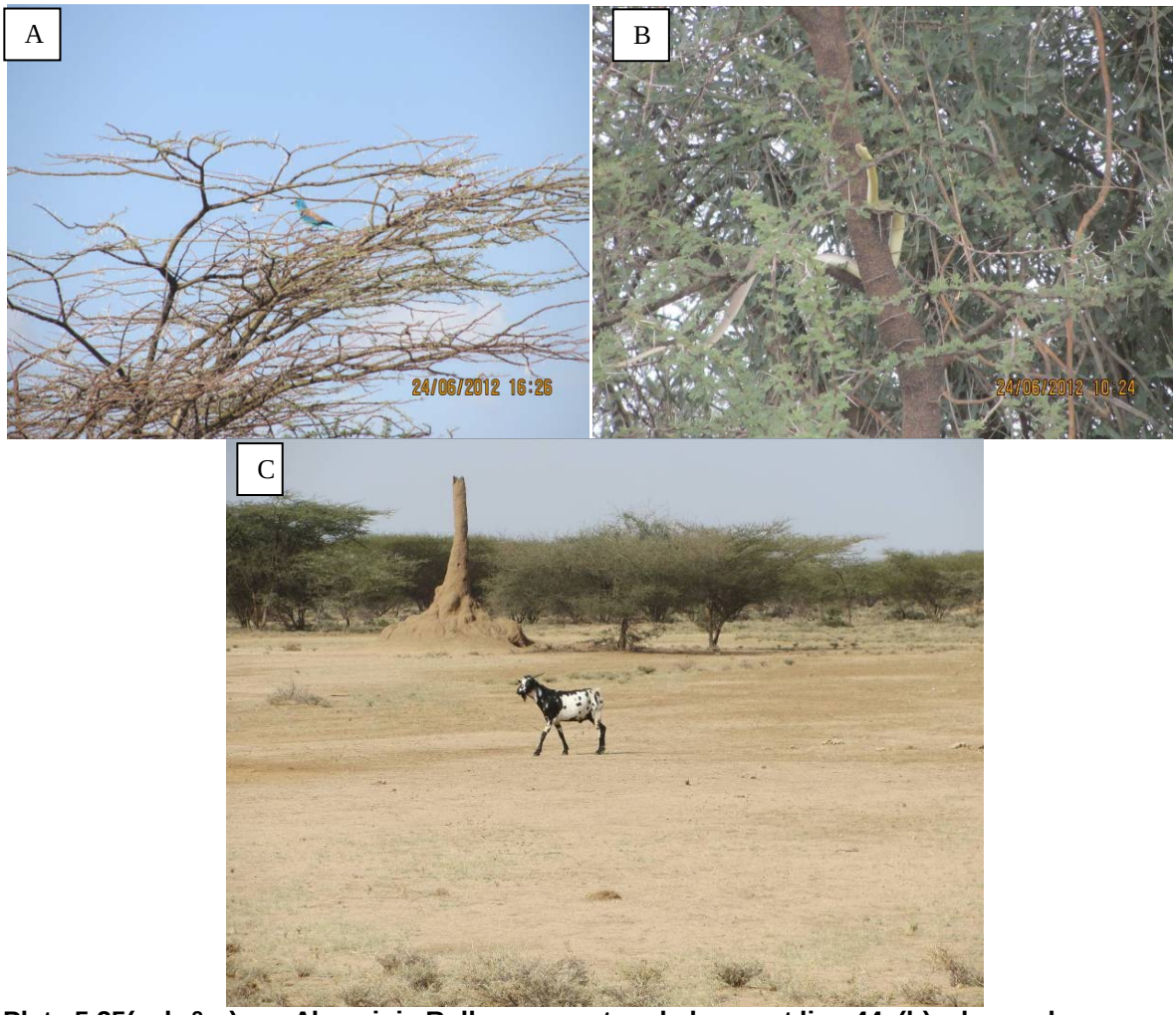


Plate 5.25(a, b & c): an Abyssinia Roller encountered along cut line 44, (b) a boomslang up a tree along cutline 10 (south-eastern part) and (c) Some of the many termite hills dotting the study area.

Relationship to Project and EMP

Though mammal diversity is low, the identified drilling sites are within an area with a high diversity of birdlife. TKBV needs to carry out its activity with the mitigations outlined in the EMP in Chapter 8 to avoid polluting and modifying the range conditions.

5.2.8 Land Resources and National Parks

The project area is an ASAL region characterised by vast tracts of land with sparse vegetation, seasonal rivers to permanent water resources like Turkwel River. Vegetation includes *Acacia* spp., *Balanites aegyptiaca, Commiphora africana*s, *Cadaba farinosa* and *Indigofera spinosa* dwarf shrubs that are useful browse for livestock. The main form of livelihood for majority of residents in the area is nomadic livestock husbandry. Livestock in the area include camel, cattle, sheep, donkeys and goats. Within the immediate neighbourhood of the project there are no gazetted or protected areas.

Plate 5.26: Scenic land features in the project area

Relationship to Project and EMP

Though the extent of area to be utilised by the proposed project is small, there may be instances where loss of vegetation during clearing of the camp site as well as during paving of the access road may be experienced. This may however be localised and the impact to the general land resource base of the project area will be minimal.

5.2.9 Archaeological, Historical and Cultural Sites

The project site falls within a region with rich history and culture. However, there are no gazetted archaeological sites in the project area. Community cultural sites are dispersed within the region but tend to have very small area of coverage, e.g. meeting places, shrines and burial areas. There are some traditional sites where community elders perform their rituals - locally known as *Akiriket/Arimo*. These sites are mainly found in the interior parts of the project area especially in Loima District.

Relationship to Project and EMP

The proposed project will not interfere with any of the community cultural sites. The project proponent should however liaise with the community elders in case of any off site activities within the project area.

5.2.10 Visual Aesthetics

Vast parts of the project area are still natural, characterised by pristine and rugged scenic beauty with hills, shrub-lands, extensive plains and several sand rivers (luggas).

Relationship to Project and EMP

The proposed project shall have minimal impact on the visual aesthetics of the area.

5.2.11 Noise and Vibrations

The project site is set in a rural area with no industrial, manufacturing or any significant traffic movement, thus the ambient noise in the project area is of low level.

Relationship to Project and EMP

The proposed exploratory well project sites shall be set away from residential neighbourhood. Machineries and other equipment that may be a source of noise pollution at the drilling site should have their noise levels reduced at source (e.g. purchasing of equipment with noise reduction mechanisms, fitting equipment with noise abatement devices, minimising number of vehicles and traffic to the level required to carry out the work efficiently, and regular servicing of equipment. Personnel assigned to work at the rig site should use personal protective equipment such as earmuffs. Working areas within the site that have excessive noise levels should be clearly marked and permit to work issued.

5.2.12 Solid and Liquid Wastes

There is minimal solid waste generation in the project area largely limited to town centres like Lokichar, Lochwaa, Kalemung'orok and Lokapel among others. Liquid waste is managed through use of pit latrines.

Relationship to Project and EMP

The proponent will employ environmentally sound solid and liquid waste management plans at the proposed project site, both at the rig site and at the residential camps. A waste management plan must entail waste minimisation, separation at source and appropriate storage in designated containers and areas. TKBV will contract the services of NEMA registered waste handling firms for final disposal of the waste in accordance with national legislation, regulations, and international best practices in order to minimise or eliminate their potential environmental impacts. Waste tracking should be incorporated in the waste management plan.

5.3 SOCIO-ECONOMIC BASELINE SURVEY

This section provides information on key socio-economic issues and activities relevant to the project. It includes an overview of social characteristics, economic settings, health, education, and demography. The EIA team confined its study within Turkana South District where the proposed drilling sites fall. Key town centres and villages visited include Lochwaa, Locher-emoit, Lokapel, Lokichar, Kalemung'orok and Kanaodon.

5.3.1 Social Characteristics

5.3.1.1 Demography

Block 13T traverses four districts, namely; Central Pokot, Turkana Central, Loima and parts of Turkana South Districts. The major communities within the project area are the Pokot and the Turkana although there are minorities like the Somalis found mainly in the major centres. The project area is sparsely populated with clustered settlements within the major centres. The population density is generally very low (Tables 5.5 to 5.8). According to the Kenya National Bureau of Statistics, Turkana South District had a population of 226,379 and a population density of 12 persons in 2009. Turkana Central had a population of 254,606 and a population density of 17 persons with Pokot Central District having 175,616 and 61 persons in total population and population density respectively.

Table 5.5: Demographic data by district

NO.	Districts	Male	Female	Total population	Total household	Area in sq. Km.	Density
1	LOIMA	-	-	-	-	-	-
2	TURKANA CENTRAL	126, 539	128, 067	254,606	41, 120	14, 590.7	17
3	TURKANA SOUTH	121,022	105,357	226,379	28,437	18,670.8	12
4	CENTRAL POKOT	87,199	88,417	175,616	32,548	2,898.7	61

Source: 2009 Kenya population and housing census, KNBS.

Table 5.6: Demographic data by division

NO.	Divisions	Male	Female	Total population	Total household	Area in sq. Km.	Density
1	LOIMA	21,003	19,901	40,904	5,288	3,429.0	12
2	TURKWEL	39,077	39,951	79,028	12,151	5,485.8	14
3	LORENGIPPI	4,110	3,511	7,621	974	617.7	12
4	LOKICHAR	35,756	31,986	67,742	8,175	4,536.6	15
5	KATILU	22,365	19,559	41,924	5,414	1,143.1	37
6	KAINUK	14,470	11,777	26,247	3,684	1,684.1	16
7	SIGOR	43,113	42,091	85,204	16,091	1,582.8	54

Source: 2009 Kenya population and housing census, KNBS.

Table 5.7: Demographic data by location

NO.	Locations	Male	Female	Total population	Total household	Area in sq. Km.	Density
1	LORUGUMU	13,152	13,519	26,671	4,437	1,612.5	17
2	LORENGIPPI	1,393	1,066	2,459	299	209.4	12
3	TURKWEL	3,871	4,268	8,139	1,602	333.3	24
4	KOTARUK	9,246	8,588	17,834	2,314	688.4	26
5	LOCHWAANG'IKAMATAK	11,137	9,644	20,781	2,346	1,674.3	12
6	LOKICHAR	12,240	11,212	23,452	3,308	878.0	27
7	KATILU	22,365	19,559	41,924	5,414	1,143.1	37
8	KAPUTIR	8,227	6,892	15,119	2,272	682.0	22
9	KAINUK	6,243	4,885	11,128	1,412	1,002.1	11
10	WEI WEI	4,487	4,354	8,841	1,722	185.6	48

Source: 2009 Kenya population and housing census, KNBS.

Table 5.8: Demographic data by sub-location

NO.	Sub Locations	Male	Female	Total population	Total household	Area in sq. Km.	Density
1	KALEMUNYANG	4,400	4,266	8,666	1,250	450.2	19
2	LORUGUMU	2,172	2,565	4,737	914	582.6	8
3	LOKICHAR	5,630	5,190	10,820	1,644	187.8	58
4	KOTARUK	5,304	4,574	9,878	1,142	225.3	44
5	NAIPA	1,860	1,746	3,606	493	199.2	18
6	LOCHWAANG'IKAMATAK	7,915	6,646	14,561	1,636	1,071.6	14
7	KANAODON	4,627	3,605	8,232	875	93.4	88
8	LOKAPEL	4,163	3,312	7,475	964	229.6	33
9	KALEMUNG'OROK	4,455	4,076	8,531	1,241	453.7	19
10	KATILU	9,120	8,566	17,686	234	366.4	48
11	KAINUK	3,936	3,215	7,151	900	186.5	38

Source: 2009 Kenya population and housing census, KNBS.

5.3.1.2 Population distribution by age

In spite of the harsh climatic realities coupled with poor distribution of health facilities, population growth is on an upward trend just like most parts of the country. The project area has a population density 12 people per Km^2. During the EIA it was noted that most parents in the age bracket of 37 – 40 and those above 41 have an average of between 6 and 7 children respectively as indicated in the figure below.

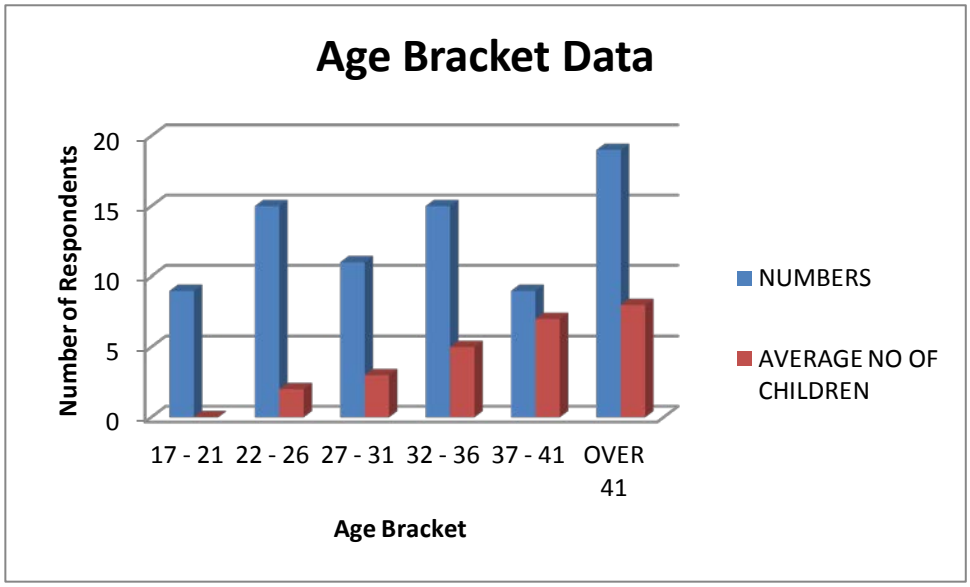


Figure 5.7: Age bracket data showing average household children numbers

5.3.1.3 Marital status

The residents of the project area are traditional and still hold their culture closely. Family values have been upheld in spite of the changing socio-economic situation. During the field study the EIA team sought to understand the marital status in the area. As indicated in the figure below majority of the residents still consider marriage as an important unit of the society.

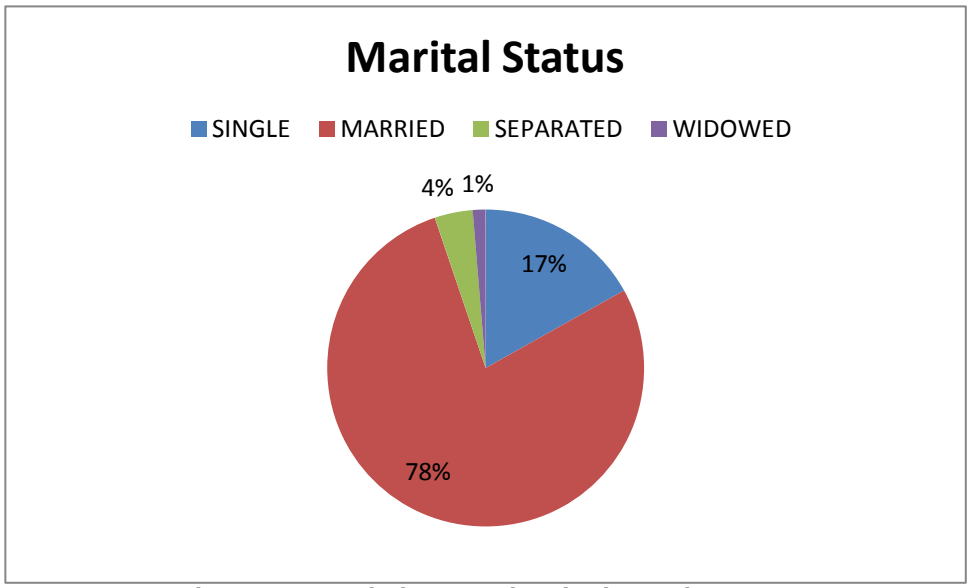


Figure 5.8: Marital status data in the project area

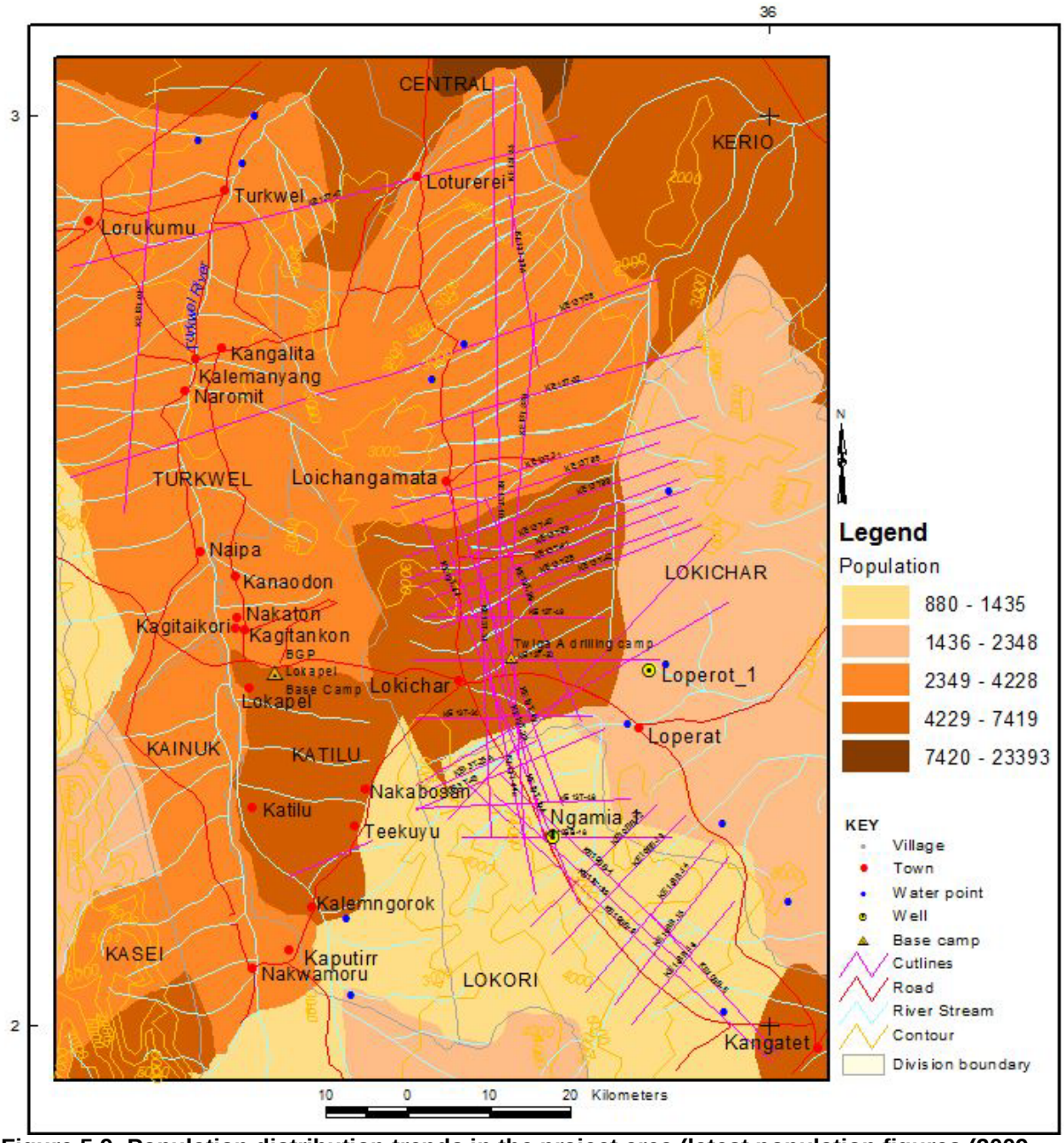


Figure 5.9: Population distribution trends in the project area (latest population figures (2009 census) are provided in Tables 5.5 to 5.7).

5.3.1.4 Education

The education sector within the area covered by Block 13T, just like any other ASAL region in Kenya faces numerous challenges. Among the key challenges are: low enrolment levels; nomadic livestock husbandry; lack of teaching aids and facilities; low transitional rates from primary to secondary schools and early marriages leading to increased school dropout. These problems are also experienced in Turkana South District where the current proposed exploratory oil and gas wells drilling project shall be located. During the study, the EIA team did a random sampling to establish education levels in the area. As shown in the education distribution figure below, approximately 24% of the respondents did not go to school and for those who reached primary level; only 10% proceed to secondary school.

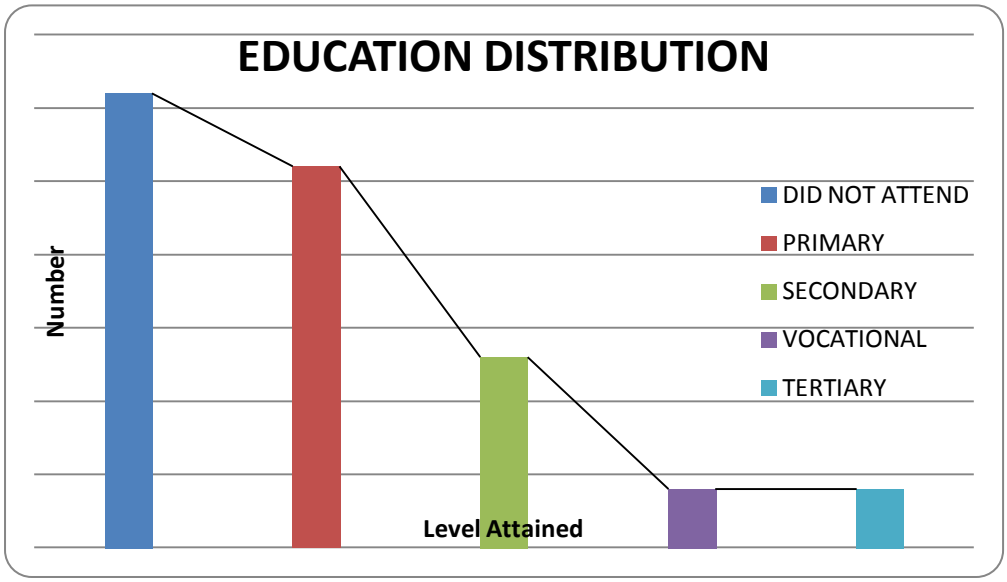


Figure 5.10: Education levels attained

During the study across the proposed project area, it was noted that there is now more emphasis on early childhood education. This initiative is spearheaded by the government in collaboration with NGOs. Provision of lunch for the pupils is used to encourage high enrolment at the ECD centres and primary schools.

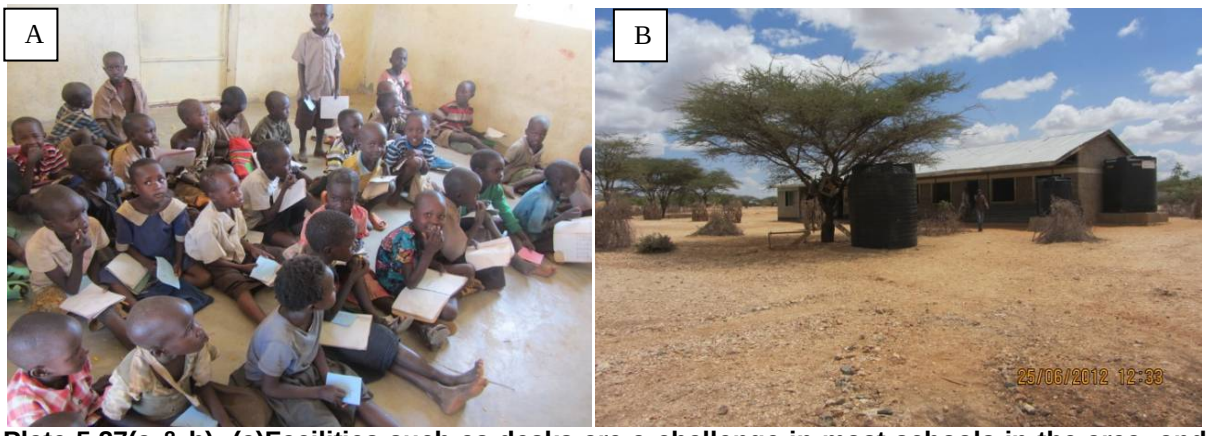


Plate 5.27(a & b): (a)Facilities such as desks are a challenge in most schools in the area; and (b)Locher-emoit Primary School.

5.3.1.5 Housing

Residents living in the project area traditionally lead a nomadic type of life that involves moving with livestock in search of pastures and erecting temporary shelters commonly referred to as *manyatta*. However, with the changing socio-economic situation and dwindling pasturelands, most residents are opting for sedentary lifestyle. The government in collaboration with some NGOs in the area are encouraging this new form of life through provision of social amenities and infrastructure construction. Water points, shopping centres, schools, religious sanctuaries and dispensaries, among others, have encouraged the development of permanent to semi-permanent residential structures. In spite of these efforts, temporary structures and *manyattas* also dot the project area. This could partly be explained by the fact the area has few job opportunities and thus local residents have low income.

Plate 5.28: A temporary homestead at Lochwaa

5.3.1.6 Energy Sources

Lokichar is the major town that is close to the proposed Twiga 1 site - the first exploratory well drilling site in the proposed test well drilling programme. The town is not yet connected to the Kenya Power and Lighting Company (KPLC) national grid power supply network. Solar power is the main source of energy for businesses and offices in the town. Residents in other small centres and the rural folks also rely on solar power, diesel generators, kerosene, charcoal and firewood for energy supply. The proponent proposes to use diesel generators to supply energy to the rig sites and the base camps, and LPG gas and charcoal for domestic purposes.

Plate 5.29: Bags of charcoal for sale near Lokapel

Plate 5.30 Use of solar power to provide energy at Kanaodon Dispensary

5.3.1.7 Land Tenure System

The land tenure system in the project area is communal. Thus, land is collectively owned by the residents and managed, on behalf of the community, by the Turkana County Council as trustees. Land adjudication is yet to take root in the area, thus pasture and settlement lands have no legal land ownership documents.

5.3.2 Economic Setting

Majority of the residents in the area are today involved in small scale business as a source of livelihood. Business activities are concentrated in shopping centres like Lochwaa, Lokichar, Locher-emoit among others. Other sources of income include casual labour, civil service, teaching and farming. It was noted that livestock husbandry as an occupation is gradually dwindling in the area largely due to changing socio-economic realities, climatic shocks, loss of pastureland and livestock rustling. Income levels are, however, low and range between 0 – 5,000 (shillings) monthly for farmers, pastoralists and small scale traders. On average it is only civil servants and teachers who earn an average income above Ksh.10, 000 to 20,000 monthly in the area.

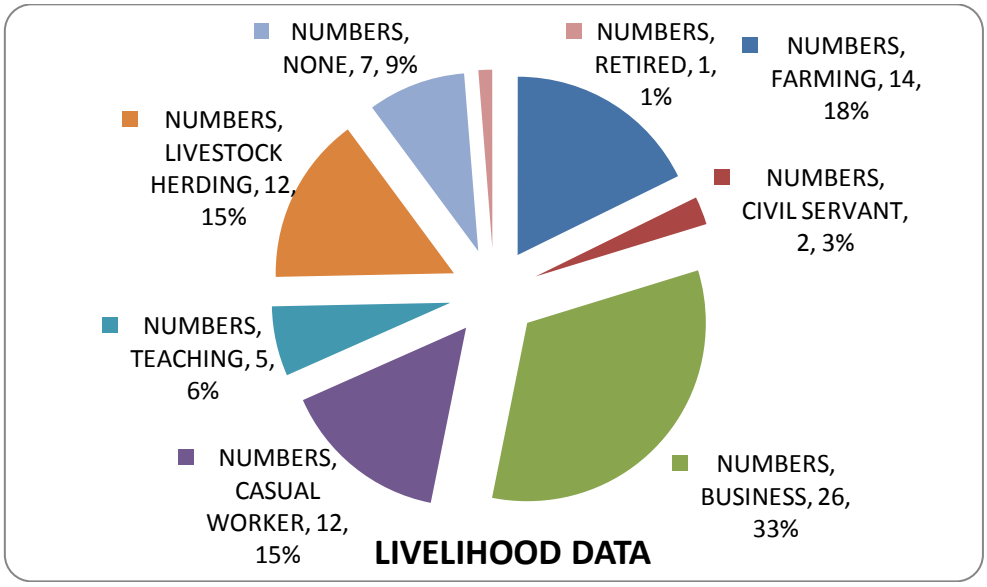


Figure 5.11: Source of Income data in the proposed project area

5.3.2.1 Labour Force

There is a readily available pool of semi-skilled and unskilled labour in the project area due to lack of major economic activities, except for livestock rearing. Many of the young unemployed school leavers are available for work, since there are limited job opportunities at the few urban centres in the area.

5.3.2.2 Livestock and Crop Production

In spite of a sedentary lifestyle taking root in the project area, nomadic livestock husbandry is still an important economic feature in the entire region. The residents rear cattle, sheep, donkeys, goats and camels. The livestock industry in the area is frequently faced with various challenges including climatic shocks, cattle rustling and diseases among others. Cattle rustling among the various communities is the major set-back for livestock keeping, and this is further compounded by drought that can lead to resource conflicts. The project area has no investment in abattoirs, thus there is no ready market for livestock products.

Plate 5.31: Livestock-keeping within the project area

Agriculture plays an important role in the economic welfare of the area. Agricultural activities are carried out mainly along the Turkwel River. This includes irrigation and rain-fed farming. There are several irrigation schemes in the area run by the National Irrigation Board, such as in Katilu and Koputiro areas. Rain-fed agriculture is undertaken on a very small scale, and the rains are often unreliable. Food crops grown along the river include maize, beans, millet, sorghum, and cassava. Horticultural produce grown across the region ranges from kales, cabbages, tomatoes to bananas. All these crops grown along the rivers, which are a source of food for almost the entire Turkana region, are supplemented with supplies from Kitale area.

Plate 5.32: Subsistence maize farming along River Turkwel in Katilu area

Plate 5.33: A Banana Tissue demonstration farm at Katilu

5.3.2.3 Industry

There are no industrial or manufacturing plants in the proposed project area.

5.3.2.4 Trade and Commerce

As noted earlier, the majority of residents living in the town centres engage in small-scale businesses. The businesses range from *Jua Kali* (artisanship), retail, wholesale, catering, distribution, and commercial rental housing. Others are kiosks, hardware, bars, private clinics and chemists, entertainment establishments (pool games and videos), carpentry and tailoring workshops, among others.

5.3.2.5 Tourism

There are no gazetted conservation areas in the immediate project site neighbourhood. However, the region, especially the lower part of Block 13T along Turkwel River, is home to many wild animals. South Turkana and Nasalot National reserves are found within the block to the south. The local people are hospitable and have a rich cultural background, unique flora and fauna, and the scenic landscape, which includes sand dunes and mountain vistas, place the region in a strategic position to benefit from ecotourism as well as the tourism industry. With the emerging fortunes of Turkana County coupled with determination by the government to boost the economy of the area through the Lamu – South Sudan – Ethiopia – Transport (LAPPSET) corridor project, the region's tourism potential is looking north and more players in the sub-sector should be encouraged to invest in the area.

5.3.3 Health Setting

The health sector in the area is largely run by the government in collaboration with NGO's. Private health clinics are not well established in the area. The main health facility in the project area is the Reformed Church health centre in Lokichar. The health centre is supported by UNICEF, Merlin (a health-related NGO), Christian Association of Kenya, World Vision and the government of Kenya. Dispensaries also dot key town centres like Kanaodon, Lochwaa, Locher-emoit and Kalemung'orok. Key challenges facing the health sector in the area include:

- Lack of adequate personnel
- Lack of facilities e.g. operating theatre, emergency facilities like oxygen, ambulances, laboratories and medicine
- Inadequate physical facilities like wards and beds
- Lack of finances to organise medical outreach programmes to the villages' most patients are unable to reach the health facilities due to poor means of transport

According to the clinical officer in charge of the Reformed Church health centre Malaria leads in the prevalence of common diseases and conditions in the area. Other prevalent diseases and conditions include diarrhoea, pneumonia, snake bites, typhoid, respiratory tract infections and fever.

5.3.4 Security and Public Safety

Security remains a major priority for the residents of the project. At the village levels security for homesteads and livestock is provided by heads of households. Village elders in collaboration with location chiefs often resolve domestic disputes, and their decisions are respected by the residents. All the villages have Kenya Police Reservists (KPR) recruited and trained by the Kenya Police Service. The district has a total of 250 KPRs spread across the villages. At the district level Turkana South have a fully-fledged police division headed by

the Officer Commanding Police Division (OCPD). Administration police camps are in the area and are located at the location levels. The main security-related issues in the area revolve around cattle rustling, highway banditry and common criminal activities.

Relationship to Project and EMP

Over the past few years oil and gas exploration activities have intensified in Northern Kenya. These activities have had an impact on the social, cultural, health, and the economic situation of the host communities. Of great interest today is the realisation by local residents that projects coming into their area should in the minimum change their socio-economic situation. This is the reality that TKBV will deal with as they commence the proposed project. Issues that will be critical to the communities include water supply and use, employment opportunities, goods and services supply, security, as well as health and education matters. The prevailing economic lifeline of the local people, particularly those in the villages, is nomadic livestock husbandry which relies heavily on large pastureland. The proposed project is to a great extend localised and will have minimal impact on pastureland. Thus it will not influence this form of livelihood in any way. The company should work closely with local provincial administration, community leaders, local NGOs and the government to initiate short, medium and long-term interventions that can improve the communities' socio-economic well-being. This in effect will make the communities identify with and appreciate the project and own it, thus leading to its successful implementation.

5.3.5 Community Views and Concerns

The community members who attended the public meetings did welcome the proposed project but appealed for adherence to environmental safeguards and labour legislation. The community, having already seen the benefit of the seismic survey and the drilling of Ngamia 1 oil drilling site that was undertaken by the same company, is optimistic that more benefit will be realized in the area. However, while in some areas the communities favoured the notion that TKBV works with them through Community Committee Liaison Officers, others did not support this view but rather preferred that job opportunities be subjected to open advertisement through the provincial administration structures. Some of the community's perceptions regarding the proposed project at the time of the public consultations included:

Community perceptions:

- The proposed project could have adverse impacts on the health of community members if toxic gases are released into the atmosphere.
- That there was a rumour doing the rounds that establishment of the first proposed exploratory test well drilling site would require community members of Kapese to be displaced from their land- a radius of 50Km. This rumour has however not been substantiated.
- If the test well drilling commences and oil is found, the country might get into war with neighbouring countries.

However, it is important to note that the community mentioned some of the positive and negative impacts they thought would be associated with the proposed project. They included:

Positive impacts

- Employment opportunities for both skilled and non-skilled labour from the community
- Provision of social amenities through CSR projects such as building classrooms and sanitary facilities for schools, and drilling of boreholes in the area;
- Creation of access roads in the area and thus improvement of the infrastructure in the area;
- Increased business opportunities and market creation for the local goods such as charcoal for use within the proponent's camps;
- Technological transfers from the skilled labourers to the unskilled labourers;
- Improved livelihoods of the community members who get job opportunities with Tullow Kenya B.V.;
- Improved levels of literacy in the community as a result of the bursaries and sponsorship programmes offered by the proponent;
- Urbanisation as a result of influx of people in the area in search of employment opportunities.

Negative impacts

- Favouritism and nepotism during the recruitment process through the use of CLOs and local administration to recruit youth.
- Increased vehicular traffic in the area would result in disturbance of livestock in their grazing areas.
- Loosening of soil and compaction in some area as a result of movement of heavy trucks in the project area
- Interference with pastures which the community highly value due to their pastoralist nature.
- Felling of trees to pave way for access roads and the proposed test well drilling site will destroy the already fragile ecosystem.
- Transportation and use of heavy machinery to the proposed test well drilling site will lead to compaction of soil.
- Air pollution from exhaust emissions and dust generated by vehicle traffic.

The EIA team mentioned that an Environmental Management Plan, addressing the potential negative impacts associated with the proposed project, which the proponent would have to adhere to strictly would be part of the EIA report.

5.3.6 Corporate Social Responsibility

The EIA team made extensive field visits in the project area and held public meetings with the local people and also administered questionnaires to households. While the community members are aware that TKBV cannot provide all their needs, they requested the company to consider a number of projects, which will be beneficial to the communities as part of their CSR.

CHAPTER 6

ANALYSIS OF PROJECT ALTERNATIVES

6.1 INTRODUCTION

A necessary part of the EIA process is the consideration of alternatives to the proposed activity.
The many complex factors controlling the location of oil wells (e.g. surface and subsurface geology, topography, communications) usually means that there are only a few viable alternatives that can be genuinely considered. The final two alternatives may simply be whether to proceed (drill option) or not proceed ("do-nothing" option). Processed and interpreted seismic data are used to indicate possible areas where hydrocarbons could be trapped in oil or gas-filled geological structures. Without exploratory drilling, however, seismic data is unable to show whether hydrocarbons are present, what their quantities are, and whether the hydrocarbons can be commercially extracted. Exploratory drilling is a necessary step in the development of commercial hydrocarbon production and is a requirement under the terms of the PSC awarded to TKBV.

6.2 PROJECT SITE ALTERNATIVES

The proposed project entails the drilling of exploratory wells to a depth of approximately 2,500 m in Block 13T at the potential locations identified from seismic data. NEMA E.I.A. regulations require an analysis of alternatives. This report therefore compares the following 2 alternatives:

i. "No action" alternative; and
ii. "Undertake drilling" alternative, which includes a consideration of the project location and project technology (rig and drilling fluids) alternatives.

6.2.1 "No action" alternative

The 'no action' alternative involves the rejection of the proposed project and all future potential field-level development alternatives. Should the 'no action' alternative be chosen, the potential financial and social benefits of oil and gas production will not be realised. In addition, this alternative would effectively prohibit development of onshore hydrocarbon resources in this instance, with the consequent impacts to businesses, future revenue and living standards. The country will continue to heavily rely on imported petroleum products. This option is not recommended for the following reasons:

Contractual reasons

- The initial Production Sharing Contract (PSC) with the Government of Kenya was awarded to Africa Oil B.V. with the aim of exploring in detail the assigned project area of 8429 km^2, in accordance with its contractual obligations under the PSC. TKBV has since become the operator in the project area and is working in collaboration with its partner, Africa Oil Corporation. Therefore, rejection of the proposed project would be in breach of the PSC contractual agreement;
- The PSC contract between the Government of Kenya and the proponent obliges the proponent to prospect for petroleum resources in the block.

Environmental and socio-economic reasons

- Similar projects in the country (CNOOC Africa Ltd. in Block 9, Merti, Africa Oil and TKBV in Block 10BB Turkana South and Turkana Central respectively) have shown that impacts are localized and can be mitigated;
- The proposed project will be vital in opening up the North Eastern Frontier areas of the country. The potential direct benefits to the region and the country at large are financial income and local business opportunities. Secondary indirect benefits are a potentially increased standard of living and better education, social services and amenities (for example, improved access roads);
- Kenya needs investments that can stimulate its economic development in order to achieve Vision 2030 and also be able to provide adequate, quality and affordable energy services;
- The project could be a source of revenue (adding to the Gross National Product) and foreign exchange earnings;
- The project has the possibility for long-term technology and knowledge transfer, bringing economic development and improving the quality of life; and
- No irreversible negative impacts that would render the project unfeasible have been found because of the environmental analysis conducted for the proposed drilling project.

The only positive impact of choosing the "No Action" alternative is that there will be no short duration impacts on the environment.

6.2.2 "Drilling" alternative

a) Project location

The project location is Block 13T as per the petroleum prospecting blocks demarcation by the National Oil Corporation of Kenya (NOCK). The Government of Kenya signed a PSC with the proponent granting them a licence to explore/prospect for oil and gas deposits within this block. Sites proposed for drilling within the block are identified after detailed geological studies, with the well location being determined by a probability of existence of reserves at a specific site based on available seismic data.

b) Project technologies

The following project technologies are considered for the proposed project due to their importance.

i. Drilling Techniques: vertical vs. directional drilling

Vertical drilling is undertaken when a wellbore is drilled with minimum deviation directly towards the reservoir. On penetrating the reservoir, drilling is stopped and the drill string removed. At this point, a string of steel casing is cemented in to preserve the integrity of the well. Drilling continues into the reservoir for a distance sufficiently long enough to allow proper well testing and evaluation to take place. A production pipe that is later perforated is run in to the bottom to allow the hydrocarbons to flow in once the well has been completed.

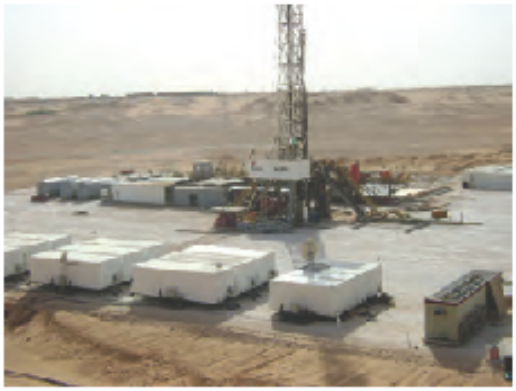
Directional (including horizontal) drilling has proven technically and economically feasible in a broad range of geologic settings, including tight gas, heavy oil, and coal-bed methane. This drilling method is proven to substantially increase production hydrocarbons by

connecting vertical fractures. Because the increased productivity more than compensates for additional costs, directional drilling can be a commercially attractive development alternative. This approach minimizes the surface area required for drilling, and simplifies the work involved to move the rig and equipment from well to well. However, directional drilling does not necessarily reduce the environmental impacts of oil/gas exploration and development (such as chemical spills and air pollution), and clustering operations can lead to an intensification of EHS impacts in the drilling area. Directional drilling is much more costly than vertical drilling, and is generally not used for exploration purposes, where the benefits are not fully realised. Directional drilling is more suited to development of hydrocarbon reserves than for exploration well drilling.

The proposed wells will be drilled vertically to a target depth of approximately 2,500 m. For this project, a standard medium duty land drilling rig which is already within Block 10BB (Ngamia 1 site) will be used as per rig specifications below.

Rig 804

Medium Duty, 1,500 HP



General Description	
Design	IDM Quicksilver
Estimated drilling depth rating	14,400 ft with 5-in. drillpipe
Camp capacity	Main camp 102 beds, mini-camp 23 beds, military camp 37 beds
Estimated total rig move loads	65 to 70 (including rig mini-camp and military camp)
Estimated total camp move loads	34 to 38

Mast

Type	IDM, triple telescoping, hydraulically raised
Height	136 ft (41.5 m)
Static hook-load capacity	750,000 lb (340,194 kg) with 12 lines
Setback capacity	1,250,000 lb (566,991 kg) Rotary table static load rating

Substructure

Type	Telescoping
Height	25 ft (7.6 m)
Clear height, rotary beam to ground	18.3 ft (5.58 m)
Casing capacity	750,000 lb (340,194 kg)
Setback capacity	400,000 lb (181,437 kg)

Drawworks

Type	IDM, single drum AC drawworks
Power rating	1,500 HP
Input power	1 × 1,500 HP continuous 1,830 HP intermittent duty AC motor
Drilling line diameter	1-3/8 in.
Auxiliary brake	Disc caliper brakes

Top Drive/Swivel

Type	Canrig portable model 1035 AC
Capacity	784,000 lb (355,616 kg)
Torque	Continuous torque 30,000 ft-lb at 160 rpm Intermittent torque 33,300 ft-lb at 180 rpm

Rotary Table

Type	American block RK 375
Table opening	37-1/2 in.
Drive type	One (1) 1,150 HP/1,500 HP AC motor

Engine

Engines	3 × Cummins KTA 50 DR diesel electric land engine rated at 1,470 HP at 1,200 rpm
Generators	3 × Kato, 1,100 kW and 1,571 kVA each
SCR/DC-DC	VFD

Well Control

Diverter	Not available
Low-pressure annular	Not available
Low-pressure ram preventer	Not available
High-pressure annular	1 × Sheffer, 11 in., 5,000 psi
High-pressure ram preventer	1× Sheffer, type LXT, 11 in., 5,000 psi, double 1 × Sheffer, type LXT, 11 in., 5,000 psi, single
Choke-and-kill manifold	Two choke valves 3 in.-5M + two -3 in. 5M valves Choke manifold 5,000/10,000
Accumulator unit	CPS, 7S-2 6-X-25 3,000 psi, 2 stations

Mud System

Mud pumps	2 × JF-1600, triplex single acting
Power rating	1,600 HP
Pressure rating	5,000 psi
Active mud volume	1,314.4 bbl
Reserve mud volume	1,290.0 bbl
Shale shakers	3 × MI Swaco Mongoose linear-motion, using four-panel, linear-motion screen decks on a common skid
Desander	One (1) 2 cones
Desilter	One (1) 16 cones
Mud cleaners	Not available
Sack storage capacity	Not available

Enhancements

Crane	Not available
Forklift	Caterpillar 966-D forklift, convertible to loader – 6 ton
Kelly spinner/pipe spinner	WFT KS 1500 AB
Desert-style moving capability	No

Weatherford International Ltd.
515 Post Oak Blvd., Suite 600
Houston, Texas 77027 USA
Tel: 713-693-4000
weatherford.com

ii. Drilling Fluids Selection

There are two basic types of drilling fluids: water-based muds (WBMs) and non-aqueous drilling fluids or Non-aqueous muds (NAFs or NAMs). WBMs have either fresh water or salt water as the primary fluid phase, while NAMs have either refined oil or synthetic materials as the primary fluid phase. For many wells, drilling conditions (e.g. deviated or horizontal wells, active shale) often require the use of NAMs instead of WBMs for efficient, cost-effective operations.

WBM is the most commonly used medium in drilling operations, one of the reasons being that drilled cuttings from WBM are much less damaging to the environment when disposed of compared with oil or synthetic oil-based fluids. However, water-based systems are not always as effective as oil- or synthetic-based fluids but NAF systems are generally only commercially attractive in operations with high day-rate costs such as offshore drilling. OBM shows improvements over standard water mud in the areas of increased drilling rate and bit life, reduction in drill-hole problems and torque, less sticking of pipe, and less hole-enlargement, but can be toxic to plants and animals, so its use is tightly controlled, and it can also be prohibitively expensive. SBMs are a relatively new class of drilling mud. They were developed to combine the technical advantages of OBMs with the low persistence and toxicity of WBMs. Again, these can be prohibitively expensive and are as a result not the mud-system of choice.

The drilling fluid to be used for this project will be Water Based Muds (WBM) prepared by mixing mud additives and chemicals on site to the desired concentrations in fresh water (See section 2.5).

iii. Camp site Design

Campsites will be built and equipped in such a manner that they will comfortably accommodate up to 150 personnel on site at any one time. They shall be sited (without compromising oil target) and constructed with advice from professional security personnel and local community leaders. Campsites shall be located at a reasonable distance away from any village, and be fenced off with controlled access only.

CHAPTER 7

ENVIRONMENTAL IMPACT ASSESSMENT

7.1 INTRODUCTION

The baseline biophysical and social environmental parameters established in Chapter 5 are critically examined in this section in relation to the potential environmental and socio-economic impacts of the proposed exploratory oil and gas wells drilling programme. In addition to adhering to the mitigations below, the proponent needs to comply with the requisite national legislation and regulations that are outlined in Chapter 4 of this report.

It should be noted that exploratory oil and gas drilling programme activities are of short duration, typically about 120 days. This is supported by the fact that a suite of exploratory oil and gas well drilling programmes have already been conducted in the onshore (Merti, Isiolo and Loperot, Turkana and currently Ngamia, Lokichar) areas of Kenya, and no adverse or long-lasting impacts have been reported from these activities. All EIA project reports that have previously been submitted to NEMA on such exploratory oil and gas drilling programmes have been approved.

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

7.2 ENVIRONMENTAL AND SOCIAL ASPECTS AND IMPACT IDENTIFICATION FOR TEST WELL DRILLING OPERATIONS

The components of exploratory wells drilling programme and related activities that have been outlined in Chapter 2 and that could result in environmental and social impacts are indicated in Table 7.1 below:

Table 7.1: Project impact sources and prediction of impacts on environmental and social structure and characteristics of the project land area.

	Environmental or Social Parameter	Impact Source	Predicted Impacts
1.	▪ Physiography and Geology	▪ Clearing of access roads using bulldozers ▪ Development of well sites	▪ Access roads to the site leave long-lasting residual impacts (tracks and/or scarring on surface rocks) ▪ Transfer of geological materials (cuttings) from the sub-surface to the surface
2.	▪ Soils	▪ Construction of access roads using bulldozers and associated equipment ▪ Construction of drill well pad and rig ▪ Construction of campsites and associated facilities ▪ Vehicular movement during project operations	▪ Compaction of soils in the working area and access ways changing percolation rates and drainage patterns ▪ Disturbance of soil through construction and excavations ▪ Possibility of enhanced gullying

		▪ Oil or chemical leaks from vehicles and machinery, garage and storage areas ▪ Effluent leaks and/or contamination from waste pits ▪ Development of well site	and erosion (wind and water) in constructed area and access roads ▪ Rutting in loose soils ▪ Contamination of soils ▪ Possible caving in of soil in well pad design (near surface competence that bear on load capacity) and drill cuts and waste pits due to soil stability factors ▪ Mixing of cleaned cuttings in soil environment
3.	▪ Air Quality	▪ Power generators and associated machinery ▪ Vehicles ▪ Sanitary systems ▪ Waste disposal points ▪ Flaring	▪ Pollution from exhaust emissions ▪ Fugitive dust generation from traffic ▪ Offensive odours ▪ Health risks ▪ Greenhouse gases
4.	▪ Water Quality	▪ Liquid effluent discharges from sanitation systems at the campsite ▪ Oil or chemical leaks from garage and storage areas, vehicles and machinery ▪ Subsurface circulation of drilling mud ▪ Inappropriate waste pit design and waste disposal protocols ▪ Accidental discharge of solid and liquid wastes on soil ▪ Casing and cementing of the well	▪ Contamination of water supply source for the camp ▪ Contamination of underlying aquifers ▪ Contamination of surface water
5.	▪ Terrestrial Environment (Habitats, Flora, and Fauna)	▪ Clearing of vegetation for construction of campsites, well pad, access roads and other facilities ▪ Noise from drilling operations, generators, vehicles and other machinery ▪ Presence of the workforce ▪ Exotic weed and pest contamination of vehicles and equipment used outside the region and then imported to the project area ▪ Development of well site	▪ Reduced vegetation cover ▪ Disturbance of wildlife (physical presence and noise) ▪ Introduced weeds and pests
6.	▪ Land Resources	▪ Drill rig and ancillary equipment ▪ Campsites ▪ Vehicles ▪ Presence of humans	▪ Manmade structures may lower aesthetic value of landscape ▪ Disturbance of animals and flora
7.	▪ Archaeological, Historical and Cultural Sites	▪ Drill rig and ancillary equipment ▪ Campsites ▪ Vehicles ▪ Presence of humans ▪ Access road construction	▪ Compaction by heavy vehicles and machinery may damage cultural sites ▪ Tension with local communities.
8.	▪ Visual Aesthetics	▪ Campsite design ▪ Access ways ▪ Rig site assembly	▪ Poor campsite design and rig site assembly may lead to visual obstruction and does not blend in the environment
9.	▪ Noise and Vibrations	▪ Drilling rig and operations ▪ Generators ▪ Support vehicles	▪ Disturbance to humans, animals and livestock ▪ Disturbance to workers ▪ Health risks

10.	▪ Solid and Liquid Wastes	▪ Drilling rig sites, campsites ▪ Workplaces in the field	▪ Pollution of surface and ground water ▪ Offensive odours ▪ Health risks ▪ Contamination of soil ▪ Litter
11.	▪ Social Characteristics	▪ Workforce influx. ▪ Activities at the proposed project site	▪ Possible increase in crime rate and other social decadences ▪ Erosion of culture and social values as a result of intermingling with workers ▪ Conflict between community and immigrants ▪ Possible increase in school drop-out by individuals searching for jobs ▪ Increased pollution: waste and air ▪ May interfere with grazing lands ▪ Improved security surveillance
12.	▪ Economic Characteristics	▪ Employment opportunities ▪ Tenders and supplies ▪ Training opportunities	▪ Improved livelihood ▪ Improved short-term business opportunities for the locals ▪ Opening up of local economy to more development
13.	▪ Occupational Health and Safety	▪ Drilling rig site and fieldwork environment ▪ Chemical material stores ▪ Vehicles	▪ Injuries to workers, visitors and area residents arising from project operations ▪ Fire hazard ▪ Other health risks such as respiratory diseases due to dust ▪ Motor accidents
14.	▪ Security and Public Safety	▪ Workforce influx	▪ Petty crimes ▪ Improvement in security due to security enhancement for project activities

7.3 IMPACTS ASSESSMENT AND MITIGATION

During the mobilisation (and demobilisation) period, including transportation of materials to (and from) the site, accidental spillage of fuel, lubricants, chemicals, etc., may occur. The mitigation of the potential impacts of these activities is addressed in the Plans (Transport Management, Hazardous Materials Management, Spill Prevention and Response, and Emergency Response) that are outlined in the EMP in Chapter 8. Here, the mitigations relate to the activities that will be undertaken within the project area and that directly relate to the objectives and foreseen outcomes of the project.

7.3.1 Physiography and Geology

The sites that are being considered for exploratory well drilling are relatively small in area compared to the total land mass of the Block 13T (8429.33 km^2) and the access roads that will be constructed will utilise existing routes to the extent possible, hence there will be very minimal impact on physiography and geology. The risk of subsidence due to passage of heavy vehicles is negligible due to the geology, but localised compaction of surface materials may occur in some places underlain with sedimentary materials or relatively thick soils. This is most probably so in the Turkwel River floodplain and some low-lying parts of the piedmont plain (Y10 unit) and sedimentary plain (Ps28 unit) especially during the wet

seasons (March to May; October to December) due to flooding and/or ponding. The area is generally aseismic so earthquake risk is very low.

Mitigation:

- Use existing access roads to the proposed drilling sites to the extent possible;
- Pre-survey possible access routes, and use the selected route(s) rather than accessing the work site through free-range driving across the open country;
- Movement of the crews and the vehicles should be restricted to existing roads and within the operation site to avoid creating unnecessary tracks and trampling of pasture around the drilling site;
- Avoid making roads on steep slopes susceptible to rock fall (see Table 5.2); and
- Avoid the Turkwel River riparian area by 30m. Circumvent the area to avoid compaction of soils that are usually used for crop growing and shallow sand aquifers that are a source of water for the local communities and livestock during the dry season.

The potential residual impacts would be rock scarring and displaced sediments (sand dunes), gravel and boulders, related to construction of new access roads to the drilling sites. There will be no residual impacts at the drilling site except the drilling hole, which will be plugged and abandoned if dry.

7.3.2 Soils

In the areas where the surface soils have high sand content, especially in the undifferentiated levels, sedimentary plains (Ps28 unit) west of Lochwaa and upper fringes of Y10 units bordering the uplands (Ux10 unit) adjacent to Loturerei, Nagetei, Lochwaa and Kaaroge, and the whole of Ux10 unit (Figure: 5.5) respectively, compaction by vehicles and machinery will be slight. However, soils of the River Turkwel floodplain [(A8 unit) (Figure: 5.5)] and soils of the piedmont plains (Y10 unit) bordering A8 unit near Kangalita, Kanaodon, Nakaton, Katilu, and Kalemng'orok are more susceptible to compaction and hence degradation due to their higher clay content and presence of salts. However, if these soils are adequately dry (soil moisture content below the plastic limit) when activities occur and vehicles and machinery minimize the number of times they drive across these soils (save for soils in mapping unit A8), compaction should be moderate and soil productivity, excepting other growth factors (as measured by a plant's ability to grow) should not be noticeably affected. Further, for activity targeting A8 unit, movement of machinery/vehicles should be restricted to the adjacent and bordering soil-mapping units where practicable.

The drainage characteristics of soils with a higher sand content in Ps28 and Ux10 units are well-drained soils and surface discharge of re-circulated/treated and decontaminated wastewater should not affect the soil drainage characteristics adversely, if done in phases to allow percolation into the soil. However, the Y10 and A8 soils are moderately to imperfectly drained and the fact that surface discharge of water may not be appropriate, as ponding for long periods is normal in such soils. The soils are susceptible to erosion by wind and water. Evidence of erosion over-wash and ponding (Ps28 unit) and rills (Ux10) has been observed on access ways and cut lines in the area.

All the soil units save for A8 unit are sodic in nature at various thresholds (see Appendix 3) and since sodium is a dispersion agent in soil, near surface competence of the soil material *vis à vis* surface loading, may be breached. This will affect mechanical surface trenching and pit establishment and contact of surface water with the soils. The results may be near surface caving in or subsidence of soil material. The exception to this is soil unit Ux10,

where soils are very shallow (0-25 cm depth), overlying parent material. This unit is very shallow to moderately deep. Though it has soils that are strongly sodic, where the surface soil is shallow, the soils can be skimmed off and subsurface development like pits can be constructed albeit with the necessary precaution of lining the walls. The soils may also be contaminated by (mostly) accidental spillages of liquid effluents, oils, fuels, and chemicals.

Mitigation:

- Mitigations in section 7.3.1 above apply;
- Access roads must be furnished with flow-diverters (cross-drains) at appropriate spacing according to slope to reduce sediment movement and erosion. Vehicles should steer away from natural drains and waterways as is practicable, and a buffer zone of 20m should be maintained except at crossing points;
- Minimize vegetation clearance as much as possible when clearing the area for well pad and campsite construction;
- Topsoil that is stripped and removed for construction should be preserved for rehabilitation of the constructed (campsite/drill rig) area at the end of the project;
- The establishment of drill cuttings pits and wastewater pits should be confined to Ux10 and Ps28 units whose drainage characteristics and soil texture allow for pit establishment. These pits should be lined with suitable Polyurethane high-density membranes since the soils are sodic and may erode easily on contact with water. The Ux10 unit has rock outcrops, boulders and stones. This unit may require use of hardened tools and competent machinery to excavate. Further, where the walls of the pits may be irregular and rugged due to occurrence of stones and rocks on the walling, an alternative to lining with HDP membrane may be the use of bricks. The A8 and Y10 units' soils are very deep and are moderately to imperfectly drained. Further, the units exhibit surface sealing and crusting thus inhibiting surface water percolation until the seal/crust is broken by water pressure in a heavy downpour (kinetic energy of raindrops) or ponded water (potential energy of the water body). Thus, drill cuts, mud and waste pits could easily overflow, pond and contaminate the surface soils and shallow groundwater table. The use of steel tanks instead of pits for these particular units is recommended;
- Pits for containment of drill cuttings, spent drilling fluids, domestic and sanitary effluents, should be sited and designed by a competent and licensed contractor and based on consideration of the geological and soil characteristics of the area to avoid soil contamination;
- Ensure that all vehicles and machinery do not have any oil leaks that could contaminate the soils and that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available;
- All fuels and other non-aqueous fluids should be stored in suitable bunded enclosures;
- Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through tool-box talks; and
- Installation and proper management of camp sanitation facilities.

The potential residual impacts would be contaminated soils and enhanced ponding, gullying and erosion due to altered runoff and drainage patterns at local scales.

7.3.3 Air Quality

On meso- to micro-scales, air quality variation relates primarily to changes in the wind speeds in the area and the associated particulate dust that the wind transports from one

place to another. The winds can raise substantial quantities of dust. The disturbance of fine-grained (fine silt to clay sized particles) soils by vehicles traversing the area will lead to small quantities of transient airborne dust being generated, especially during windy conditions, but will be far less than the naturally generated particulate air loading in the area.

Project operations will affect air quality on a micro-scale, and in a transient manner, through exhaust emissions from vehicles and machinery as well as fugitive emissions (such as from leaking pipes and tubing, valves, connections, pump seals, compressor seals, pressure relief valves, tanks or open pits / containments, hydrocarbon loading and unloading operations, and poorly managed waste disposal and sanitary facilities).

Diesel generator sets at the test well drilling sites will be in operation 24 hours a day to power the drilling rig. Emissions from the generators will consist mainly of CO_2 and water, and contain traces of NO_2, SO_2 and suspended particles. The concentration of SO_2 in the emitted gas will depend on the fuel source. Emissions are expected during temporary well flaring in the event that hydrocarbons are discovered. Such emissions will include volatile organic compounds (VOCs) such as methane and ethane, benzene, ethyl benzene, toluene, and xylenes (BTEX); glycols, and polycyclic aromatic hydrocarbons (PAHs).

Mitigation:

- Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation;
- Field vehicles, trucks and any other machinery should be switched off when not in use;
- Regular servicing of all trucks, service vehicles, and any other machinery should be carried out to ensure efficient combustion and minimisation of exhaust emissions;
- Use low sulphur fuels if available and where suitable;
- Employees working in dusty conditions must use appropriate PPE;
- If litter is to be burned, it should be done at a time of low wind movement, and preferably in areas shielded from wind by vegetation;
- Installation and proper management of camp sanitation facilities should be ensured;
- An efficient test flare burner head equipped with an appropriate combustion enhancement system should be selected to minimize incomplete combustion, black smoke, and hydrocarbon fallout;
- Flaring should adhere to the Global Gas Flaring and Venting Reduction Voluntary Standard (part of the World Bank Group's Global Gas Flaring Reduction Public-Private Partnership (GGFR program) or equivalent industry standard; and
- Fuel usage and hydrocarbons flared will be recorded and monitored.

There shall not be any residual impacts.

7.3.4 Surface and Ground Water Resources

This section deals with mitigation of impacts on water resources in terms of quantity and availability. Mitigation of impacts on water quality is addressed in section 7.5.5 below.

Water supplies will be accessed as outlined in Chapter 2, section 2.6. There are shallow groundwater aquifers that supply the springs and shallow wells with water, which is used for domestic purposes and livestock watering. Such aquifers could potentially be compacted by heavy vehicles and/or equipment, thereby reducing yields.

Mitigation:

- The company should drill its own water supply boreholes;
- An efficient water-use policy shall be adopted by the project proponent at the camp base and drilling sites and other work areas (section 4.2.2);
- An efficient sanitation system should be put in place in the base camp and drilling operation site to handle effluents (sections.4.3.8, 4.4.9);
- Ensure proper spill control and management for machinery and vehicles at site and in the field;
- Use proper engineering techniques during the drilling, cementing and casing of the exploratory wells;
- All chemical and fuel storage areas will have proper bunds so that contaminated run-off cannot meet the storm-water drainage system;
- Hazardous and toxic waste material should be managed according to international protocols and practices (the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989) and must comply with the Environment Management and Coordination (Waste Management) Regulations;
- The storm water system will be efficiently designed and maintained;
- TKBV will carry out proper designing of on-site storage disposal for processing wastes in accordance with Central Pollution Control Board (CPCB) guidelines and with proper liner systems; and
- Heavy vehicle and equipment movement to and from the campsite/drilling areas should detour known groundwater supply points (e.g. wells and springs) by at least 500m and cross *luggas* at road crossings to avoid contamination particularly during rainy seasons.

Residual impacts on surface and groundwater resources in terms of quantity and availability are not expected if the mitigations outlined above are effected.

7.3.5 Water Quality

There are several potential point and non-point sources of pollutants that can be generated during the life cycle of the project and that can lead to contamination of surface and ground water at site-specific and local scales. During construction of the access roads, campsite and drill pad areas, fluid leakages (e.g. accidental spillage of fuel, and lubricants from vehicles and other machinery being used in the construction process) may occur, and could eventually contaminate surface and groundwater. During the operational phase, poor site drainage and sanitary system design, accidental spillages of fuel, lubricants and liquid or liquid-soluble solid chemicals from the drill rig area and storage areas, drilling waste disposal pits, vehicles, and machinery may occur, if they are not properly designed or maintained. Groundwater aquifers that may be encountered during the drilling operations may also be susceptible to contamination from drilling fluids if proper well control, construction and management are not instituted and monitored. Depending on the nature of the contaminant, its source, the location at which it is released into the environment, the nature of the environment into which it is released (e.g. flowing or ponded surface water, shallow or deep aquifer), and the response time and method used to contain the pollutant, the pollution may be site-specific or local in extent, and of short to long-term duration.

Mitigation:

- An efficient sanitation system should be put in place for camp workers to eliminate or minimise the levels of potential water pollutants from domestic effluents;
- Pits must be lined with an impermeable liner such as HDPE; for containment of drill cuttings, spent drilling fluids, domestic and sanitary effluents, should be sited by a competent and licensed contractor and based on consideration of the geological and soil characteristics of the area to avoid contamination of nearby surface and ground water systems;
- All chemical and fuel storage areas should be bunded, with spill kits readily available and operatives trained in their use. The bunds must be a minimum of 110% of the capacity of the largest vessel to be bunded;
- The company should use proper engineering techniques during the drilling, cementing and casing of the exploratory well;
- Fuelling will take place in a designated area;
- Hazardous and toxic waste material should be managed according to international protocols and best practices and in compliance with Kenyan legislation, specifically the Environment Management and Coordination (Waste Management) Regulations;
- Ensure that all vehicles and machinery operating in the field and at drilling operation sites do not have any oil leaks(section 4.3.10);
- All refuelling operations to be carefully overseen and managed;
- Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through toolbox talks.

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

7.3.6 Terrestrial Environment (Habitats, Flora, and Fauna)

Within Block 13T, several habitats exist, namely: dwarf shrublands, shrublands, and riverine forests and near barren habitats. Potential impacts to biodiversity could arise due to the physical disturbance during the construction and operation (drilling) phases of the project, contamination of the environment due to chemical/ oil spillage or leakage and inappropriate liquid and solid waste disposal mechanisms. Removal of vegetation and topsoil during the development of well pads, access roads and other ancillary facilities will lead to impacts such as a loss of wildlife habitat, reduction in plant diversity, potential for increased erosion, and potential for the introduction of invasive flora species. Indirect impacts to vegetation would include increased deposition of dust, spread of invasive and noxious species, and the increased potential for wildfires. Dust settling on vegetation may alter or limit plants' abilities to photosynthesize and/or reproduce. These processes may lead to the reduction in habitat, food and nutrient supplies and breeding areas.

Mitigation:

- The mitigations related to soils (See 7.3.2) apply;
- Trees with trunk diameter greater than 20cm should not be cut;
- Ensure that equipment is in perfect working order and cause less noise/ vibration/air pollution nuisance to fauna;
- Hunting, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. This prohibition should extend to the purchase of these items from the indigenous population by workers;
- A material safety data sheet should be maintained for all potentially hazardous materials, as well as supporting documentation for the transport, use and disposal of such materials;

- Used motor oil and filters from vehicles and generators should be removed from the area for proper disposal. Used motor oil should not be used from dust suppression on access roads. Disposal of chemicals and motor oil should be documented, including quantities involved, and disposal locations;
- A plan should be prepared to prevent and contain accidental oil discharges or fuel spillages. All equipment should be fitted with drip trays and stationary fuel storage facilities should have secondary containment;
- Pre-planning siting of wells and access roads; and
- Restoration.

The residual impact will be reduced vegetation cover around the drilling rig site; however, this will recover in a few years. Given the small scale of vegetal matter removal, this impact is not considered significant.

7.3.7 Land Resources and National Reserves

Pasture and browse are the major land resources in the area and support the pastoral lifestyle of the local community. The drilling operations within the block may impact on livestock pasture and browse area. The Nasolot and Turkana South National Reserves are tourist attraction sites within the area.

Mitigation:

- Mitigations in sections 7.3.1 (Physiography and Geology), 7.3.2 (soils), 7.3.4 (Surface and ground water) and 7.3.6 (Terrestrial Environment) apply;
- Before the commencement of the drilling activities, the proponent should liaise with the community to identify any cultural or revered sites in the area;
- Extensive consultations should be made with community leaders to ensure that the proposed drilling projects do not interfere with the community's valued land resources; and
- In as much as possible, the exploration process and the associated activities should avoid sensitive ecological systems and cultural sites.

7.3.8 Archaeological, Historical and Cultural Sites

The project area has no known archaeological sites but cultural sites like meeting points and graves are present in the residential neighbourhoods. The proposed project site locations shall avoid cultural sites.

Mitigation:

- Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites prior to the construction of proposed exploratory drilling pads and construction of associated auxiliary infrastructure like access roads in order to prevent conflict with the community; and
- All project field workers must be informed, before commencement of operations, that any disturbance to, defacement of, or removal of archaeological, historical, or sacred material will not be permitted.

No residual impacts are expected.

7.3.9 Visual Aesthetics

It is anticipated that there will be minimal impacts on the aesthetics of the pristine environment. Construction of campsites and drill rigs will have some minor impact on the outlook of the project area. The proposed drilling project has a limited time frame and is transient in nature, thus the visual intrusion shall be negligible.

Mitigation:

- Drill rig and campsite design should take into consideration the aesthetics of the selected areas.

7.3.10 Noise and Vibrations

During drilling, there will be noise emissions from the drill rig, power generators, support vehicles, and other machinery. Noise emissions from the proposed development would be localised, and thus would have minimal effect.

Mitigation:

- Ensure that equipment such as generators, drilling rig components, and other machinery have working silencers to muffle noise and effect a noise mitigation policy for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations;
- Provide full personal protective gear to workers as appropriate (e.g. helmets and ear muffs/plugs) and as specified in the Occupational Safety and Health Act;
- Workers should be sensitized on noise-related and other hazards likely to be encountered in such a work environment, and trained accordingly;
- Engage local leaders in sensitising the communities near the drilling area about the project and its possible noise impacts;
- All machineries such as generators and drilling rig components should be fitted with noise abatement devices like silencers to muffle noise;
- Use generators with minimal noise levels (silent pack enclosures) at the residential campsites and effect a noise mitigation policy for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations; and
- Segregate the drilling area from the residential area and construct a fence and/or berm; and living quarters nearest to the boundary should be made of containers which are reasonably sound-proofed.

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

7.3.11 Solid and Liquid Wastes

Solid and liquid wastes will be generated by a number of operational streams during the course of implementation of the project. These include: papers, plastics, drill cuttings, drilling fluids, domestic waste and sewage, waste oils, and others. These wastes will need to be properly managed in order not to undermine the environmental integrity of the project site. Disposal options include: incineration, compaction and removal from site, and burial (especially for biodegradable material and drill cuttings), or a combination of these activities. These options have been outlined in Chapter 2, section 2.7.2 for the various waste stream components.

Mitigation:

- Mitigations relating to section 7.3.5 apply;
- A waste management plan (based on the principles of the Waste Management Hierarchy [section 2.7.2]) documenting the waste strategy, storage (including

facilities and locations), handling procedures, and means of disposal should be developed and should include a clear waste-tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location in compliance with the Environmental Management and Coordination (Waste Management) Regulations (section 4.4.9);

- Systems for treating drill cuttings, and solid and liquid wastes generated in the course of rolling out the project, should be properly selected, installed, managed and decommissioned according to national legislation, regulations, the Tullow Drill Fluids and Cuttings Disposal Standard and associated Guidelines, and international best practices in order to minimise or eliminate their potential environmental impacts;
- Waste materials should be segregated into non-hazardous and hazardous waste, and consideration given to re-use, recycling, or disposal (section 4.4.1) as appropriate. This should be done by an authorised waste handler licensed under the Waste Management Regulations, 2006;
- A materials/chemical management plan will be developed, and a safety data sheet should be maintained for all potentially hazardous materials, as well as supporting documentation for the transport, use and disposal of such materials;
- The structural integrity of containment pits for drill cuttings, drilling fluids, mud pits and water storage reservoirs should be ensured – such pits should be appropriately lined and / or bunded;
- A plan should be prepared to prevent and contain accidental drilling fluid, oil discharges or fuel spillages. All equipment should be fitted with drip trays and stationary fuel storage facilities should have secondary containment;
- Hygienic sanitation and disposal of grey and black water will be covered in the waste management plan in order to protect the general health of the workers and the general public;
- The EHS department to document any accidental releases as to cause, corrective actions taken, and resulting environmental or health and safety impacts; and
- The EHS officer shall consult with the local authorities in Lokichar and Lodwar to determine where and how the different types of wastes that will be generated during the project can be disposed of.

7.3.12 Social Characteristics

The people in the project area are from the Turkana community. The locals are conservative with respect to their culture and may appear to outsiders as resistant to change. The unique characteristic of the communities is their traditional system of nomadic pastoralism. From the field visit and interactions with members of the local community, it is apparent that the people value their livestock as their most valued possession and this goes hand in hand with their land and vegetation, which provide pastures. The area is also associated with high poverty levels and over-reliance on relief food. The youth in particular complain about lack of employment opportunities in the area. Due to the poverty levels in the area, illiteracy levels are also high. The proposed project is expected to have positive impacts on the area through supported social projects. These include building of classrooms and latrines for schools, drilling of boreholes, increased levels of security, employment opportunities and provision of bursaries for needy students. However, the community expressed their views in relation to the potential negative impacts that could be experienced as a result of the proposed project. They included:

- Their culture might be compromised due to influx of outsiders into the area in search of job opportunities;

- Loss of their grazing lands /pastures during the construction of drilling sites and base camps;
- Displacement of people from their land;
- Increased school dropouts as students seek to earn income to support their families;
- Moral decay due to the arrival of people of different cultures and values into the area;
- Misinformation of community on the nature of the proposed test well drilling project; and
- Reduced security personnel guarding the community due to employment opportunities at the test well drilling sites.

Mitigation:

- Ensure that the project does not offer job opportunities to school going children;
- Sensitize workers to respect the community cultural beliefs and values;
- Proponent to maintain good relations with community;
- Sensitisation of the community on the activities to be carried out in the proposed project, and the scheduling of such activities and their potential impacts, should be done periodically and continually. Community Liaison Officers shall be employed by the proponent to perform such duties;
- The proponent should liaise with Administration Police to ensure the area is safe;
- Provision to be made to compensate local property and landowners for any loss or damage caused by the operations culminating the proposed project;
- The proponent should ensure that its employees and contractors relate well with the community. This can be achieved through enlightenment of the workers on the community's culture and traditions;
- The proponent should liaise with the local police departments to ensure that the community's security is ensured at all times. This can be achieved through employment of security personnel on a rotational basis; and
- Grievance process developed to deal with any complaints.

7.3.13 Economic Characteristics

Livestock are central to the Turkana culture and all aspects of their social and economic life revolve around the livestock. Cattle, sheep, goats, camels and donkeys are vital to the people and are the primary source of food. Livestock also play an important role in payment of bride price, compensation for crimes, fines for fathering illegitimate children, and as gifts on social occasions. The community, especially along the riverine areas, has also embraced fishing and agriculture. The proposed project is expected to offer limited, short-term, unskilled and semi-skilled employment opportunities to the locals. This may result in influx of people from other areas, and could lead to recruitment-related conflicts if not properly handled. Due to the poor infrastructure in the project area, the community could also benefit from the access roads that will be created by the proponent at the time of preparation and construction of the exploratory well drilling sites.

Some of the issues raised by the community likely to occur due to the proposed project include:

- Transfer of skills for the locals;
- Employment opportunities to the locals;
- Increased short-term business opportunities for the locals;
- Unequal distribution of employment opportunities in the area, with some parts of the Block benefitting more than others;

- Lack of transparency and discrimination in the allocation of employment; and
- Age limits in the provision of employment opportunities.

Mitigation:

- A portion of skilled and semi-skilled labour should be sourced from the local community;
- Gender and age should be factored in when offering employment opportunities;
- Liaise with community leaders during the recruitment process;
- Ensure that the recruitment process is representative of all the areas in the Block; and
- Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan.

The residual impacts in this instance would mostly be positive, including short-term employment opportunities and infrastructure improvements if access roads are designed in such a manner that they would be useful to the community post-project.

7.3.14 Occupational Health and Safety

The proposed project will involve around the clock operations at the rig sites. This may expose workers to occupational and health hazards from falling objects, malfunctioned machineries, well blowouts and H_2S gas pollution.

Mitigation:

- Conduct a safety assessment to describe potential safety issues (rig sites access, work practices, hazardous materials, security, entry into confined spaces, transportation and installation of heavy equipment, traffic management, emergency response procedures and fire control and management, among others) and measures to mitigate them;
- Develop and continuously review as need may arise and implement a health and safety program for all workers and visitors to the drilling sites, addressing all of the safety issues identified in the assessment and all applicable safety standards;
- All operations will be conducted in compliance with Tullow's EHS and driving policy, Tullow Safety Rules, international best practices and Kenya Government requirements (as set out in the Occupational Health and Safety Act and the Public Health Act, Energy Act, Physical Planning Act and NEMA Regulations); see also section 4.2.6 of this report);
- Appropriate and well-stocked first aid kits and fire fighting equipment should be available to all crew, and specific crew members should be trained on first aid administration and handling of fire fighting equipment (section 4.3.7);
- At all times, crews should put on job-specific personal protective equipment, regular drills, training and tool kit talks should be conducted, and their use made mandatory in designated areas (section 4.3.7);
- A Base Camp Clinic is to be provided, manned by suitably qualified field medical staff, licensed as appropriate to operate in-country, equipped with equipment and medication as appropriate, including ambulance vehicle(s);
- Adequate warning or cautionary signage will be posted as required;
- All electrical equipment shall be properly installed, earthed and regularly inspected, and where practicable, will comply with IEE 17th edition regulations;
- Only properly trained and authorised employees shall operate equipment or machinery; and

- Provision of an Emergency Response Plan, Evacuation Plan, Medivac Plan, Malaria Management Plan and a communicable diseases education programme.

No residual impacts are expected in this case.

7.3.15 Security and Public Safety

The proposed project will draw a workforce from the project area as well as staff from other areas. The staff will need to be assured of their security and safety. Similarly, equipment and facilities to be used at the project site will be required at the site and during transportation. Transportation of staff members to and from the project site is also paramount and their security while on transit must be assured. The security situation in the project area can be described as shaky. There is threat posed by cattle rustlers who are normally armed as well as threat from highway bandits. Tribal tensions and conflicts between the local Turkana community and the neighbouring Pokot community also heighten insecurity in the area. However, it should be noted that there is a police station at Lokichar and KPR officers deployed in the area.

Mitigation:

- Access to the project site must be controlled and all workers/ visitors be identified by use of tracking cards;
- Adequate security measures should be provided, e.g. construction of reinforced perimeter fencing, construction of earth berms, provision of safe havens and security manning around the project site on a 24 hour basis;
- The company should liaise with the Provincial Administration, the Kenya Police, Kenya Police Reservists and other agencies to provide adequate security at the proposed test well drilling sites and while on transit;
- Barriers and guards will be installed as necessary to protect employees and visitors from physical hazards and criminal activity;
- Camp population will be restricted and will not be allowed to interact with the local populace while at the project site;
- Camp will be located at a significant distance from any local communities;
- Journey management policy and monitoring to be enforced; and
- Vehicle speed will not exceed 40 km/h, with all vehicles fitted with vehicle tracking and monitoring systems.

Engaging KPRs and use of Provincial Administration to coordinate security issues will enhance the security situation in the project area.

7.3.16 Construction of the Campsite

TKBV and subcontractors' staff will reside in a base camp that will be constructed by a professional civil and building contractor with experience in setting up such camps. Issues such as camp security, provision of basic services (e.g. accommodation, water, sanitation, lighting, and health care), waste management, materials storage areas, etc., shall be incorporated in the camp design.

Mitigation

- Mitigations in sections 7.3.1 (Physiography and Geology), 7.3.2 (soils), 7.3.4 (Surface and ground water) and 7.3.6 (Terrestrial Environment), 7.3.10 (Noise and vibrations) 7.3.14 (occupational health and safety) and 7.3.15 (security and public safety) apply;
- Excavated soil should be used in landscape design of the campsite rather than stockpiling;
- Campsite will be erected by a qualified and licensed civil and building contractor with workers who are qualified to carry out assigned tasks;
- Construction workers shall use appropriate Personal Protective Equipment;
- Adequate temporary housing and sanitation facilities shall be provided for the construction workers;
- Construction equipment and vehicles shall be well maintained, checked and promptly repaired to ensure no spillage of oils and fuels and to minimise gaseous emissions;
- Construction of the campsite shall be undertaken during daylight hours only;
- The campsite should be set up away from populated areas and location shall be determined in consultation with the local community leaders;
- Company employees shall comply both with the relevant national legislation, and its own in-house environmental health and safety (EHS) policies
- Adequate warning signs and fire extinguisher equipment will be visibly and appropriately posted;

7.3.17 Fuelling Station

A parking bay for vehicles will be demarcated within the campsite area, and it will have a fuelling station.

Mitigation

- Fuelling station will be underlain with a spill-containing liner;
- The fuel storage area will be set at one end of the parking bay area, and will be bunded. The bunds should have the capacity to contain all the fuel stored inside the fuel bladder in case of leakage;
- The fuel storage floor shall be concrete-based, and canvas-lined to capture minor spillages, with a structure measuring at least 12m x 8m x 0.05m;
- The bladder will be charged with fuel ferried by tankers, and will be conveyed to the pump via an outlet hose;
- Clearly marked spill kits will be placed adjacent to the refuelling area, and all staff involved in vehicle maintenance and refuelling will be trained in their use;
- Clear ‘no smoking’ signage shall be posted in this area;
- Fire-fighting equipment will be placed at strategic places within the fuelling station and in other areas of the campsite;
- All workers will be trained in the use of the installed fire-fighting equipment;
- The fuel storage area will have a tarpaulin covering to protect it from the weather, and should be well aerated.

7.3.18 Camp clinic

There will be a fully equipped and staffed clinic that will be located in the base camp. It will be supported by a properly equipped and manned ambulance that will be on standby in case of accidents or emergencies. There will also be an on-call helicopter for crew movement and emergency evacuations.

Mitigation

- Wastes will be handled as per NEMA Waste Management Regulations 2006;

- The wastes will be segregated, and disposed of in the waste disposal facility as provided for by the relevant Local Authority
- Biomedical waste will not be stored above 0ºC for more than seven days without the written approval of the relevant lead agency, provided that untreated pathological waste shall be disposed of within 48 hours.

7.3.19 Water Borehole drilling

The groundwater in the project area is exploited mainly through boreholes and shallow wells excavated in *luggas,* and tend to have widely variable quality, from human-potable through livestock-potable to saline and non-potable. Borehole water quality is generally good for use as drinking water, and is the cleanest source of potable water in the area, but in some existing water the sulphates and/or fluoride levels may be high. TKBV will drill a water borehole to meet its water needs.

Before the borehole drilling, a hydrogeological survey will need to be carried out and will involve: study of the geology of the area (no environmental impact), and resistivity sounding and profiling using a Terrameter with connecting cables, stainless steel non-polarising current electrodes and copper potential electrodes (minimal clearing of low-level vegetation along a transect about 30cm wide and a maximum of 800m long) to identify the water-bearing stratum. The resistivity sounding is a passive technique with no environmental impact. The hydrogeological report will be submitted to the Water Resources Management Authority as a pre-condition for obtaining a drilling permit. Boreholes may be drilled with either percussion (cable-tool) or rotary plant.

Mitigation

- Minimise soil disturbance and vegetation clearance as is practicable ;
- Well development must be done with the Airlift method for at least 30 minutes or until the water is clear of drilling cuttings;
- Great care should be taken that the water quality of the different aquifers is accurately determined. Upon the first strike, drilling fluids should be effectively flushed, and after sufficient time, a water sample should be taken of the air-blown (rotary) or bailed (percussion) yield;
- On-site analysis using an EC meter, and preferably a portable laboratory, is recommended;
- Screen-off non-targeted aquifer(s);
- The Drilling Contractor should engage the services of an experienced hydrogeologist during the drilling, design, installation, and testing of the borehole;
- Drill cuttings from the borehole should be buried in clay or other suitably lined pit in the event that the borehole is successful but if not successful, the drill hole should be refilled with the drill cuttings;
- Drilling should be carried out at a diameter of not less than 6”, using either a rotary type or percussion machine, to allow for casing, gravel packing and pump installation.
- The borehole should be cased to the bottom using suitable non-polluting material, with screens at the aquifer position and plain casings at non-aquifer position;
- The borehole should be bottom plugged in loose formations;
- The annular space must be gravel packed at the screen and aquifer position with durable and suitably sized material with respect to the size of the aquifer materials;
- Grouting should be done by placing a concrete mixture up to 6m depth from ground surface;

- Any drilling additives to be used (e.g. foam or polymer) must be non-toxic and bio-degradable. Bentonic additives should not be acceptable, as they may plug the aquifer zones and are extremely difficult to remove during development.

7.4 CUMULATIVE IMPACTS

Cumulative impacts are the impacts, which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions.

The proposed project area's soils and vegetation have been under pressure from the huge herds of livestock that are the main livelihood sources of the largely pastoralist communities. This is an activity that has been going on for centuries, but it is clear now that due to the rapid increase in human population in recent decades and concomitant increase in livestock populations, the carrying capacity of the land is steadily reducing due to the impacts of the pastoralist way of life. The small land area which will be temporarily modified in this project (<9ha) and the associated access roads that will need to be constructed, are insignificant in relation to the local to regional scale of habitat and land use related changes that have taken place. There will be no impact to fauna due to the small spatial scale and short temporal duration of the project, in relation to the present human and environmental pressures that they are exposed to. No threatened species of flora was identified in the area during the field surveys, and the faunal species that were observed are highly motile avian and chiropteran species whose home range is significantly large. In the context of the seismic survey that has already been carried out in recent times over a much larger spatial area and with no reported significant environmental impacts, the proposed exploratory wells drilling project would register a very small impact. Thus, the cumulative impacts on the soils, vegetation, habitat and biodiversity of the area are considered insignificant.

The water situation, in terms of quantity and quality, has always been dire in this region. It is one resource over which sporadic conflicts may occur due to its scarcity. There have been a number of governmental and NGO efforts to increase the water supply situation in the area through various water projects. World Vision has been known to initiate water pan construction in the area, but these still fall far short of the human and livestock water requirement for enhanced quality of life. The flora and fauna cope with the climate-driven changes in the hydrological balance, and there is currently no evidence that humans and livestock demand for water is competing with environmental demands for the same. Two boreholes drilled recently by the project proponent in Nakukulas have improved on this situation at least for this settlement. Implementation of the project will increase demand for water, which will be sourced from deep aquifers that are generally not utilised in the area and that do not interact hydrologically with flora and fauna. Thus, no cumulative impacts are foreseen in relation to deep groundwater abstraction.

Due to the small and spatially restricted scale of the project, any inadvertent pollution arising from the operations would be localised and mostly site-specific, but it is expected that such incidents will not arise on the basis of the proposed mitigations. The scale of fugitive particulate material and the generation gaseous emissions and their impacts on the surrounding environment will be negligible on account of the scale of the operation, its temporary nature, the strong dust-laden winds that characterise parts of the project area, and the mitigations that have been proposed. The scope for cumulative negative impacts on items or sites on cultural heritage of significance remain absent from the proposed activity areas. Consultation with available heritage databases indicates that no known sites of significance will be impacted by the proposed activity.

7.5 SIGNIFICANCE OF IMPACTS

The exploratory oil and gas wells drilling will utilise standard oilfield equipment and work will be conducted using good oilfield practice in line with the Petroleum (Onshore) Act (1991) and Regulations, the 'Schedule of Onshore Exploration and Production Safety Requirements' and the 'APPEA Code'. The operations are regarded, from an industry standpoint, as being of a small scale in both effort and the time taken to complete them. In addition, the majority of operations will be conducted a long distance away from any habitation, town or workplace so that the inhabitants will be largely insulated.

The short-term duration of the exploratory drilling programme and its small scale impacts relative to natural processes acting on the environment in the area, and previous actions undertaken, indicate that there would not be any impacts significant enough to contribute measurably to increase cumulative impacts following cessation and decommissioning of the programme.

Table7.2: Summary of impact evaluation and analysis from the proposed exploratory oil and natural gas drilling operations (pre, during and post project) on environmental and social factors in the project area (see Chapter 3, section 3.5.2 for impact assessment criteria and rating). Note: Project Operations includes - site preparation, construction, exploratory drilling, decommissioning and rehabilitation.

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
Physiography and Geology	Baseline (Pre-project)	- Periodic flooding of the Turkwel floodplain - Active sand dune building and degradation - Periodic ponding of the piedmont plain adjacent the Turkwel floodplain and in low lying areas	Medium	Regional	Permanent	Definite	Neutral	High	Low	Low
	Project Operations	- Access roads to the sites leave long-lasting residual impacts (tracks and/or scarring on surface rocks)	Low	Site-specific	Long-term	Highly probable	Negative	High	Low	Low
		- Transfer of geological materials (cuttings) from the sub-surface to the surface	Low	Site-specific	Short-term	Definite	Negative	High	Low	Low
Climate	Baseline (Pre-project)	- Climate change leading to higher frequency and intensity of droughts and floods	Medium	Regional	Permanent	Definite	Negative	Medium	Low	Low

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
	Project Operations	- None								
Air quality	Baseline (Pre-project)	- Dust generated by wind and enhanced by low vegetation cover - Natural wind and water erosion - Offensive odours from point sources e.g. pit latrines and garbage dumps	Medium	Local	Short-term	Definite	Negative	Low	Low	Low
	Project Operations	- Dust generated and enhanced by machinery and vehicular movement - Offensive odours from point sources e.g. pit latrines and garbage dumps - Air pollution from exhaust fumes all lowering the air quality	Medium	Local	Short-term	Definite	Negative	Medium	Medium	Low
Surface and Groundwater	Baseline (Pre-project)	- Freshwater shortage - Uneven distribution of resource - High demand for water resources	High	Regional	Permanent	Highly probable	Negative	Medium	Low	Low

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
	Project Operations	- Compaction of near-surface aquifers such as springs, reducing yield - Downward draining of groundwater through well drilling - Contamination of water supply source for the camp	Low	Site-specific to local	Short-term	Improbable	Negative	Medium	Medium	Low
Soils	Baseline (Pre-project)	- Soil particulates erosion and deposition generated by wind and enhanced by low vegetation cover - Water ponding and erosion via runoff - Soil compaction by grazing animals and livestock	Medium	Regional	Long term	Highly probable	Negative	High	Medium	Low
	Project Operations	- Dust generated by vehicles/machinery movement - Soil compaction by vehicles/machinery - Soil erosion via wind and water through runoff	Medium	Local	Medium	probable	Negative	High	Medium	Low
Terrestrial Environment	Baseline (Pre-project)	- Land degradation from overgrazing - Desertification - Local extinction threat of species	Low	Local	Permanent	Probable	Negative	Low	Low	Low

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
	Project Operations	- Clearing of vegetation, thereby modifying habitats	Medium	Local	Long-term	Probable	Negative	Medium	Medium	Low
Water Quality	Baseline (Pre-project)	- High sediment loads in rivers - Point-source pollution of springs and wells from stock and locals	Low	Site-specific to local	Permanent	Probable	Negative	Medium	Low	Low
	Project Operations	- Contamination of water supply source for the camps	Low	Site-specific to local	Short-term	Probable	Negative	Medium	Low	Low
Land Resources	Baseline (Pre-project)	- Overgrazing	High	Regional/ Local	Long-term	High	Negative	Medium	High	High
	Project Operations	- Disturbance of pasture area	Medium	Local	Short-term	Probable	Negative	High	Medium	Low
Archaeological, Historical and Cultural Sites	Baseline (Pre-project)	- None								
	Project Operations	- None								
Visual Aesthetics	Baseline (Pre-project)	- Land degradation - Loss of vegetation	Medium	Local	Short-term	Probable	Negative	Low	Medium	Low

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
	Project Operations	- Visual intrusion - Land degradation	Medium	Local	Short-term	Probable	Negative	Low	Low	Low
Noise and Vibrations	Baseline (Pre-project)	- Natural strong winds - Anthropogenic (but not excessive) noise localised in small towns and centres	Medium	Regional/ Local	Permanent	Definite	Negative	Low	Medium	Medium
	Project Operations	- Noise from machineries at the rig site - Vehicular noise	Medium	Local	Short-term	Definite	Negative	Low	High	Low
Liquid and Solid Wastes	Baseline (Pre-project)	- Minimal waste generated and poorly managed in town centres like Lokichar	Low	Local	Medium-term	Probable	Negative	Low	Low	Low
	Project Operations	- Poor solid waste management at the drill rig and campsite.	Medium	Local	Short-term	Probable	Negative	Low	Medium	Low
Social Characteristics	Baseline (Pre-project)	- Low education levels - Low literacy levels - Poorly equipped health facilities - Poor housing	Medium	Local	Long-term	Definite	Negative	High	Medium	Medium
	Project Operations	- No facilities will be provided by the proponent	None							

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
Economic Factors	Baseline (Pre-project)	- Few job opportunities - Poor access to markets - Slow economic growth rate - Emerging investment opportunities	High	Local	Long-term	Definite	Negative	Low	High	High
	Project Operations	- Creation of job opportunities - Poor access to markets - Slow economic growth rate - Emerging investment opportunities	Medium	Local	Medium-term	Probable	Positive	Low	High	Low
Occupational Health and Safety	Baseline (Pre-project)	- None								
	Project Operations	- Accidents at the work place - Health related incidences	Medium	Local	Short- term	Probable	Negative	Medium	High	Low
Security and Public Safety	Baseline (Pre-project)	- Frequent cattle rustling - Proliferation of small arms - Conflict over pastures and water resources	High	Regional	Long-term	Definite	Negative	High	High	Medium

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
	Project Operations	- Resource conflicts	Medium	Regional/ local	Medium-term	Low probability	Negative	Medium	High	Low

CHAPTER 8:

ENVIRONMENTAL MANAGEMENT PLAN

8.1 INTRODUCTION

Environmental Management Plan (EMP) is a management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented, and that the positive benefits of the projects are enhanced. Environmental Management Plan (EMP) involves the protection, conservation and sustainable use of the various social and environmental elements or components. The EMP for the proposed project provides all the details of project activities, potential impacts, suggested mitigation measures, desired outcomes, objective indicators, responsibilities and commitments proposed to minimize environmental impacts of activities, including, monitoring and evaluation during the implementation and decommissioning phases of the project.

The tool for achieving this is the incorporation of an Environmental Management Plan (EMP) into the EIA to ensure adherence and future compliance with legislation, good environmental performance, and integration of environmental issues into the project decision. The EMP provides the means of assessing the accuracy of the predicted project impacts and the monitoring of the effectiveness of the proposed mitigation measures contained in the EIA study report. The EMP should therefore indicate how the environmental concerns highlighted in the EIA would be managed. The EMP shall be incorporated in to project operating procedures to ensure compliance.

8.2 OBJECTIVES OF THE EMP

The objectives of the EMP are to:

- Address and adhere to necessary legal frameworks and other requirements;
- Promote environmental management and communicate the aims and goals of the project EMP to all stakeholders;
- Incorporate environmental management into project design and operating procedures;
- Ensure all workers, contractors, sub-contractors and others involved in the project meet all legal and institutional requirements with regard to environmental management;
- Provide a framework for implementing commitments of the project (i.e. mitigation measures identified in the EIA);
- Prepare and maintain records of project environmental performance (i.e. monitoring, audits and compliance rating);
- Prepare an environmental monitoring plan whose aim is to ensure that the negative environmental impacts identified in Chapter 7 of this EIA report are effectively mitigated by way of design, construction, operational and decommissioning stages of the project;
- Respond to unforeseen events; and
- Provide feedback for continual improvement in environmental performance.

8.3 PROJECT DESCRIPTION

The proponent, TKBV, is proposing to undertake drilling of exploratory wells in Block 13T in Turkana County. The objective of the project is to check for hydrocarbons presence based on the delineation of potential hydrocarbons traps considered present due to analysis of recently acquired seismic data. The proposed drilling sites, which will measure 450m x 250m, will incorporate: the drilling rig pad, working area, accommodation facilities, waste management facilities, water reservoir (120mx130m), kitchen facilities, power generation facilities, a laydown area for storage of bulk mud and cement, dry process materials, pipe rack, machinery, and secondary operations such as welding, painting, and machining. The site will also include medical and emergency response facilities and security personnel quarters (see Chapter 2).

8.4 APPLICABLE LEGISLATION AND REGULATIONS

The spectrum of legislation and regulations that apply to the exploratory oil and natural gas wells drilling programme has been detailed in Chapter 4. Some of the key legislation that relate to the activity are the:

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

8.5 TULLOW POLICIES AND PROCEDURES

Tullow has two key policies that relate to this activity, namely, the Environmental, Health and Safety (EHS) Policy, and the Corporate Social Responsibility Policy (CSR). Through its EHS policy, Tullow commits to strict high standards of environmental, health and safety, and aims to conduct its business operations to the best industry standards. The policy is also aimed at managing high risk activities that have the potential to adversely affect personnel at the project site, the environment and the surrounding communities.

The Tullow Oil Environmental Standards (**TOES**) were rolled out across Tullow in March 2012. The revised toes documentation specifies the minimum Environmental Standards Tullow Business Units must meet in the following four key areas: Biodiversity, Greenhouse Gases, and Resource Management. In addition, **TOES** provides a Toolbox to support delivery of these standards. **TOES** are designed to deliver consistent environmental management throughout our operations.

8.6 ROLES, RESPONSIBILITIES AND TRAINING

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

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

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

Specific training requirements are mentioned under the relevant sections of the EMP in this chapter.

8.7 COMMUNICATION WITH STAKEHOLDERS AND GRIEVANCE MECHANISM

TKBV will develop and maintain a formal procedure for communication with various stakeholders to inform on the various stages of project activities, as well as to receive their views and concerns, if any. TKBV should maintain a written register of its interactions and discussions with the various stakeholders so that issues that require to be followed up are clear and well-understood, and the outputs can be assessed.

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

8.8 AUDITING

It is a requirement by law that any project activity being undertaken be audited after every year of operation until closure. The proposed exploratory wells drilling programme will take a shorter time and will therefore be audited upon completion of the project. The auditing to be undertaken at the end of the project is to ensure that the project adhered to the EMP as outlined in this project report and that corrective measures were put in place in cases where impacts were identified. If the audit findings indicate that there are impacts that were not corrected, then the proponent will be required by NEMA to undertake such corrective measures before the Authority signs off the project.

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

8.9 THE ENVIRONMENTAL (AND SOCIAL) MANAGEMENT PLAN (EMP) FOR THE DRILLING OF EXPLORATORY WELLS

The EMP for the drilling of exploratory wells addresses the following environmental and social issues:

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

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

1. Potential Impacts and Mitigations – These outline the impacts and mitigations that have been identified and that are peculiar to the project area (see Chapter 7);
2. Identification of Desired Outcomes, Objective Indicators, and Monitoring – The Desired Outcomes reflect what the project proponent and stakeholders would like to see once the operation has been completed;
3. The Objective Indicators indicate how the Desired Outcomes can be measured, and their success determined (either qualitatively, quantitatively, or both);
4. The Monitoring aspect is based on assessment of project operations *vis à vis* the Objective Indicators and the Desired Outcome, Responsibilities and Management.

8.9.1 Physiography and Geology

The impact sources from the project operations will include the mobilization of vehicles, machineries and drilling-associated equipment to the drilling operation sites.

Potential Impacts	Mitigation
• Access roads to the sites leave long-lasting residual impacts (tracks and/or scarring on surface rocks) • Transfer of geological materials (cuttings) and gravel (road paving) from the sub-surface to the surface	• Use existing access roads to the drilling sites to the extent possible; • Pre-survey possible access routes, in uncharted areas and use the selected route(s) rather than accessing the work sites through free-range driving across the open country; • Movement of the crews and the vehicles should be restricted to the existing roads and within the operation sites to avoid creating unnecessary tracks and trampling of pasture around the drilling sites; • Avoid making roads on steep slopes susceptible to rock fall (see Table 5.2); • Avoid the Turkwel River riparian area by 30m. Circumvent the area to avoid compaction of soils that are usually used for crop growing and shallow sand aquifers that are a source of water for the local communities and livestock during the dry season.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium, or Low)**
▪ Impacts of new access roads minimized to the extent possible ▪ Landslips, rock topples from excavated material do not occur in the course of the drilling operation	▪ 100% pre-survey of existing access roads on the ground ▪ Actions taken to minimise new access roads impacts are recorded ▪ No project-related landslips, or rock topples recorded ▪ Number of site specific excavation pits for construction material inventoried and monitored	▪ Continuous, daily. ▪ One-time assessment and site selection ▪ Desired rehabilitation plan put in place	▪ The field operations supervisors will be responsible for the day-to-day monitoring and management, and will report to the Drill-site supervisor on a weekly basis, or immediately, in case of an incident occurring	▪ Low

8.9.2 Soils

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

Potential Impacts	Mitigation
▪ Compaction of soils in the working area and access ways changing percolation rates and drainage patterns ▪ Disturbance of soil through construction and excavations ▪ Possibility of enhanced gullying and erosion (wind and water) in constructed areas and access roads ▪ Rutting in loose soils ▪ Contamination of soils ▪ Possible caving in of soil in well pad design (near surface competence that bear on load capacity) and drill cuts and waste pits due to soil stability factors ▪ Disposal of cuttings in soil environment	• Mitigations in section 8.9.1 (Physiography and geology) apply • Access roads must be furnished with flow-diverters (cross-drains) at appropriate spacing according to slope to reduce sediment movement and erosion. Vehicles should steer away from natural drains and waterways as is practicable, and a buffer zone of 20m should be maintained except at crossing points; • Minimize vegetation clearance as much as possible when clearing the area for well pads and campsites construction; • Topsoil that is stripped and removed for construction should be preserved for rehabilitation of the constructed (campsite/drill rig) areas at the end of the project; • The establishment of drill cuttings pits and wastewater pits should be confined to Ps28 and Ux10 units whose drainage characteristics and soil texture allow for pit establishment. These pits for the two units should be lined with suitable HDP geo-membranes and bricks respectively, since the soils are sodic and may erode easily on contact with water. The Y10 (lower areas) and A8 units though with deep soils, have impeded drainage. Drill cuts, mud and waste pits could easily overflow and pond and contaminate the surface soils and shallow groundwater table. The use of steel tanks in A8 unit instead of pits for this particular unit is recommended; brick lined pits or use of steel tanks for Y10 unit is recommended. • Pits for containment of drill cuttings, spent drilling fluids, domestic and sanitary effluents should be sited and designed by a competent and licensed contractor and based on consideration of the geological and soil characteristics of the area to avoid soil contamination; • Ensure that all vehicles and machinery do not have any oil leaks that could contaminate the soils and that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available; • All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures; • Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through tool-box talks; and • Installation and proper management of camp sanitation facilities.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium, or Low)**
▪ Minimal, (if any) , compaction of soils where applicable ▪ Minimal disturbance of soils especially on waterways and natural drains ▪ Protection of surface soil from	▪ 100% of existing routes and possible alternatives pre-surveyed on the ground ▪ Appropriate campsites surveyed and selected	▪ Continuous, duration of pre-survey route checking, adjusting and opening bypasses where appropriate ▪ Pre-survey checking and actual exploratory wells site ground truthing ▪ One-time assessment and site selection of base-camps and pit sites	▪ TKBV EHS field representatives will be responsible for the day-to-day monitoring and management, and will report to TKBV EHS Manager on a weekly basis, or	▪ Low

subsidence ▪ Zero spillage of chemicals and hazardous material on soils		▪ Continuous monitoring and safeguard mechanisms established to check spillage	immediately in case of an incident occurring.	

8.9.3 Air Quality

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

Potential Impacts	**Mitigation**
▪ Pollution from exhaust emissions ▪ Fugitive dust generation from vehicular traffic ▪ Offensive odours ▪ Health risks ▪ Green House Gases (GHG)	• Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation; • Field vehicles, trucks and any other machinery should be switched off when not in use; • Regular servicing of all trucks, service vehicles, and any other machinery should be carried out to ensure efficient combustion and minimisation of exhaust emissions; • Use low sulphur fuels if available and where suitable; • Employees working in dusty conditions must use appropriate PPE; • If litter is to be burned, it should be done at a time of low wind movement, and preferably in areas shielded from wind by vegetation; • Installation and proper management of camp sanitation facilities. • An efficient test flare burner head equipped with an appropriate combustion enhancement system should be used to minimize incomplete combustion, black smoke, and hydrocarbon fallout; and • Flaring should adhere to the Global Gas Flaring and Venting Reduction Voluntary Standard (part of the World Bank Group's Global Gas Flaring Reduction Public-Private Partnership (GGFR program) or equivalent industry standard. • Fuel usage and hydrocarbons flared will be recorded and monitored.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium, Low)**
▪ Minimal pollution from exhaust emissions ▪ Minimal dust generation from traffic ▪ No offensive odours ▪ No health risks	▪ Number of equipment with low emissions ▪ Use of low sulphur versus other fuels ▪ Adherence to equipment maintenance schedule ▪ Set speed limits are not exceeded (record exceeded incidents) ▪ No offensive odours recorded ▪ No violation of OHS requirements for dust impact mitigation (violations recorded).	▪ Malfunctioning equipment removed immediately from operations for repair ▪ Compliance with use of low sulphur fuel (fuel supply tenders) ▪ Daily inspection of sanitary facilities and waste disposal points ▪ Continuous monitoring of EHS compliance	▪ The field operations supervisors will be responsible for the day-to-day monitoring and management of air quality issues in the field, while the camp supervisors will be responsible for monitoring the air quality at and around the campsite. The field operations supervisors and the camp supervisors will report to the EHS Manager on a weekly basis, and will immediately report on health risk incidents.	▪ Low

8.9.4 Surface and Groundwater Resources

The impact sources from the project operations will include water supply sources for the base camps, heavy vehicles and machinery, and drilling mud preparation.

Potential Impacts	Mitigation
▪ Conflict with neighbouring communities if water source is shared ▪ Compaction of near-surface aquifers hence reducing yield ▪ Downward draining of groundwater through exploratory well drilling ▪ Liquid effluent discharges from sanitation systems at the campsite ▪ Oil or chemical leaks from garage and storage areas, vehicles and machinery ▪ Unorganized disposal of drilling waste and mud in a disposal facility	▪ The company should drill its own water supply boreholes. ▪ An efficient water-use policy shall be adopted by the project proponent at the camp base and drilling sites and other work areas (section 4.2.2) ▪ An efficient sanitation system should be put in place in the base camp and drilling operation site to handle effluents (sections.4.3.8, 4.4.9) ▪ Ensure proper spill control and management for machinery and vehicles at site and in the field. ▪ Use proper engineering techniques during the drilling, cementing and casing of the exploratory wells ▪ All chemical and fuel storage areas will have proper bunds so that contaminated run-off cannot meet the storm-water drainage system • Hazardous and toxic waste material should be managed according to international protocols and practices (the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989) and must comply with the Environment Management and Coordination (Waste Management) Regulations. • The storm water system will be efficiently designed and maintained. • TKBV will carry out proper designing of on-site storage disposal for processing wastes in accordance with Central Pollution Control Board (CPCB) guidelines and with proper liner systems. • Heavy vehicle and equipment movement to and from the campsite/drilling areas should detour known groundwater supply points (e.g. wells and springs) by at least 500m and cross *luggas* at road crossings to avoid contamination particularly during rainy seasons..

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium, or Low)**
▪ No conflict over water use with neighbouring communities ▪ No compaction of near surface aquifers ▪ No unorganized disposal of drilling waste ▪ No waste and mud in a disposal facility ▪ No oil or chemical leaks from garage and storage areas, vehicles and machineries. ▪ No downward draining of groundwater through drill holes	▪ TKBV has its own water boreholes or other independent water source ▪ Identification of nearby surface and groundwater resources ▪ No violation of buffer zone limits around groundwater sources ▪ Water yields do not decrease ▪ Inventory of drill well is maintained	▪ Continuous, during drilling Compliance with buffer zone requirements ▪ Weekly monitoring of yields ▪ Compliance with buffer zone requirements ▪ Weekly monitoring of yields for a period of 4 weeks	▪ The field operations supervisors will be responsible for the day-to-day monitoring and management of surface and groundwater resources in the field, while the base camp supervisors will be responsible for water monitoring at and around the campsite. The field operations supervisors and the camp supervisors will report to the Operations Manager on a weekly basis, and will immediately	▪ Low

			report on incidents of concern.	

8.9.5 Water Quality

The impact sources from the project operations will include: liquid effluent discharges from sanitation systems at the base camp and drilling site, oil or chemical leaks from garage and storage areas, vehicles and machinery operating in the camp and field.

Potential Impacts	**Mitigation**
▪ Contamination of water supply source for the camp ▪ Contamination of underlying aquifers ▪ Contamination of surface water	• An efficient sanitation system should be put in place for camp workers to eliminate or minimise the levels of potential water pollutants from domestic effluents (sections 4.4.3, 4.4.9); • Pits must be lined with an impermeable liner such as HDPE; for containment of drill cuttings, spent drilling fluids, domestic and sanitary effluents, should be sited by a competent and licensed contractor and based on consideration of the geological and soil characteristics of the area to avoid contamination of nearby surface and groundwater systems; • All chemical and fuel storage areas should be bunded, with spill kits readily available and operatives trained in their use. The bunds must be a minimum of 110% of the capacity of the largest vessel to be bunded; • The company should use proper engineering techniques during the drilling, cementing and casing of the exploratory wells; • Fuelling will take place in a designated area; • • Hazardous and toxic waste material should be managed according to international protocols and best practices and in compliance with Kenyan legislation, specifically the Environment Management and Coordination (Waste Management) Regulations; • Ensure that all vehicles and machinery operating in the field and at drilling operation sites do not have any oil leaks (section 4.3.10); • ; • All refuelling operations to be carefully overseen and managed; • Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through tool-box talks.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium, Low)**
▪ No contamination of water supply source for the camp ▪ No contamination of underlying aquifers in the project area	▪ Camp water supply source is fit for human consumption ▪ Camp water supply source is protected ▪ Zero spillage of chemicals and hazardous material on soils that may lead to surface/groundwat	▪ Physico-chemical and microbiological testing, weekly ▪ Casing and cementing of borehole and wellhead area ▪ Protocols for and conditions of oils and chemicals storage at the camp are adhered to	▪ The field operations supervisors will be responsible for the day-to-day monitoring and management of actions to protect water quality in the field, while the camp supervisors will be responsible for such actions at and around the campsites. The field operations supervisors and the	▪ Low

	er pollution ▪ Waste pits and landfills are professionally sited ▪ Buffer zones are observed	▪ Professionals recruited for the work ▪ Compliance with buffer zone requirements	camp supervisors will report to the Operations Manager on a weekly basis, and will immediately report on incidents of concern.	

8.9.6 Terrestrial Environment (Habitats, Flora, and Fauna)

The impact sources from the project operations will include: drilling rig and ancillary, transport vehicles, and physical presence of the workforce.

Potential Impacts	**Mitigation**
▪ Cutting of vegetation during the construction of campsites and drilling assembly. ▪ Disturbance of wildlife (physical presence) ▪ Introduced weeds and pests ▪ Contamination of the environment (solid and liquid wastes) ▪ Land take ▪ Erosion	▪ The mitigations related to soils (See 8.9.2) apply ▪ Trees with trunk diameter greater than 20cm should not be cut; ▪ Ensure that equipment is in good working condition and cause less noise/ vibration/air pollution nuisance to fauna ▪ Hunting, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. This prohibition should extend to the purchase of these items from the indigenous population by workers ▪ A material safety data sheet should be maintained for all potentially hazardous materials, as well as supporting documentation for the transport, use and disposal of such materials; ▪ Used motor oil and filters from vehicles and generators should be removed from the area for proper disposal. Used motor oil should not be used from dust suppression on access roads. Disposal of chemicals and motor oil should be documented, including quantities involved, and disposal locations; and ▪ A plan should be prepared to prevent and contain accidental oil discharges or fuel spillages. All equipment should be fitted with drip trays and stationary fuel storage facilities should have secondary containment. ▪ Pre-planning siting of wells and access roads ▪ Restoration

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium, or Low)**
▪ Minimal cutting of vegetation for construction purposes ▪ Minimal disturbance of wildlife ▪ No weeds or pests introduced into the area ▪ Minimal contamination of the environment	▪ Construction of support camp and derrick assembly installation where minimal or no vegetation clearance is required ▪ A material safety data sheet should be maintained for all potentially hazardous materials, as well as supporting documentation for the transport, use and disposal of such materials	▪ During pre-mobilisation site-specific assessment ▪ MSDS sheets will be held by the drilling manager	▪ An ecologist may be designated to be in charge of the management and monitoring of the terrestrial environment, and would liaise closely with and advise the field operations supervisor on a day-to-day basis.	▪ Low

8.9.7 Land Resources and National Reserve

The impact sources from the project operation will include use of heavy vehicles and machinery, drilling rig assembly, access road construction and the presence of work force in the area.

Potential Impacts	**Mitigation**
▪ Man-made structures may lower aesthetic value of landscapes ▪ Impact as a result of use of heavy machineries ▪ Disturbance of animals and flora ▪ Campsites, rig assembly and access ways lower aesthetic value of landscape ▪ Visual intrusion from anthropogenic structures	• Mitigations in sections 8.9.1 (Physiography and Geology), 8.9.2 (soils), 8.9.4 (Surface and ground water) and 8.9.6 (Terrestrial Environment) apply; ▪ Before the commencement of the exploration activities, the proponent should liaise with the community to identify any cultural or revered sites in the area; ▪ Extensive consultations should be made with community leaders to ensure that the proposed drilling projects do not interfere with the community's valued land resources; and ▪ In as much as possible, the exploration process and the associated activities should avoid sensitive ecological systems and cultural sites.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium, or Low)**
▪ Minimal disturbance and damage to habitats, biological diversity and vegetation ▪ No disruption to pastoralists	▪ No animal encounters recorded ▪ No conflict with pastoralists ▪ Land and soil not exposed to erosion agents	▪ Monitoring of animal presence along operation areas ▪ Procedures for dealing with incidences or/ and accidents involving injury to local people and livestock ▪ Adhere to the use of existing access roads and restrict the use of heavy vehicles to specific access roads ▪ Enforce policy against hunting and gathering through training and direct supervision where applicable	▪ The Field Operation Supervisors and Transport Managers	▪ Low

8.9.8 Archaeological, Historical and Cultural Sites

The impact sources from the project operations will include influx of people, access road construction and use of vehicles.

Potential Impacts	**Mitigation**
▪ Influx of people from outside ▪ Access road construction ▪ Use of vehicles	▪ Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites prior to the construction of proposed exploratory drilling pads and construction of associated auxiliary infrastructure like access roads in order to prevent conflict with the community ▪ All project field workers must be informed, before commencement of operations, that any disturbance to, defacement of, or removal of archaeological, historical, or sacred material will not be permitted

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low)**
▪ Negligible interference, if any, with historical and cultural sites	▪ No violations of buffer zone restrictions ▪ The sites are flagged for avoidance of interference with buffer zones	▪ Cultural and historic sites are not interfered with ▪ Buffer zones are adhered to ▪ Flagging is done in collaboration with local elders and cleared once work is completed	▪ Field operations supervisor shall ensure compliance and that cultural sites are not disturbed, ▪ Site awareness creation to workers	▪ Low

8.9.9 Visual Aesthetics

The impact sources from the project operations will include campsite design, access ways and rig site assembly.

Potential Impacts	**Mitigation**
▪ Poor campsite design and rig site assembly may lead to visual obstruction and does not blend in with the environment	▪ Drill rig and campsite design should take into consideration the aesthetics of the selected area. ▪

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low)**
▪ Minimal vegetation cover removal ▪ Proper design of access roads ▪ Drill rig and camp site blending with the prevailing environment	▪ Camp site and drill rig design enhance aesthetic value of the area ▪ Clearance for access road minimized ▪ No residual impacts	▪ Adhere to the approved camp site design ▪ Physiography, Geology and Soils sections apply here too	▪ Operations Manager to ensure maintenance of aesthetic value at the site and project areas ▪ Design of the camp site and drill rig to incorporate 'green' principle where applicable	▪ Low

8.9.10 Noise and Vibrations

The impact sources from the project operations will include drilling rig and operation, generator and vehicular noise pollution.

Potential Impacts	Mitigation
▪ Disturbance to humans, animals and livestock ▪ Disturbance to workers ▪ Health risks	• Ensure that equipment such as generators, drilling rig components, and other machinery have working silencers to muffle noise and effect a noise mitigation policy for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations; ▪ Provide full personal protective gear to workers as appropriate (e.g. helmets and ear muffs/plugs) and as specified in the Occupational Safety and Health Act; ▪ Workers should be sensitized on noise pollution related hazards likely to be encountered in such a work environment, and trained accordingly; ▪ Engage local leaders in sensitising the communities in the vicinity of the exploratory well drilling area about the project and its possible noise pollution impacts; ▪ All machineries such as generators and drilling rig components should be fitted with noise abatement devices like silencers to muffle noise; ▪ Use generators with minimal noise levels (silent pack enclosures) at the residential campsites and effect a noise mitigation policy for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations. ▪ Segregate the drilling area from the residential area and construct a fence and/or berm; and living quarters nearest to the boundary should be made of containers which are reasonably sound-proofed

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low)**
▪ To ensure ambient noise levels of the project area are maintained near the baseline conditions during the construction and operation stage	▪ Sound level measurement equipment installed to monitor noise levels ▪ Regularly serviced and efficient vehicle engines ▪ Generators muffled to abate noise	▪ Review of design parameters, as needed ▪ Monitor installed equipment ▪ Strict servicing work and schedules	▪ Managers in charge of drilling and transport	▪ Low

8.9.11 Solid and Liquid Wastes

The impact sources from the project operations will include the wastes generated at the campsites and drill rig sites.

Potential Impacts	Mitigation
▪ Pollution of surface and ground waters ▪ Offensive odours ▪ Health risks ▪ Litter ▪ Contamination of soil	• Mitigations relating to section 8.9.5 (Water Quality) apply; ▪ A waste management plan (based on the principles of the Waste Management Hierarchy [section 2.7.2]) documenting the waste strategy, storage (including facilities and locations) and handling procedures should be developed and should include a clear waste tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location in compliance with the Environmental Management and Coordination (Waste Management) Regulations (section 4.4.9);Systems for treating drill cuttings, solid and liquid wastes generated in the course of rolling out the project should be properly selected, installed, managed and decommissioned according to laid down regulations, national legislations the Tullow Drill Fluids and Cuttings Disposal Standard and associated Guidelines, and international best practices in order to minimise or eliminate their potential environmental impacts; ▪ Waste materials should be segregated into non-hazardous and hazardous waste, and consideration given to re-use, recycling, or disposal (section 4.4.1) as appropriate. This should be done by an authorised waste handler licensed under the Waste Management Regulations, 2006; ▪ A materials/chemical management plan will be developed, and a safety data sheet should be maintained for all potentially hazardous materials, as well as supporting documentation for the transport, use and disposal of such materials; ▪ The structural integrity of containment pits for drill cuttings, drilling fluids, mud pits and water storage reservoirs should be ensured – such pits should be appropriately lined and / or bunded; ▪ A plan should be prepared to prevent and contain accidental drilling fluid, oil discharges or fuel spillages. All equipment should be fitted with drip trays and stationary fuel storage facilities should have secondary containment; ▪ Hygienic sanitation and disposal of grey and black water will be covered in the waste management plan in order to protect the general health of the workers and the general public; ▪ The EHS department to document any accidental releases as to cause, corrective actions taken, and resulting environmental or health and safety impacts;; ▪ The EHS officer shall consult with the local authorities in Lokichar and Lodwar to determine where and how the different types of wastes that will be generated during the project can be disposed of

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low**
▪ No pollution of soils and water ways ▪ No offensive odours ▪ No reported health risks	▪ No leakages of oils, chemicals or liquid effluent reported ▪ No blockages to sanitary and drainage system ▪ Hazardous and non-hazardous wastes are properly disposed off and monitored ▪ PPEs appropriately used	▪ Daily checks on sanitary and drainage system ▪ Storage areas well secured and only authorized personnel allowed ▪ Waste disposal done by registered waste handlers ▪ Adherence to HSE policy and use of PPEs monitored ▪ Audits of waste management plan and waste tracking process	▪ EHS Manager	▪ Low

8.9.12 Social Characteristics

The impact sources from the project operations will include workforce influx and activities around the drilling sites.

Potential Impacts	**Mitigation**
▪ Possible increase in school drop-out by individuals searching for jobs ▪ Erosion of culture and social values as a result of intermingling with workers ▪ Conflict between community and immigrants ▪ May interfere with grazing lands and pastures ▪ Misinformation of residents on the nature of the project ▪ Influx of people into the area ▪ Insecurity	▪ Ensure that the project does not offer job opportunities to school going children; ▪ Sensitize workers to respect the community cultural beliefs and values; ▪ Proponent to maintain good relations with community; ▪ Sensitisation of the community on the activities to be carried out in the proposed project, and the scheduling of such activities and their potential impacts, should be done periodically and continually. Community Liaison Officers shall be employed by the proponent to perform such duties; ▪ The proponent should liaise with Administration Police to ensure the area is safe. ▪ Provision to be made to compensate local property and landowners for any loss or damage caused by the operations culminating the proposed project; ▪ The proponent should ensure that its employees and contractors relate well with the community. This can be achieved through enlightenment of the workers on the community's culture and traditions; ▪ The proponent should liaise with the local police departments to ensure that the community's security is ensured at all times. This can be achieved through employment of security personnel on a rotational basis ▪ Grievance process developed to deal with any complaints.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low)**
▪ Decrease in crime rates and no school drop-outs ▪ Preservation of cultural and social values ▪ Protection of grazing lands and watering points	▪ No violations of Tullow CSR policy ▪ No complaints from the locals on cultural or social values, concerns relating to the workers ▪ Relates to Soils (8.10.2) and Surface and Groundwater Resources (8.10.4) sections	▪ Awareness of Tullow CSR policies by workforce ▪ Grievance mechanism in place and implemented ▪ Related monitoring aspects are being undertaken	▪ The project management team should ensure community involvement in establishment of recruitment and tender committees to check on recruitment procedures, gender balance and potential conflict areas. ▪ A community liaison officer (CLO) should be responsible for implementation of the grievance mechanism.	▪ Low

8.9.13 Economic Characteristics

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

Potential Impacts	**Mitigation**
▪ Improved livelihood ▪ Employment opportunities ▪ Improved short-term business opportunities for the locals ▪ Boost economy ▪ Technological installation and advancement ▪ Transfer of skills to locals ▪ Unequal opportunities of employment ▪ Age limits in employment	• A portion of skilled and semi-skilled labour should be sourced from the local community; • Gender and age should be factored in when offering employment opportunities; • Liaise with community leaders during the recruitment process; • Ensure that the recruitment process is representative of all the areas in the Block; and • Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low)**
▪ Improved economy and living standards	▪ Number of locals recruited ▪ Number and type of CSR projects that TKBV commits to ▪ Establishment of recruitment and tender committees	▪ As needed	▪ The project management should ensure community involvement in the establishment of recruitment committees to check on work influx, gender balance and potential conflict areas.	▪ Low

8.9.14 Occupational Health and Safety

The impact sources from the project operations will include the drill rig and camp sites

Potential Impacts	**Mitigation**
▪ Injuries to workers, visitors and area residents arising from project operations ▪ Fire hazard ▪ Other health risks and diseases ▪ Motor vehicle accidents	▪ Conduct a safety assessment to describe potential safety issues (rig site access, work practices, hazardous materials, security, confined spaces entry, transportation and installation of heavy equipment, traffic management, emergency response procedures and fire control and management among others) and measures to mitigate them; ▪ Develop, continuously review as need may arise and implement a health and safety program for all workers and visitors to the site, addressing all of the safety issues identified in the assessment and all applicable safety standards; • All operations will be conducted in compliance with Tullow's EHS and driving policy, Tullow Safety Rules, international best practices and Kenya Government requirements (as set out in the Occupational Health and Safety Act and the Public Health Act, Energy Act, Physical Planning Act and NEMA Regulations); see also section 4.2.6 of this report); ▪ Appropriate and well-stocked first aid kits and fire fighting equipment should be available to all crew, and specific crew members should be trained on first aid administration and handling of fire fighting equipment (section 4.3.7); ▪ At all times crews should put on job-specific personal protective equipment; regular drills, training and tool kit talks should be conducted, and their use made mandatory in designated areas (section 4.3.7); ▪ A Base Camp Clinic is to be provided, manned by suitably qualified field medical staff, licensed as appropriate to operate in-country, equipped with equipment and medication as appropriate, including ambulance vehicle(s); ▪ Adequate warning or cautionary signage will be posted as required; ▪ All electrical equipment shall be properly installed, earthed and regularly inspected, and where practicable will comply with IEE 17th edition regulations; ▪ Only properly trained and authorised employees shall operate equipment or machinery; ▪ Provision of an Emergency Response Plan, Evacuation Plan, Medivac Plan, Malaria Management Plan and a communicable diseases education programme.

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low)**
▪ Workers and / or visitors secure from possible injuries and harm from work or health related hazards	▪ PPEs appropriately used ▪ Visible caution and warning signs placed in strategic areas ▪ Trainings and drills on HSE issues undertaken	▪ Continuous monitoring and recording of incidences in all sections at the project site	▪ Managers in charge of EHS to ensure that policy on EHS is strictly adhered to ▪ Schedule drills and trainings and monitor efficacy regularly	▪ Low

8.9.15 Security and Public Safety

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

Potential Impacts	**Mitigation**
▪ Petty crimes ▪ Improvement in security due to security enhancement for project activities	▪ Access to the project site must be controlled and all workers/ visitors be identified by use of tracking cards; ▪ Adequate security measures should be provided, e.g. construction of reinforced perimeter fencing, provision of safe havens and security manning around the project site on a 24 hour basis; ▪ The company should liaise with the Provincial Administration, the Kenya Police, Kenya Police Reservists and other agencies to provide adequate security at the site and while on transit; ▪ Barriers and guards will be installed as necessary to protect employees and visitors from physical hazards and criminal activity; ▪ Camp population will be restricted and will not be allowed to interact with the local populace while at the project site; ▪ Camp will be located at a significant distance from any local communities; ▪ Journey management policy and monitoring to be enforced; ▪ Vehicle speed will not exceed 40 km/h, with all vehicles fitted with vehicle tracking;

Desired Outcomes, Objective Indicators and Monitoring				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with Mitigation (High, Medium or Low)**
▪ No security-related incidents ▪ Adequate security for the workforce at the campsite and on transit	▪ Number of security-related incidents recorded	▪ Continuous monitoring and recording of security incidences during project life	▪ Project manager to coordinate all security matters through security section ▪ Liaison with provincial administration and Kenya Police will greatly enhance security at workplace and when on transit	▪ Low

8.9.16 Camp Construction

The impact sources from the project operations will be; camp design, disturbance of soil and vegation, air quality, camp security, water supply, waste management, socio-economic factors and Occupational health and safety.

Potential Impacts	Mitigation
▪ Disturbance to soils and vegetation during construction ▪ Reduced landscape aesthetics due to stockpiling of excavated soils ▪ Health and safety hazard due to poor campsite construction ▪ Spillage of chemicals, oils and fuels from construction equipment and vehicles ▪ Disturbance to communities ▪ Insecurity ▪ Health and safety hazard during campsite occupation	• Mitigations in sections 8.9.1 (Physiography and Geology), 8.9.2 (soils), 8.9.4 (Surface and ground water) and 8.9.6 (Terrestrial Environment), 8.9.10 (Noise and vibrations) 8.9.14 (occupational health and safety) and 8.9.15 (security and public safety) apply; ▪ Excavated soil should be used in landscape design of the campsite rather than stockpiling; ▪ Campsite will be erected by a qualified and licensed civil and building contractor with workers who are qualified to carry out assigned tasks; ▪ Construction workers shall use appropriate Personal Protective Equipment; ▪ Adequate temporary housing and sanitation facilities shall be provided for the construction workers; ▪ Construction equipment and vehicles shall be well maintained, checked and promptly repaired to ensure no spillage of oils and fuels and to minimise gaseous emissions; ▪ Construction of the campsite shall be undertaken during daylight hours only; ▪ The campsite should be set up away from populated areas and location shall be determined in consultation with the local community leaders; ▪ Company employees shall comply both with the relevant national legislation, and its own in-house environmental health and safety (EHS) policies ▪ Adequate warning signs and fire extinguisher equipment will be visibly and appropriately posted;

Desired Outcomes, Objective Indicators, Monitoring, Responsibility, and Risk				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium or Low)**
▪ Minimal disturbance to environment during construction ▪ Reduced potential for environmental pollution due to oil and fuel leaks and noise and gaseous emissions ▪ Communities are not disturbed ▪ No security-related incidents ▪ No safety and health-related incidents	▪ Soil and vegetation are not unnecessarily cleared ▪ Maintenance schedule for equipment and vehicles adhered to and no pollution incidents reported ▪ Number of community disturbance incidents reported ▪ Number of security-related incidents recorded ▪ Number of safety and health-related incidents recorded	▪ Continuous monitoring and recording of incidences	▪ The construction of the campsite shall be supervised by the chosen contractor and overseen by TKBV. Camp operations shall be supervised and coordinated by the Camp Manager.	Low

8.9.17 Fuelling Station

The impact sources will include: oil leaks from garage and storage areas, vehicles and machinery.

Potential Impacts	**Mitigation**
▪ Fuel spills ▪ Fire hazard ▪ Fuel contamination	▪ Fuelling station will be underlain with a spill-containing liner; ▪ The fuel storage area will be set at one end of the parking bay area, and will be bunded. The bunds should have the capacity to contain all the fuel stored inside the fuel bladder in case of leakage; ▪ The fuel storage floor shall be concrete-based, and canvas-lined to capture minor spillages, with a structure measuring at least 12m x 8m x 0.05m; ▪ The bladder will be charged with fuel ferried by tankers, and will be conveyed to the pump via an outlet hose; ▪ Clearly marked spill kits will be placed adjacent to the refuelling area, and all staff involved in vehicle maintenance and refuelling will be trained in their use; ▪ Clear 'no smoking' signage shall be posted in this area; ▪ Fire-fighting equipment will be placed at strategic places within the fuelling station and in other areas of the campsite; ▪ All workers will be trained in the use of the installed fire-fighting equipment; ▪ The fuel storage area will have a tarpaulin covering to protect it from the weather, and should be well aerated.

Desired Outcomes, Objective Indicators, Monitoring, Responsibility, and Risk				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium or Low)**
▪ No fuel spills ▪ No fires ▪ No fuel contamination	▪ Number of incidents recorded	▪ Continuous monitoring and recording of incidences	▪ Proper operations in the fuel filling station shall be supervised and coordinated by the Camp Manager.	Low

8.9.18 Camp Clinic

The impact sources for the project operations will be waste management and handling practises.

Potential Impacts	**Mitigation**
▪ Pollution due to poor handling of biomedical and pharmaceutical wastes	▪ Wastes will be handled as per NEMA Waste Management Regulations 2006; ▪ The wastes will be segregated, and disposed of in the waste disposal facility as provided for by the relevant Local Authority ▪ Biomedical waste will not be stored above 0ºC for more than seven days without the written approval of the relevant lead agency, provided that untreated pathological waste shall be disposed of within 48 hours.

Desired Outcomes, Objective Indicators, Monitoring, Responsibility, and Risk				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium or Low)**
▪ No pollution from medical and pharmaceutical wastes	▪ Number of incidents of improper disposal recorded	▪ Continuous monitoring and recording of incidences	▪ The operation of the medical clinic will be under the direct management of the Camp Doctor, and shall be overseen by the Camp Manager.	Low

8.9.19 Water Borehole Drilling

The impact sources for the project activities will be vegetation and soil disturbance in the borehole located area which will be relatively small.

Potential Impacts	Mitigation
▪ Disturbance to soils and vegetation during data acquisition and borehole drilling ▪ Contamination during well development ▪ Drill cuttings from borehole ▪ Pollution/contamination of borehole/aquifer water	▪ Minimise soil disturbance and vegetation clearance as is practicable ; ▪ Well development must be done with the Airlift method for at least 30 minutes or until the water is clear of drilling cuttings; ▪ Great care should be taken that the water quality of the different aquifers is accurately determined. Upon the first strike, drilling fluids should be effectively flushed, and after sufficient time, a water sample should be taken of the air-blown (rotary) or bailed (percussion) yield; ▪ On-site analysis using an EC meter, and preferably a portable laboratory, is recommended; ▪ Screen-off non-targeted aquifer(s); ▪ The Drilling Contractor should engage the services of an experienced hydrogeologist during the drilling, design, installation, and testing of the borehole; ▪ Drill cuttings from the borehole should be buried in clay or other suitably lined pit in the event that the borehole is successful but if not successful, the drill hole should be refilled with the drill cuttings; ▪ Drilling should be carried out at a diameter of not less than 6", using either a rotary type or percussion machine, to allow for casing, gravel packing and pump installation. ▪ The borehole should be cased to the bottom using suitable non-polluting material, with screens at the aquifer position and plain casings at non-aquifer position; ▪ The borehole should be bottom plugged in loose formations; ▪ The annular space must be gravel packed at the screen and aquifer position with durable and suitably sized material with respect to the size of the aquifer materials; ▪ Grouting should be done by placing a concrete mixture up to 6m depth from ground surface; ▪ Any drilling additives to be used (e.g. foam or polymer) must be non-toxic and bio-degradable. Bentonic additives should not be acceptable, as they may plug the aquifer zones and are extremely difficult to remove during development.

Desired Outcomes, Objective Indicators, Monitoring, Responsibility, and Risk				
Desired Outcomes	**Objective Indicators**	**Monitoring**	**Responsibility and Management**	**Risk with mitigation (High, Medium or Low)**
▪ No disturbance to soil and vegetation ▪ No contamination of the aquifer during well development and post-development ▪ Non-target aquifer strata are protected ▪ Drilling cuttings are safely disposed of	▪ No unnecessary clearing of vegetation and soil disturbance ▪ No contamination of aquifers ▪ Aquifers, borehole and well-head are protected based on good construction practice ▪ Drill cuttings are safely disposed	▪ Monitoring during the drilling and well-head construction phases	▪ The TKBV EHS Representative should ensure all the protocols relating to environmental health and safety, and occupational health and safety policies are adhered to by the Drilling Contractor. Overall supervision will be the responsibility of the Camp Manager, who should also ensure that a qualified and registered hydrogeologist is available on site to supervise the drilling and well protection works.	Low

8.10 OTHER GENERAL REQUIREMENTS AND TRAINING ISSUES

8.10.1 Occupational Health and Safety Plan

TKBV will develop an Occupational Health and Safety Plan (OHSP), based on Tullow's EHS and CSR policies, prior to commencement of the project operations. The OHSP will uphold TKBV's commitment to a safe environment for employees, contractors and visitors. The plan will also address all applicable legal requirements relating to health and safety. The OHSP will set out the framework under which health and safety on the project site, and to and from the site, will be managed. The roles and responsibilities of the company, manager, supervisors and workers will be set out under this plan.

A health and safety training programme will also be implemented at the site. The objectives of this training programme will be to:

- Provide appropriate orientation and support to all employees, contractors and visitors on site so that they can act in an appropriately safe manner;
- Provide on-going training to workers; and
- Inform at-risk workers to help attain a positive and safe work environment.

8.10.2 Vehicle Traffic Plan

The following guidelines will apply to vehicular traffic:

- All drivers will be properly licensed and trained according to specific vehicle type and operating conditions;
- Vehicle use will be determined by local ground conditions and access requirements;
- All local traffic laws and speed limits will be obeyed;
- Traffic on the rights-of-way will follow the posted speed limits, which might vary depending on site-specific conditions;
- All vehicular traffic will be confined to approved rights-of-way, workspace and access roads or trails; and
- Site-specific features of concern (e.g., archaeological sites, sensitive wildlife habitat) will be flagged, or otherwise designated, so that subsequent traffic can avoid these areas.

8.10.3 Materials Management

A Materials Management Plan will be developed that will identify handling and management of materials. Transportation, storage, use and ultimate disposal will be considered. Safety of the workers and the surrounding communities will be taken into account for all stages of materials handling during all project phases. The EHS officer shall consult with the local authorities to determine where and how the different types of wastes that will be generated during the project can be disposed of.

Employees who are tasked with receiving, off-loading and storing potentially hazardous materials or involved in the storage and shipment off-site of hazardous wastes should receive hazardous materials handling training.

8.10.4 Pollution Control Plan

A pollution control plan that includes an oil spill response plan will be developed. The objective of the spill response measures will be to ensure that where accidental spills occur, all available resources are used appropriately to minimize the extent and severity of effect on the environment. All spills occurring on the project site will be responded to in a way that will uphold the following priorities: protection of human life and health; protection of the

environment; protection of property; and minimized disruption to operational activities. At all times, applicable regulations will be used to guide response and clean-up activities.

At locations where the potential for spillage of hazardous material is highest, such as at the wellbore and fuelling points, spill control and containment means will be incorporated into the infrastructure during construction. The storage of materials will be tied in with the HMMP.

Spill response kits appropriate to the types and volumes of materials that will be used during the project operations will be specified, including the types of equipment that will handle or transport contaminant materials (including fuel). Spill response kits will be located at appropriate material handling and storage locations. The contents of the kits will be based on the potential risk associated with the material, volume of material, and environmental sensitivity of the area. General kit contents could include: oil absorbent pads; absorbent socks; granular absorbents; and protective equipment such as gloves, goggles and protective suits. All kits will be stored in a visible location, and in appropriate weather-resistant containers. Regular inspections of the kits will be performed to ensure that they are complete and all materials remain functional.

All TKBV employees and contractors will undergo, as part of their orientation to the site, a training programme on spill-prevention and hazard-identification, as well as spill-response, containment and reporting procedures. Other aspects of the training will include education on the:

- Pollution prevention and control
- Applicable legislation
- Potentially affected environmental receptors (e.g. soil, surface and groundwater)
- Field application of appropriate spill-response techniques.

8.10.5 Emergency Response Plan

A more general plan that will deal with emergencies such as those related to accidents and personal injury, medical evacuations, fires, and escalating insecurity shall be put in place before the commencement of project operations. Issues to be addressed would include the capacity for response and management, and the support agencies that can be called in to assist (e.g. the Kenya Police, hospital staff, KWS, etc).

8.10.6 Decommissioning or Well Abandonment

Decommissioning is an important phase in the project cycle and comes last to wind up the operational activities of a particular project. It refers to the final disposal of the project and associated materials at the expiry of the project lifespan. Alternatively, a decision may be taken to abandon the project at some stage. If such stages are reached, the proponent needs to remove all materials resulting from the demolition/ decommissioning or abandonment from the site. The following should be undertaken to restore the environment:

i) Remove all underground facilities from the site;
ii) The site should be well landscaped by flattening the mounds of soil ;
iii) Planting indigenous trees and flowers;
iv) All the equipment should be removed from the site;
v) Fence and sign post unsafe areas until natural stabilization occurs; and
vi) Backfill surface openings if practical.

8.11 COST OF THE EMP AND TIMEFRAME FOR THE ACTIVITY

It is estimated that the entire project will cost USD 28.76 million. The costs of implementing the EMP will largely be borne through salaried employees who will be tasked to carry out the

various EMP monitoring and evaluation activities. Therefore the EMP will not incur significant additional costs, over and above those already budgeted for in the project.

CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

9.1 SUMMARY OF THE PROJECT COMPONENTS

Tullow Kenya B.V is a wholly owned subsidiary of Tullow Oil PLC, an International Oil and Gas exploration company with interests in many parts of the African continent including Kenya, Uganda, Ivory Coast and Ghana. The company signed a Production Sharing Contract (PSC) with the Government of Kenya in 2011 and obtained an Exclusive Prospecting Right (EPR) for Block 13T (surface area of 8,429 km^2), which covers Central Pokot, Turkana South, Loima and parts of Turkana Central Districts. The company now intends to drill exploratory wells in parts of the block largely in Turkana South District after undertaking seismic surveys in the area.

Exploratory drilling is a temporary and short duration activity taking approximately 120 days under normal conditions. The drilling process is undertaken to determine where hydrocarbons are present and to measure the area and thickness of the oil/gas bearing reservoir or reservoirs. It also includes logging and coring wells to measure the permeability, porosity and other properties of the geologic formation encountered. After the exploratory well drilling data has been analysed, the proponent can then ascertain the economic viability or abandonment of the drilled wells.

This EIA report covered the area and requirements as spelt out in the EMCA 1999 and the EIA/ EA Regulations of 2003. Key areas covered in the report include a comprehensive project description, project area baseline information, guiding legal and regulatory framework and alternatives to the proposed project. The EIA has also noted the likely impacts as a result of implementation of the project and suggested mitigation measures aimed at ensuring that the proposed project protects the environmental base with minimal negative impacts. A comprehensive EMP has been included in the report and monitoring mechanisms suggested.

9.2 RECOMMENDATIONS

The proposed project will have both positive and negative impacts. The EIA team has endeavoured to give comprehensive mitigation measures and environmental management and monitoring mechanisms which if put in place will minimise or completely eradicate the possible negative impacts. The EMP developed in this report should be strictly adhered to, to ensure that the project remains environmentally and technically sound throughout its life. Some of the measures in Chapter 8 that need close implementation and monitoring include the following:

- To avoid destroying vegetation and pastures, and to minimise land degradation in the proposed project area, pre-survey possible access routes, and use the selected route(s) rather than accessing the work site through free-range driving across the open country;
- In as much as possible, avoid the Turkwel River riparian area by 30m. Circumvent the area to avoid compaction of soils that are usually used for crop growing and shallow sand aquifers that are a source of water for the local communities and livestock during the dry season;
- Vehicles should steer away from natural drains and waterways as is practicable, but a buffer zone of 20m should be maintained except at crossing points;

- Topsoil that is stripped and removed for construction should be preserved for rehabilitation of the constructed (campsite/drill rig) area at the end of the project;
- Ensure that all vehicles and machinery do not have any oil leaks that could contaminate the soils;
- All fuels and other non-aqueous fluids should be stored in suitable bunded enclosures;
- Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation;
- Only the minimum volume of hydrocarbons required for the flaring test should be flowed and well test durations should be reduced to the extent practical;
- The company should drill its own water supply borehole for use during drilling;
- Develop a policy for efficient water usage;
- Hazardous and toxic waste material should be managed according to international protocols and best practices and in compliance with Kenyan legislation, specifically the Environment Management and Coordination (Waste Management) Regulations;
- Refuelling areas must be underlain with spill-proof hard-standing or bund, with spill kits readily available and operatives trained in their use;
- Avoid clearing/altering any land unless necessary; if unavoidable, use best practices that minimise disturbance of the land resources, flora and fauna;
- Hunting, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. This prohibition should extend to the purchase of these items from the indigenous population by workers;
- Before the commencement of the exploration activities, the proponent should liaise with the community to identify any cultural or revered sites in the area;
- All project field workers must be informed, before commencement of operations, that any disturbance to, defacement of, or removal of archaeological, historical, or sacred material will not be permitted;
- Drill rig and campsite design should take into consideration the aesthetics of the selected areas;
- Ensure that equipment such as generators, drilling rig components, and other machinery have working silencers to muffle noise and effect a noise mitigation policy for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations;
- Ensure that solid waste is removed from site for recycling/disposal only by an authorised waste handler, ideally a handler licensed under the Waste Management Regulations, 2006;
- Sensitisation of the community on the activities to be carried out in the proposed project, the scheduling of such activities and their potential impacts should be done periodically and continually. Community Liaison Officers can be employed by the proponent to perform such duties;
- As much as possible, a portion of skilled and semi-skilled labour should be sourced from the local community; and
- Develop and continuously review as need may arise and implement a health and safety program for all workers and visitors to the drilling sites, addressing all of the safety issues identified in the assessment and all applicable safety standards;

REFERENCES

Bashat H. Managing Waste in Exploration and Production Activities of the Petroleum Industry. hc2/101/1191.

Drill Rig, 2009. In *Wikipedia, the free encyclopedia*. Retrieved May 27, 2009 from http://en.wikipedia.org/wiki/Drilling_rig.

Exploration and Production (E&P): *Environmental Management in Oil and Gas Exploration and Production*. E&P Forum/ UNEP 1997. Report No. 2, 72/254.

E&P Forum, (1993). Exploration and Production (E7P) Waste Management Guidelines. Report No. 2.58/196 September 1993.

Fairburn, W.A., and Matheson, F.J., 1970. Geology of the Loiya-Lorugumu Area. Report No. 85, Ministry of Natural Resources Geological Survey of Kenya.

FAO, 1988. FAO Soils bulletin 39**:** Salt affected soils and their management. FAO Soil Resources Management and Conservation Service.

FAO-UNESCO, 1997. Soil Map of the World; revised legend with corrections and updates, ISRIC, Wageningen, 1997.

GVEP Kenya, 2006. Energy Road Map to Achieving MDG Targets Kenya Sectoral Energy Requirements. Final Report. Consultant: S. Arungu Olende PhD, and Benard Osawa. Published by GVEP Kenya.

Government of Kenya, 1999. Environmental Management and Coordination Act (No. 8 of 1999). Government printer, Nairobi, Kenya.

Kenya National Bureau of Statistics, 2009. Kenya Population and Housing Census. Volume 1A.

Kenya Soil Survey 1987. Manual for soil survey and land evaluation volume I, miscellaneous soil paper No. M24, 1987, National Agricultural Research Laboratories.

Landon, J.R (ed). (1984). Booker tropical Soil manual. A handbook for soil survey and agricultural land evaluation in the tropics and subtropics.

McCall, G. J. H., 1964. Geology of the Sekerr Area. Report No. 65, Ministry of Natural Resources Geological Survey of Kenya.

Neff, J.M., S. McKelvie, and R.C. Ayers, Jr. 2000. Environmental Impacts of Synthetic Based Drilling Fluids. OCS Study MMS 2000-64. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Program, New Orleans, LA. 118 pp.

Neff J. M., 2005. Composition, environmental fates and biological effect of water based drilling muds and cuttings discharged to the marine environment: a synthesis and annotated bibliography. Report prepared for the Petroleum Environment Research Forum (PERF). American Petroleum Institute. Washington, DC, 16pp.

Nicholson, S., 1980. Climatic fluctuations in the arid belt of the 'old world' since the last glacial maximum; possible causes and future implications. *Palaeoecol. Afr.*, 12: 3–12.

NOCK, 1987. Aeromagnetic data interpretation of the Winam Gulf and the East African Rift areas in Kenya. National Oil Corporation of Kenya, Unpubl. Rep. No. 26/2 16 D.

OGP (International Association of Oil & Gas Producers). 2003. Environmental aspects of the use and disposal of non aqueous drilling fluids associated with offshore oil & gas operations. Report 342 from OGP, London, England. 103 pp.

Pratt, D.J. and Gwynne, M.D.: *Rangeland Management and Ecology in East Africa*. Hodder and Stoughton, London (1977).

Republic of Kenya, 2002. Turkana District Development Plan, 2002-2008. Ministry of Finance and Planning. Government Printers.

Sombroek, W.G.,Braun H.M.H. and Van der Pouw B.J.A., 1982. Exploratory Soil Map and Agroclimatic Zone Map of Kenya. Kenya Soil Survey, Ministry of Agriculture, Nairobi. Report No. E1.

Walsh, J., 1966. Geology of the Karasuk Area. Report No. 72, Ministry of Natural Resources Geological Survey of Kenya.

White, F. 1983. The vegetation of Africa, a descriptive memoir to accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa (3 Plates, Northwestern Africa, Northeastern Africa, and Southern Africa, 1:5,000,000). UNESCO, Paris.

APPENDICES:

APPENDIX 1: PROPOSED EXPLORATORY WELL DRILLING SITE LAYOUT

APPENDIX 2: PUBLIC CONSULTATIONS – MINUTES OF MEETINGS

MINUTES OF THE MEEETING HELD IN LOCHWAA SUB LOCATION , LOCHWAA LOCATION, LOKICHAR DIVISION AT THE TRADING CENTER ON SATURDAY 23RD JUNE 2012.

Attendance

1. Mary Amoni Lokope - Assistant Chief, Lochwaa Sub-location
2. Community opinion leaders and members
3. EIA Experts

The meeting was chaired by the Assistant Chief of Lochwaa Location, Ms. Mary Amoni who called the meeting to order at 9.00 a.m. She invited Pastor Griffin Lokoro to start with a word of prayer. She then welcomed and thanked the EIA team and the community members for attending the meeting and requested the EIA team members to introduce themselves to the community members.

Mr. Edwin Omori gave the community members an overview of the proposed exploratory wells drilling by Tullow Kenya B.V. beginning with Twiga 1 well in Block 13T. He expounded on the oil company's intention to carry out the exploratory wells drilling following promising results at Ngamia 1 well. He told the community that the main purpose of the meeting was to collect their opinions concerning the proposed project. He also explained that with the inception of the proposed project, only a small area of land would be used for the exploratory wells drilling programme and that environmental protection would be given priority. He then encouraged the community members to give their views concerning the proposed project.

The community expressed the following views:

- They expressed support for the ongoing oil prospecting activity in the area and welcomed the proposed exploratory oil wells drilling project in Block 13T.
- They wanted to find out the kind of agreement that existed between the government of Kenya and Tullow Kenya B.V.
- They wondered whether they would benefit from the job opportunities created as a result of the drilling of Twiga 1 exploratory test well.
- They said that the area had skilled people who Tullow Kenya B.V. should consider for job opportunities.
- They said that Lochwaa Sub-location had not benefited from CSR projects like other parts of Lokichar Division.
- The community expressed fear that the test well drilling process would negatively affect the soil structure of the area.
- They wondered if the vibrations caused by the vibroseis could cause earth tremors in the area.
- They wanted to know if the proposed test wells drilling would result in air pollution as a result of the release of gases into the atmosphere.
- They worried about the possibility of their grazing land being destroyed by the proposed project.
- They said that the seismic cut lines which went hand in hand with the drilling process were easily used by thieves to raid their livestock.
- They wondered if they would be required to move away from their land to give way for the test wells drilling programme.
- They requested Tullow Kenya B.V. to assist their needy children to go to school by providing bursaries.

- They stated that they were worried about the possibility of attacks from cattle rustlers and no one to protect them as most of the KPR officers had been taken by BGP.
- They requested adequate dissemination of information regarding the test wells drilling process to eliminate tensions, disputes and misinformation.
- They wanted to know the measures that had been put in place by Tullow Oil to curb accidents as a result of increased vehicle traffic in the area.

The EIA experts responded to the concerns of the community members by informing them that the area used for any of the test wells drilling would be small just as that previously demarcated for Ngamia 1 test well drill. The community was therefore urged not to worry about being displaced or their grazing lands being destroyed by the proposed exploratory test wells drilling. They were assured that the project activities will not have adverse negative impacts to the environment and the community's health, and mitigation measures will be put in place to reduce or avoid the anticipated impacts

It was further reiterated that the exploratory test wells drilling process would be done while taking into consideration all relevant laws and policies on the environment such as EMCA, 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003. The community was further informed that all their views and comments to Tullow Oil would be included in the EIA report for their consideration and that copies of the report would be availed to the various stakeholders in the area such as county council offices, divisional and district offices as well as Turkana County NEMA office for easy access to all.

The community members were guaranteed their continual involvement in the project through Community Liaison Officers who would act as a bridge between the community and Tullow Kenya B.V.

The meeting ended with a prayer at 1.00 p.m.

MINUTES OF THE MEETING HELD AT LOCHER-EMOIT VILLAGE IN LOCHWAA SUB-LOCATION, LOCHWAA LOCATION, LOKICHAR DIVISION IN TURKANA SOUTH DISTRICT ON SUNDAY 24TH JUNE, 2012.

Attendance:

1. Samuel Loperito- Headman Locher-emoit
2. Benjamin Ekaru- Local Teacher
3. Community members
4. EIA Experts

The meeting began with a prayer from Samuel Loperito at 1.00 p.m. The EIA experts introduced themselves to the community and informed the community about the aim of their visit. They briefed the community about the proposed exploratory wells drilling programme in Block 13T, including the proposed Twiga 1 exploratory well drilling that was due to commence at Kapese.

A brief explanation of the activities involved in a typical exploratory well drilling project was given to the community to give them an overview of the proposed project.

The community's views concerning the proposed project included:

- They welcomed the oil prospecting project in the area.
- They thanked the EIA team for meeting the community to discuss issues of development.
- They stated that many youth in the area were unemployed and they hoped that the proposed project would provide some employment opportunities for the youth.
- They complained that they felt marginalised from Lokichar area whose members had benefited from employment opportunities offered by Tullow Kenya and its contractors at the Ngamia 1 project site.
- They mentioned that the community suffered from unemployment and food insecurity and hoped the proposed project would benefit them.
- They mentioned that Locher-emoit area had not benefited from CSR from Tullow Kenya B.V in their previous exploratory well drilling project in Ngamia 1, and that they now hoped to benefit from the proposed exploratory wells in the Block.
- They said that their leaders and Community Liaison Officers were biased and thus creating a rift between community members and Tullow Kenya B.V.
- They blamed favouritism and nepotism vices practiced by their leaders as the main reasons why the youth were missing out on employment opportunities.
- They wondered if they would have to move away from their land when the proposed Twiga 1 test well drilling is initiated.
- They inquired if the proponent would compensate the community for any damages incurred as a result of implementation of the proposed project.
- The members were worried about possible interference with their pastureland and safety and security issues as a result of increased vehicle traffic and insurgence of population into the area.
- They requested Tullow Kenya and its contractors to respect the Turkana people's traditions and revered places.
- They requested Tullow Kenya B.V. to consider all Sub-locations in the Block when offering employment opportunities so that the whole area benefits from the employment opportunities.
- They requested that community members be enlightened more about the proposed project as some of them were not aware of the benefits to their community and the costs that they would incur as a result of the proposed project.

To address some of the community's concerns, the EIA experts assured them that the proposed project would not displace the inhabitants of the area. They further explained that only a small area would be used to set up the test drilling well equipment and camps. The community was assured that they would still continue to practice livestock keeping as their grazing land would not be interfered with. On Issues of CSR, the community was assured that their requests and concerns would be documented in the EIA report and a copy passed over to the proponent for consideration. The meeting ended with a prayer at 3.00 P.M.

MEETING HELD IN LOKAPEL SUBLOCATION, KATILU LOCATION, KATILU DIVISION IN TURKANA SOUTH DISTRICT AT THE BARAZA GROUND ON MONDAY 25TH JUNE, 2012.

Attendance:

1. Josephat Lochii Alakwa- Ass. Chief, Lokapel
2. Community members
3. EIA Experts

The meeting started with a prayer from one of the community members at 10.00 a.m. and was chaired by the Assistant Chief. He thanked and welcomed the EIA team and requested them to explain to the community the purpose of their visit.

The EIA experts then gave a brief background of the proposed hydrocarbons exploratory wells drilling in Block 13T. Mr. Nicholas Aketch explained to the community that the proposed exploratory wells were meant to find out if the underlying rock reservoirs in the area were oil bearing and if the oil was commercially viable. He added that the proposed activity would occupy a relatively small piece of land.

The importance of public participation and consultations in development projects was elaborated on to the community. The community members were then given a chance to express their views concerning the proposed project with regard to the potential positive and negative impacts likely to be experienced with the inception of the proposed project. The views included:

- They welcomed the proposed development project into the area.
- They requested to be given more insight into the proposed project.
- They mentioned that they had been informed that the proposed camp would be set up quite far away from their settlements.
- They wondered whether they would also benefit from CSR projects just like other parts in Block 10BB had from the previous Ngamia 1 exploratory well drilling project.
- They mentioned potable water, bursaries for school going children, improved medical facilities and improvement of the Lokapel-Lodwar road as some of the CSR projects that the proponent should consider.
- They requested for early communication of issues concerning the proposed exploratory wells drilling project, particularly on the onset of the first Twiga 1 exploratory well in Kapese area.
- They requested the proponents of the project to ensure that the community's valued resources and conserved areas including grazing lands are not interfered with.
- They expressed fear that their soils would be loosened by the heavy trucks and eroded by both wind and rain.
- They requested that Tullow Kenya B.V. and its contractors take appropriate measures to ensure that their trucks do not loosen their soils.
- They requested that Tullow Oil should send their representatives to elaborate to community the actual cost benefit analysis associated with the proposed project.
- They advised that should the proposed camp be set up, the proponent should ensure adequate waste disposal methods that discourage scavenging by community members.
- They mentioned that with the inception of the proposed project, the community had high expectations of getting employment opportunities.
- They wanted to know the criteria that would be used in sourcing of labour from within the community and requested that the recruitment methods used be free and fair to allow equal representation of members from all the Sub-locations in the Block.

- They expressed fear that the proposed project could result in wars with neighbouring countries.
- They wondered if the proposed project would displace them from their land.

The community was assured that their views and concerns were appreciated and would be included in the EIA report for consideration by Tullow Kenya B.V. They were further told that the proposed exploratory well drilling programme would be done in consideration of Kenya's legislations on the environment, including EMCA 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003. The community was then guaranteed that their natural resources would be protected throughout the life of the proposed project.

The EIA team thanked the community for attending the meeting and the Assistant Chief gave a closing prayer at 12.00.

MEETING HELD IN KANAODON SUBLOCATION, KATILU LOCATION, KATILU DIVISION IN TURKANA SOUTH DISTRICT AT KANAODON DISPENSARY ON 25TH JUNE 2012.

Attendance:

1. Mr. Daniel Katilu- Assistant Chief, Kanaodon Sub-location
2. Community opinion leaders and members
3. EIA experts

The meeting started with a prayer from the Assistant Chief, Mr. Daniel Katilu at 1.00 P.M. He then introduced the EIA experts to the community members in attendance. A brief description of the purpose of the meeting was given to the community members. This included the proposed test wells drilling project in Block 13T. The community was then given the opportunity to express their views concerning the proposed project and to mention the potential positive or negative impacts they anticipated from the proposed project.

The community's views included:

- They wondered why the exploratory wells drilling project was being done on their grazing land and not in other places.
- They had no qualms about the proposed project as they hoped to benefit from CSR like the communities within Block 10BB.
- They wanted to know how the proposed project would benefit their community.
- They wondered whether the proposed exploratory wells drilling project would improve the security situation in the area.
- They expressed fear that they might be displaced by the Pokot people who were claiming that the area within which oil deposits had been detected was theirs. This claim could not however be substantiated.
- They mentioned that their dispensary had no maternity wing and hoped that Tullow Kenya B.V. would assist them to set up that section within the dispensary as part of its CSR to the community.
- They mentioned classrooms for schools, hospitals, water and employment opportunities as some of the CSR the proponent should consider. They however emphasised on lack of sufficient potable water as the main need that they required to be addressed by the proponent.
- They complained they had inadequate security as most of the KPR had been hired by Tullow Oil B.V.
- They requested the proponent to use other channels of communicating with the community to complement CLOs and to countercheck their performance in acting as a bridge between the proponent and the community. This followed complaints from the community members that the CLOs did not present the community interests to the proponent.

The EIA team assured the community that the proposed project was not drilling for oil but rather to find out the existence of oil in the area and if it was commercially viable. The community was also told that the proposed project would only utilise small parcels of land which would be reinstated to their normal conditions once the proposed hydrocarbons exploratory programme is decommissioned.

The Assistant Chief thanked the community for attending the meeting and the EIA team for sharing the important information concerning the proposed exploratory hydrocarbon well drilling programme in the area. The Assistant Chief implored the EIA team to ensure that all their views and concerns reach the proponent to which the EIA team responded that the

issues discussed would be included in the EIA report for Tullow Kenya B.V.'s consideration. The meeting was concluded at 3.30 P.M. with a prayer by a community member.

MEETING HELD AT THE BARAZA GROUND IN KALEMUNG'OROK SUB-LOCATION, KAPUTIR LOCATION, KATILU DIVISION IN TURKANA SOUTH DISTRICT ON TUESDAY 26TH JUNE, 2012.

Attendance:

1. Mr. Henry Etabo - Chief, Kalemung'orok Location
2. Community members
3. EIA experts

The meeting started at 10:00 p.m. with a word of prayer. The local chief of Kalemung'orok Location chaired the meeting. He welcomed everyone present to the meeting and requested the EIA experts to introduce themselves to the community members and detail to them the purpose of the meeting.

Mr. Edwin Omori gave a concise outline of the proposed exploratory wells drilling programme in Block 13T by Tullow Kenya B.V. He indicated to the community that Kenya's legislation on the environment such as EMCA, 1999 and the Environmental (Impact Assessment and Audit) Regulations, 2003 required that before any project is initiated within a given locality, public participation and consultations with the community is mandatory. The community members were then told to express their views and concerns regarding the proposed project with consideration to the probable effects of the proposed project on the environment and social welfare.

The community's views included:

- They welcomed the proposed project into the community.
- They wanted to know how the proposed project would be beneficial to them.
- They pointed out availability of job opportunities as some of the benefits that would be experienced with the proposed project.
- They anticipated that they would also benefit from CSR that other communities within the neighboring Block 10BB had benefited.
- They stated that some of the CSR they expected from Tullow Kenya B.V. included: provision of potable water, boarding facilities for their schools and exposure and training for the locals to enable them to apply for job opportunities within Tullow Kenya B.V.
- The women implored that the proponent should consider gender issues when administering CSR projects. They mentioned water as the most important resource which would relieve women off the burden of fetching the resource over long distances and give them time to engage in other income-generating activities.
- They wondered how Tullow Kenya B.V. had obtained the land for the proposed test well drilling.
- They expressed fear that there are rumors doing the rounds that they would be evicted from their land to pave way for the proposed project.
- They wondered whether the country would go to war with neighboring countries like Sudan, Ethiopia and Uganda if the implementation of the proposed project was successful.
- They were worried that the community's natural resources that they rely on such as livestock, trees and pastures would be interfered with.
- They wanted to know how the proponent would deal with the community's revered areas such as graveyards should they be affected by the proposed project.
- They requested that the proponent seeks the consent of the community whenever they wanted to make decisions concerning clearing of vegetation.

- They requested that the proponent considers providing sponsorship to Form Four leavers to enable them to attend tertiary colleges so as to match the employment opportunities within the company.

The EIA experts reacted to some of the concerns of the community members by informing them that their comments would be written in the EIA report for consideration by Tullow Kenya B.V. The community was also assured that the report would contain an EMP which Tullow Kenya B.V. would follow to ensure that the environment is protected.

The community was informed that their grazing land would not be destroyed because the area used for the exploratory well drilling programme would be small and that the probable negative impacts of the proposed project on the environment and the community's health would be mitigated.

The Chief concluded the meeting by thanking the EIA experts for holding the public consultations. The meeting ended with a prayer at 1.00 p.m.

MEETING HELD IN LOKICHAR LOCATION, LOKICHAR DIVISION IN TURKANA SOUTH DISTRICT ON MONDAY 27TH JUNE, 2012.

Attendance:

4. Josephine Akiru Ekal – Chief, Lokichar Location
5. Community elders and members
6. EIA team

The meeting started with a prayer by one of the community members at 10.00 a.m. and was chaired by the Chief. The EIA team was requested to introduce themselves and to give a brief background of the proposed hydrocarbon exploratory test wells drilling project.

The community views with regards to the proposed project included:

- They said that they had not yet seen previous EIA reports such as the EIA report for Block 10BB and that information concerning previous EIA had not yet reached them.
- They stated that they wanted access to previous EIA reports on the area.
- They wanted Tullow Kenya B.V. to create more awareness to the community on matters concerning the proposed project.
- They inquired if Tullow had in mind any CSR for vulnerable groups in the community.
- They said they wanted local contractors to be engaged whenever Tullow Kenya B.V. wanted to perform CSR that involved construction works.
- They requested the proponent to train a local labour force so as to be competent for the available job opportunities.
- They wanted to know the criteria that the proponent was using in sourcing for local labour.
- They requested the proponent to support their pastoralist market by purchasing their livestock for beef and buying groceries from the community.
- The community wanted the test wells drilling site to be named after local names like Nakukulas and Kapese as opposed to Ngamia 1 and Twiga 1 respectively.
- They worried that most of the KPR officers were being taken by Tullow Oil and its contractors and leaving them unprotected.
- They said that the proponent should ensure that they have good relations with community members and respect every community member.
- They wanted the proponent to use the down-top approach in consulting the community by using village elders as some of the CLOs were not passing over the right information to and from the company and vice versa in good time.
- They alleged that the proponent had put age limits for employment at 45 years locking out some of the community members from accessing job opportunities.
- They worried that the oil exploration process would result in war with neighbouring countries.
- They worried and stated that they had heard rumours that the proposed project would displace them from their land, a radius of 50km.
- They stated that they wanted their resources such as grazing land and trees to remain intact.
- They requested that the proponent sources for their drivers within the community.
- They inquired about the benefits that the proposed project would bring to every member of the community.
- They inquired if they would be compensated by Tullow Oil for using their land for oil exploration.
- They wanted an explanation on the possible impacts on their land, especially their pastures.

- They wanted to know what plans the proponent had in mind in cases where the community-revered areas such as graves had been interfered with by the proposed project.
- The youth were particularly concerned about recruitment of drivers. They said the test was unnecessarily skewed to fail them and thus requested the company to recruit drivers through the local administration.

Responses were given to some of the community's inquiries. They were assured that the proposed exploratory test well drillings would utilise only a small portion of land and that potential environmental impacts would be mitigated using the recommendations of the EIA report and the Environmental Management Plan.

The EIA team further reassured the community that their views and concerns would be included in the EIA project report for the proponent's consideration. The area Chief gave her closing remarks and the meeting ended at 1.00 p.m.

APPENDIX 3: LABORATORY RESULTS

(1) SOILS LABORATORY RESULTS

Mapping unit Y10

From laboratory results (Table A3.6), the soil reaction indicates a pH range of 8.6 to 9.0. For classification purposes the pH is taken as 9.0 (Bw1 horizon) this is a strongly alkaline soil. The electrical conductivity indicates a soil that is none saline despite high values of calcium. The exchangeable sodium percentage (ESP) gives a value of 2.2 in horizon Bw1 (Table A3.6). A value of 15 for ESP is regarded as the boundary between sodic and non-sodic soils (Landon, 1984). These results negate the expected salt threshold values for a soil exhibiting a pH value of 9. According to FAO, (1988) sodic soils are those which have an exchangeable sodium percentage (ESP) of more than 15. Excess exchangeable sodium has an adverse effect on the physical and nutritional properties of the soil, with consequent reduction in crop growth, significantly or entirely. The soils lack appreciable quantities of neutral soluble salts but contain measurable to appreciable quantities of salts capable of alkaline hydrolysis, e.g. sodium carbonate. The electrical conductivity of saturation soil extracts are, therefore, likely to be variable but are often less than 4 dS/m (4 mS/cm) at 25 °C. The pH of saturated soil pastes is 8.2 or more and in extreme cases may be above 10.5. Going by the pH, Ec and Ca^{2+} value, these soils are slightly to moderately saline and moderately to strongly sodic. The physical status of the soils at the Bw1 horizon indicate a soil structure that is also prismatic and that has a low infiltration capacity (Tables A3.1, A3.6, and plate 5.9 in text), typical of sodic soils. The cation exchange capacity for the topsoil is 11.6 me%, rated as a low value (Landon, 1984). Going by above and previous results obtained in the same soil unit (Africa Oil pre-drilling EIA report), the soils classify as *haplic Solonetz.*

Mapping unit Ps28

From laboratory results (Table A3.7), the soil reaction indicates a pH range of 7.9 to 9.0. For classification purposes the pH is taken as 8.7 (Bw1 horizon). This is a strongly alkaline soil. The electrical conductivity indicates a soil that is none saline and an ESP value of <15 makes it also none sodic, Bw1 (Table A3.7). Going by the pH and Ec values however, the soils can be considered sodic. Soils exhibiting a pH range of 8.5-10 and an Ec value of < 4 mS/cm have an ESP greater than 15 and are considered sodic (Kenya soil survey, 1987). A value of 15 for ESP is regarded as the boundary between sodic and non-sodic soils (Landon, 1984). The cation exchange capacity for topsoil is 13.6 me%, rated as moderate value (Landon, 1984). The soils classify as *haplic Lixisols (sodic phase).*

Mapping unit Ux10

From laboratory results (Table A3.8), the soil reaction indicates a pH range of 8.7 to 8.8. For classification purposes the pH is taken as 8.8 (A being the diagnostic horizon this case). This is a strongly alkaline soil. The electrical conductivity indicates a soil that is none saline and an ESP value of <15 makes it also none sodic, A horizon (Table A3.8). Going by the pH, Ec and Ca values however, the soils can be considered saline and sodic. Soils exhibiting a pH range of 8.5-10 and an Ec value of < 4 mS/cm have an ESP greater than 15 and are considered sodic (Kenya soil survey, 1987). A value of 15 for ESP is regarded as the boundary between sodic and non-sodic soils (Landon, 1984). The cation exchange capacity for topsoil is 15.6 me%, rated as moderate value (Landon, 1984). The soils classify as *Calcaric Regosols (saline sodic phase).* This classification is collaborated by Sombroek *et al* 1982 where the classification for the soil unit is the same.

Mapping Unit A8

This mapping unit bisects Block 13T into two from the north at Turkwel town to the south at Nasolot (Figure A3.7). The unit was visually observed but not sampled. According to Sombroek *et al*, the soils are developed on sediments from various sources (recent floodplains). They are well drained to imperfectly drained, very deep, dark brown to yellowish brown, stratified, micaceous, strongly calcareous, predominantly loamy soils. They classify as *Calcaric Fluvisols*.

Table A3.1: Soil mapping unit description for Mapping Unit Y10, Kapese

Profile Pit	PP: KTW 001 Twiga A well site, Kapese
Coordinates	WP 722
Parent material	Alluvium from undifferentiated basement system rocks mainly gneisses
Physiography	Piedmont plain (nearly level to gently undulating)
Drainage	Well drained
Vegetation/Land use	Natural shrub/pastoral shrubland with sparse vegetation of *Acacia tortilis, Luqata sigmama* and *Indigofera spinosa* dwarf shrub
Rock outcrops/surface stones	None
Depth	Deep
Soils general	The unit consists of deep, dark yellowish brown to dark brown, sandy loam to gravelly sandy clay soils. They have an ABC sequence of horizons with abrupt and smooth to clear and smooth boundaries. The soils in the A horizon, are fine granular and sub-angular blocky structured of strong and moderate grades respectively. In the B horizon; fine sub-angular blocky, course angular blocky and course prismatic structured of moderate and strong grades. The B horizon varies from slightly compact to very compact while the C horizon is compact.
Color(moist): **A- horizon** **B- horizon**	 Dark yellowish brown (10 YR 5/4) Dark yellowish brown (10 YR 3/4) and dark brown (10 YR 3/3)
Structure **A-horizon** **B-horizon**	 Fine granular and sub-angular blocky structure of strong and moderate grades respectively Fine sub-angular blocky, course angular blocky and course prismatic structure of moderate and strong grades respectively
Consistency (dry, moist, wet) **A-horizon** **B-horizon**	 Slightly hard when dry; very friable when moist; slightly sticky and slightly plastic when wet Slightly hard to hard when dry; friable to firm when moist; sticky and slightly plastic to plastic when wet
Texture **A-horizon** **B-horizon**	 Sandy Loam Gravely Sandy Loam to Sandy Clay
Diagnostic Horizon	*Natric B*
Soil classification	***Haplic Solonetz***

Table A3.2: Soil mapping unit description for Mapping Unit PS 28

Profile Pit	PP: KTW 002 Kasuroi
Coordinates	E 035.68076 N 02.52170

Parent material	Cover sands
Physiography	Sedimentary plain (nearly level to gently undulating)
Drainage	
Vegetation/Land use	Open grassed shrub/pastoral shrubland with sparse vegetation of *Acacia tortilis, Acacia reficiens* and *Indigofera spinosa* dwarf shrub
Rock outcrops/surface stones	None
Depth	Deep to very deep
Soils general	The unit consists of deep to very deep, brown to strong brown, loamy sand to sandy loam soils. They have an ABC sequence of horizons with gradual smooth to clear smooth boundaries. The soils are fine, granular structured and coarse sub-angular blocky structured with moderate grades respectively (A horizon) and medium to coarse angular blocky structured and course columnar structured both exhibiting strong grades (B horizon). The B horizon is slightly compact to compact while the C horizons is compact to very compact .
Color(moist): **A- horizon** **B- horizon**	 Brown (7.5 YR 4/4) Brown (7.5 YR 4/4) and Strong brown (7.5 YR 4/6)
Structure **A-horizon** **B-horizon**	Fine, granular and coarse sub-angular blocky structured with moderate grades respectively Medium to coarse angular blocky and course columnar structured with strong grades respectively
Consistency (dry, moist, wet) **A-horizon** **B-horizon**	 Loose and slightly hard when dry; very friable when moist; slightly sticky and non-plastic when wet Slightly hard when dry; very friable to friable when moist; non-sticky to slightly sticky and non- plastic when wet
Texture **A-horizon** **B-horizon**	 Sandy Loam Loamy sand to Sandy Loam
Diagnostic properties/horizon	CEC value, Argic B horizon
Soil classification	***Haplic Lixisol***

Table A3.3: Soil mapping unit description for Mapping Unit Ux10, Kobiribiri

Profile Pit	PP: KUx 001 Kobiribiri
Coordinates	E 035.63297 N 02.56037
Parent material	Undifferentiated basement systems rocks predominantly gneisses
Physiography	Upland (irregular, rolling and intensely dissected with narrow interfluves)
Drainage	Well drained
Vegetation/Land use	Natural shrub/pastoral shrub land with sparse vegetation of *Acacia tortilis, Acacia Senegal, Acacia reficiens, Delonix elata* and *Indigofera spinosa* dwarf shrub and *grass spp*
Rock outcrops/surface stones	Rock outcrops, boulders, stones predominantly gneisses, and some basalts
Depth	Shallow to moderately deep (39-48 cm)
Soils general	The unit consists of shallow to moderately deep, yellowish brown, to dark brown gravely sandy clay loam soils. They have an AC sequence of horizons with clear smooth (A-C1) and gradual and diffuse (C1-C2) boundaries. The soils are coarse, prismatic and platy structured with moderate grades and fine granular structured with a strong grade (A horizon) and fine granular with strong grades and medium, angular blocky structured exhibiting moderate grades (C horizon)
Color(moist): **A- horizon**	Dark brown (10 YR 4/3)
Structure **A-horizon** **C-horizon**	Medium sized, moderate graded prismatic and coarse structured and strong grade fine granular structured Fine granular with strong grade and medium, angular blocky structured with moderate grades
Consistency (dry, moist, wet) **A-horizon** **C-horizon**	Slightly hard when dry; friable when moist; slightly sticky and non-plastic when wet Slightly hard when dry, very friable when moist; slightly sticky and non plastic
Texture **A-horizon** **C-horizon**	Gravely Sandy Clay Loam Gravely Sandy Loam to Sandy Clay Loam
Diagnostic properties	Calcareous
Soil classification	***Calcaric Regosol***

Table A3.6: Laboratory data for soils of mapping Unit Y10

Profile pit: Kapese KTW	**Soil analytical data**				
Horizon	A	AB	Bw1	Bw2	C
Soil depth cm	0-20	20-53	53-77	77-107	107-150+
Lab. No. /2010	14071	14072	14073	14074	14075
Soil pH-H_2O (1:2.5)	8.6	9.0	9.0	8.7	9.0
Elect. Cond. mS/cm	0.2	0.2	0.3	0.6	0.6
Carbon %	0.16	0.21	0.06	0.07	N/D*
Sand %	80	68	80	60	64
Silt %	8	8	4	4	6
Clay %	12	24	16	36	30
Texture Class	SL	SCL	SL	SC	SCL
Cat. Exch. Cap. me%	11.6	16.0	13.6	26.4	18.4
Calcium me%	35.3	27.0	31.7	79.6	83.0
Magnesium me%	2.1	2.2	2.0	2.4	2.0
Potassium me%	0.7	0.5	0.2	0.4	0.5
Sodium me%	1.0	1.0	1.1	2.2	2.7
Sum me%	38.3	29.9	34.2	83.0	86.1
Base %	100+	100+	100+	100+	100+
ESP	1.7	1.3	2.2	2.3	3.3

Table A3.7: Laboratory data for soils of mapping Unit Ps28

Profile Pit: Kasuroi KTW 002	**Soil Analytical Data**				
Horizon	A	Bw1	Bw2	Bw3	C
Soil depth cm	0-9	9-45	45-103	103-136	136-150+
Lab. No. /2010	14076	14077	14078	14079	14080
Soil pH-H_2O (1:2.5)	7.9	8.7	8.8	9.0	8.8
Elect. Cond. mS/cm	0.15	0.11	0.14	0.16	0.14
Carbon %	0.12	0.03	0.04	0.15	0.04
Sand %	80	88	86	84	86
Silt %	6	4	4	2	4
Clay %	14	8	10	14	10
Texture Class	SL	LS	LS	SL	LS
Cat. Exch. Cap. me%	13.6	8.0	7.2	8.0	7.2
Calcium me%	19.9	17.0	15.3	27.5	15.3
Magnesium me%	2.3	1.9	1.9	2.2	1.9
Potassium me%	1.4	0.3	0.2	0.4	0.2
Sodium me%	0.2	0.2	0.2	0.6	0.2
Sum me%	23.8	19.4	17.6	30.7	17.6
Base %	100+	100+	100+	100+	100+
ESP	1.5	2.5	2.8	7.5	2.8

Table A3.8: Laboratory data for soils of mapping Unit Ux10

Profile pit: KUx 001	Soil analytical data		
Horizon	A	C1	C2
Soil depth cm	0-10	10-27	27-48
Lab. No. /2010	14081	14082	14083
Soil pH-H_2O (1:2.5)	8.8	8.8	8.7
Elect. Cond. mS/cm	0.15	0.17	0.18
Carbon %	0.73	0.52	0.13
Sand %	74	68	70
Silt %	6	4	12
Clay %	20	28	18
Texture Class	SCL	SCL	SL
Cat. Exch. Cap. me%	15.6	16.0	16.0
Calcium me%	86.7	147.0	142.0
Magnesium me%	2.3	2.3	2.3
Potassium me%	0.9	0.5	0.3
Sodium me%	0.2	0.1	0.1
Sum me%	90.1	149.9	144.7
Base %	100+	100+	100+
ESP	1.3	0.6	0.6

Key:
SL - Sandy Loam
SC - Sandy Clay
C – Clay

Infiltration rates and soil moisture characteristics for Mapping unit Y10

From the measurements, the basic infiltration rate for the piedmont plains soils (Mapping unit Y10) is 0.22 cm/hr which is categorized as slow (Table A3.9 and Figure A3.8).

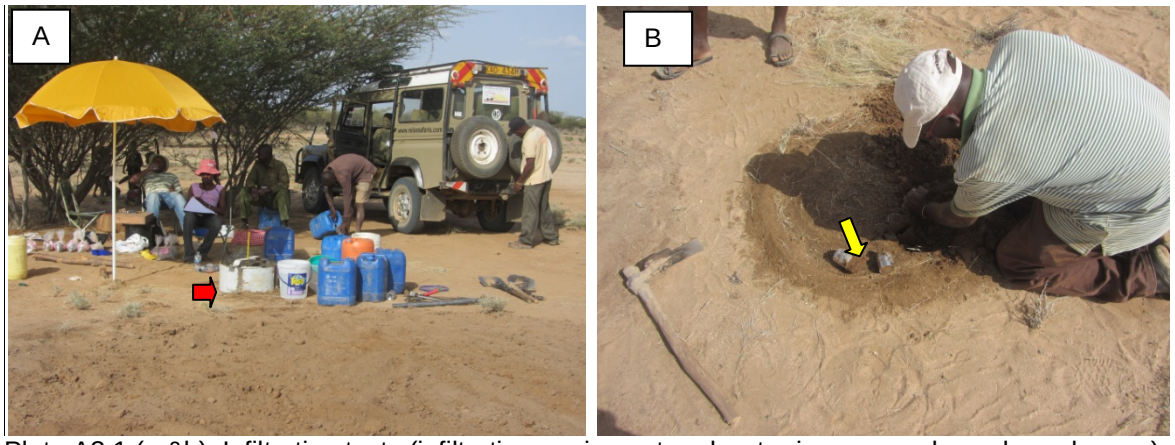


Plate A3.1 (a &b): Infiltration tests (infiltration equipment and water jerry cans shown by red arrow) at Twiga-1, exploratory well drill site (Mapping unit Y10) and (b) Same site, removal of surface soil core ring samples for soil moisture characteristics determination (yellow arrow).

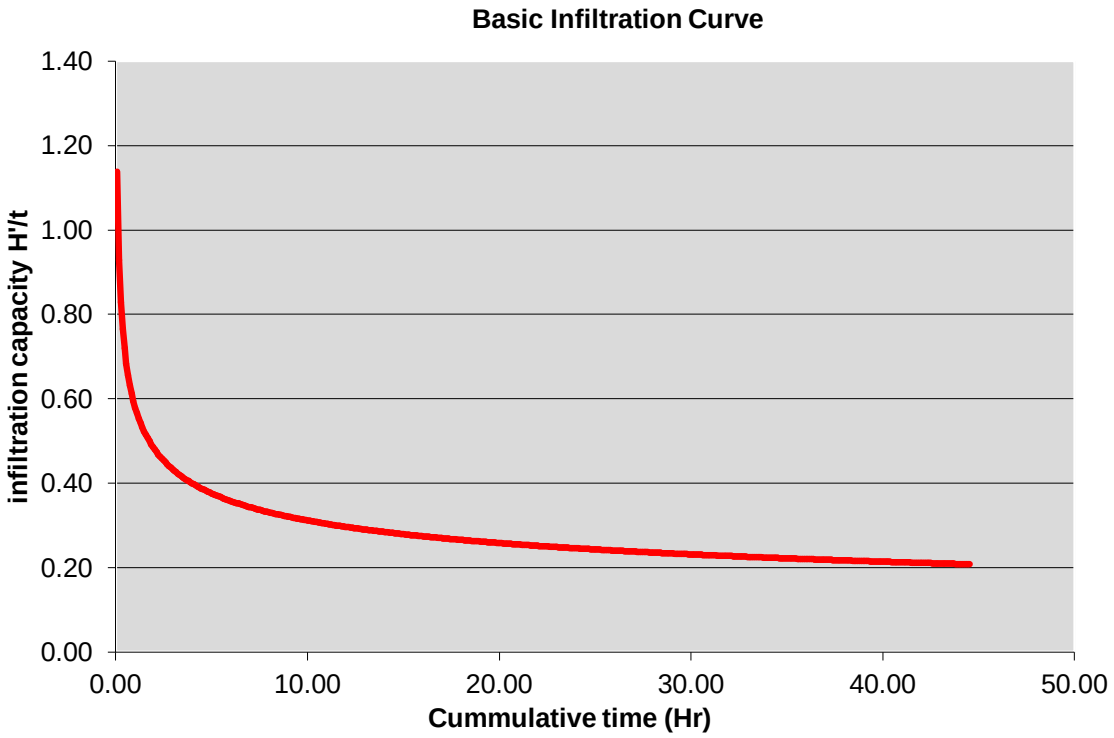


Figure A3.8: Graph showing the saturated basic infiltration rate (cm/hr) of Twiga exploratory well drill site (Mapping unit Y10). The stable state is realized after 5 Hr 55 min

Table A3.9: Basic infiltration rate measurements for mapping unit Y10

Time t_1(Hr)	Cumulative time t(Hr)	Change in height H_1(cm)	Infiltration capacity (H_1/t_1)
0.08	0.08	0.10	1.20
0.12	0.20	0.10	0.86
0.15	0.35	0.10	0.67
0.18	0.53	0.10	0.55
0.22	0.75	0.10	0.46
0.25	1.00	0.30	1.20
0.33	1.33	0.30	0.90
0.42	1.75	0.40	0.96
0.50	2.25	0.20	0.40
0.58	2.83	0.30	0.51
0.67	3.50	0.40	0.60
0.78	4.28	0.20	0.26
0.90	5.18	0.40	0.44
1.03	6.22	0.40	0.39
1.33	7.55	0.10	0.08
1.83	9.38	0.10	0.05
2.00	11.38	0.40	0.20
2.17	13.55	0.80	0.37
2.67	16.22	1.70	0.64
3.67	19.88	2.00	0.55

4.67	24.55	1.20	0.26
5.92	30.47	1.30	0.22
6.67	37.13	1.20	0.18
7.42	44.55	2.80	0.38

The soils of the piedmont plains are deep and though there is moderate surface sealing of the soil, once they are moist, the soils are very friable and the granular and sub-angular structure allows for a high initial surface water percolation during the infiltration test. This is moderated when the subsurface horizons are penetrated. The B-horizon is slightly compact and compaction increases with depth, therefore the infiltration rate is reduced with depth. This is corroborated by the change of soil structure from sub-angular blocky to prismatic. Drainage pores are thus reduced and therefore slowing the infiltration rate significantly reaching a constant value of 0.22 cm/hr at five hours and fifty five minutes at the Bw1 horizon. Bw2 horizon is more compact than the overlaying horizon (strong grade course prismatic structure) and the infiltration rate decreases further before increasing in the underlying C-horizon which is less compact (moderate grade, medium size prismatic and moderate grade, fine to medium size sub-angular blocky structure) with increased sand fraction in the sandy clay loam texture matrix (Table A3.3 and Figure A3.8). This unit experiences moderate seasonal flooding and ponding and also compaction due to animal grazing, predominantly goats and camels which feed on the *Acacia reficiens* and *Indigofera* dwarf shrubs. The surface compaction caused by trampling accelerates soil structure degradation. Further, the unit has a compact B-horizon and is moderately saline and strongly sodic (inferred) affecting negatively soil structure stability.

The unit is therefore unsuitable for surface water discharge/drainage and protection measures are therefore required to guard against soil and groundwater pollution.

Infiltration rates and soil moisture characteristics for mapping unit Ps28

From the measurements, the basic infiltration rate for the sedimentary plains soils (Mapping unit Ps28) is 0.55 cm/hr which is categorized as moderately slow (Figure A3.9).

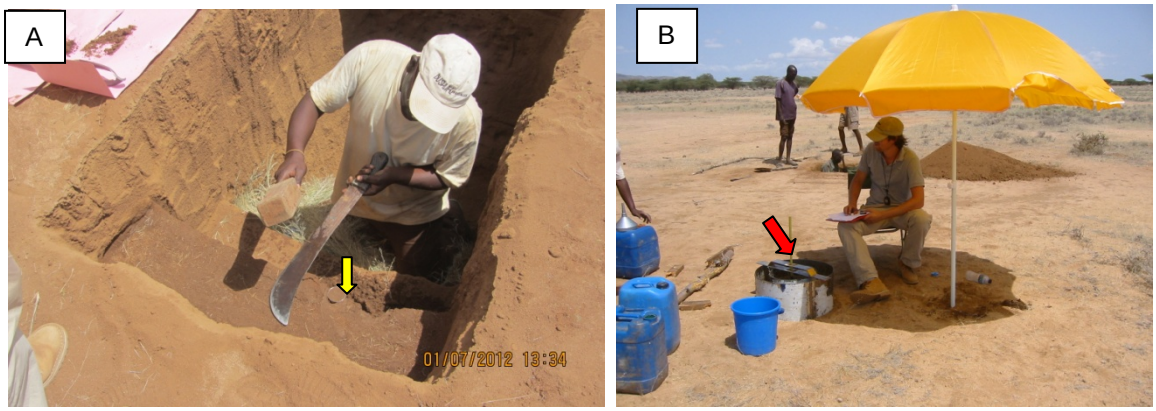


Plate A3.2 (a & b): Kasuroi profile pit site; sampling subsurface soil core rings (Ring in situ-yellow arrow) and (b) Carrying out Infiltration tests [(infiltration equipment-red arrow)--(Mapping unit Ps28)]

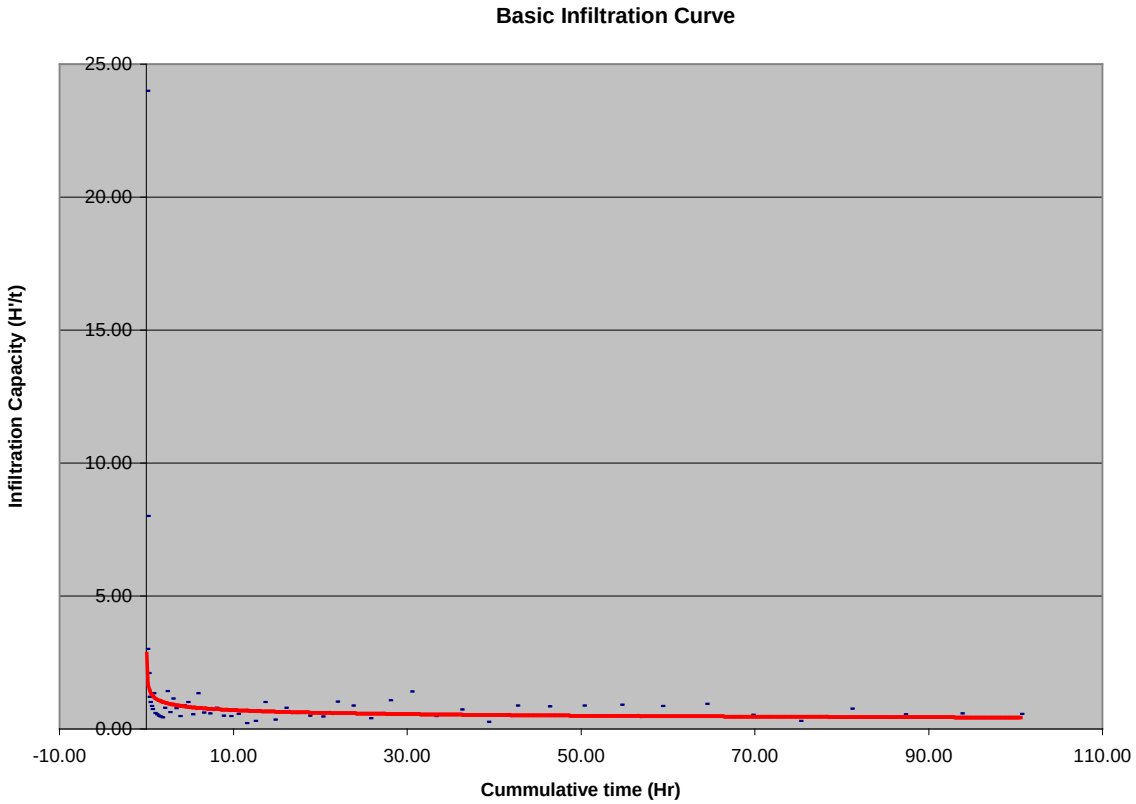


Figure A3.9: Graph showing the saturated basic infiltration rate (cm/hr) of Kasuroi site (Mapping unit Ps28). The stable state is realized after 6 Hr 17 min

Table A3.10: Basic infiltration rate measurements for mapping unit Ps28

Time t_1(Hr)	Cumulative time (Hr)	Change in height (H_1)	Infiltration capacity (H_1/t_1)
0.02	0.02	0.40	24.00
0.03	0.05	0.10	3.00
0.05	0.10	0.40	8.00
0.07	0.17	0.30	2.10
0.08	0.25	0.10	1.20
0.10	0.35	0.10	1.00
0.12	0.47	0.10	0.86
0.13	0.60	0.10	0.75
0.15	0.75	0.20	1.33
0.17	0.92	0.10	0.60
0.18	1.10	0.10	0.55
0.20	1.30	0.10	0.50
0.22	1.52	0.10	0.46
0.23	1.75	0.10	0.43
0.25	2.00	0.20	0.80
0.28	2.28	0.40	1.41
0.32	2.60	0.20	0.63
0.35	2.95	0.40	1.14
0.38	3.33	0.30	0.78

0.42	3.75	0.20	0.48
0.45	4.20	0.40	0.89
0.50	4.70	0.50	1.00
0.55	5.25	0.30	0.55
0.60	5.85	0.80	1.33
0.65	6.50	0.40	0.62
0.70	7.20	0.40	0.57
0.75	7.95	0.60	0.80
0.80	8.75	0.40	0.50
0.85	9.60	0.40	0.47
0.90	10.50	0.50	0.56
0.95	11.45	0.20	0.21
1.00	12.45	0.30	0.30
1.10	13.55	1.10	1.00
1.17	14.72	0.40	0.34
1.25	15.97	1.00	0.80
1.33	17.30	0.80	0.60
1.42	18.72	0.70	0.49
1.50	20.22	0.70	0.47
1.67	21.88	1.70	1.02
1.83	23.72	1.60	0.87
2.00	25.72	0.80	0.40
2.25	27.97	2.40	1.07
2.50	30.47	3.50	1.40
2.75	33.22	1.30	0.47
3.00	36.22	2.20	0.73
3.08	39.30	0.80	0.26
3.33	42.63	2.90	0.87
3.67	46.30	3.10	0.85
4.00	50.30	3.50	0.88
4.33	54.63	3.90	0.90
4.67	59.30	4.00	0.86
5.08	64.38	4.80	0.94
5.33	69.72	2.80	0.53
5.50	75.22	1.60	0.29
5.87	81.08	4.50	0.77
6.17	87.25	3.40	0.55
6.50	93.75	3.80	0.58
6.85	100.60	3.80	0.55

The soils of the sedimentary plains are very deep and exhibit surface sealing, however once they are moist, the soils are very friable and the granular and sub-angular blocky structure allows for initial high infiltration. This is moderated when the subsurface horizons are penetrated. The B-horizon is compact and varies in degree of compaction (Bw1-compact;

Bw2 less compact; Bw3 very compact) and the C horizon is also compact. This variation affects the infiltration rate which slows down in the compact zones and increases slightly in the less compact horizons. This is corroborated by the change in the soil structure (plate 5.2.2) from angular blocky and columnar to angular blocky structure of different sizes and strong grades. Thus the drainage pores are reduced and therefore slowing the infiltration rate reaching a constant value of 0.55 cm/hr at six hours and seventeen minutes at the Bw1 horizon. There is slight variation in the infiltration rate (Table A3.10) in the underlaying horizon due to similar texture matrix (very slight variation of the sand fraction in the loamy sand and sandy loam texture matrix (Table A3.7 and Figure A3.9).

Due to the topography of the unit (gently undulating) and drainage characteristics (drainage is improved by the dominant sand fraction in the soil texture matrix), the infiltration rate could be higher but it is only impeded by the compact nature of the sub soil. However, the infiltration rate is classified as moderately slow (Landon 1984) and the unit can support surface water discharge/drainage so long as the discharge is done commensurate to the infiltration rate. Where the discharge is more than the infiltration rate however, protection measures would be required to guard against soil and groundwater pollution.

Fertility status of the study area

The following is a summary of the soil fertility status of mapping units (Y10, Ps28 and Ux10) which form the study area

Soil Mapping Y10

The soils of the piedmont plains have a strong alkaline pH (8.63) and are low in nitrogen and organic carbon. Soil phosphorous is low in supply while potassium, calcium and magnesium are adequately supplied in the soil. The micronutrient iron and copper are in adequate supply save for zinc and manganese which are low in supply (Table A3.11).

Soil Mapping Ps28

The soils of the sedimentary plains have a medium alkaline pH (8.45) and are low in nitrogen and organic carbon. Soil phosphorous is low in supply while potassium, calcium and magnesium are in adequate supply. The micronutrients manganese, copper, iron and sodium are in adequate supply while zinc is low in supply (Table A3.11).

Soil Mapping Ux10

The soils of the uplands have a medium alkaline pH (8.45) and are low in nitrogen and organic carbon. Soil phosphorous is low in supply while potassium and calcium are in adequate supply. However, magnesium is high in supply. All the micronutrients are adequate in supply with the exception of zinc which is low in supply (Table A3.11).

Table A3.11: Soil Fertility Status for the study sites

	Soil Analytical Data					
Field	**Y10**		**Ps28**		**Ux10**	
Sample designation	**0006F**		**012F**		**015F**	
Lab. No/2012	14068		14069		14070	
Soil depth cm	0-20		0-20		0-20	
Fertility results	value	Class	value	class	value	class
Soil pH	8.63	Strong alkaline	8.45	Medium alkaline	8.45	medium alkaline
Total Nitrogen %	0.05	Low	0.04	low	0.05	Low
Org. Carbon %	0.48	Low	0.37	low	0.49	Low
Phosphorus ppm	2.3	Low	3.0	low	5.0	Low
Potassium me%	0.59	Adequate	0.41	adequate	0.79	Adequate
Calcium me%	2.7	Adequate	2.0	adequate	4.5	Adequate
Magnesium me%	2.78	Adequate	2.59	adequate	4.19	High
Manganese me%	0.04	low	0.14	adequate	0.15	Adequate
Copper ppm	3.29	adequate	3.01	adequate	3.26	Adequate
Iron ppm	34.8	adequate	32.2	adequate	38.6	Adequate
Zinc ppm	2.36	Low	1.91	low	2.38	Low
Sodium me%	0.20	Adequate	0.16	Adequate	0.40	Adequate
Elect. Cond. mS/cm	0.20	adequate	0.07	adequate	0.16	Adequate

APPENDIX 5: TKBV PIN NUMBER AND VAT CERTIFICATES

APPENDIX 4: CERTIFICATES OF THE CONSULTANTS

PR/10351

Application Reference No. .....

Registration No: 0014355

For official use

nema

mazingira yetu | uhai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT LICENSE

This is to certify that the Project Report/Environmental Impact Assessment Study Report received from Tullow Kenya B.V, Westlands Office Park .....(Name of of individual/firm) of P. O. Box 63298-00619 Nairobi ..... (Address submitted to the National Management Environment Authority (NEMA) in accordance with the Environmental Impact Assessment and Audit Regulations regarding Proposed Exploratory Oil and Natural Gas wells Drilling Programme .....

.....(title of project) whose objective is to carry on Determine the presence of natural Gas and Oil in Block 13T .....

..... (briefly describe purpose) located at Block 13T, Turkana County .....

.....(locality and district) has been reviewed and a licence is hereby issued for implementation of the project, subject to attached conditions.

Dated this 30th Day of Jan 2013

Signature.....

(SEAL)

Director General
The National Environment Management Authority

CONDITIONS OF LICENSE

1. This licence is valid tor a period of.....(time within which the project should commence) from the date hereof.
2. The Director-General shall be notified of any transfer/variation/surrender of this license.

P.T.O.

1.0 General Conditions

1.1 This approval is for the proposed exploratory oil and natural gas wells drilling programme in Block 13T in Turkana County, costing KShs.3,057,407,415/=.

1.2 The license shall be valid for 24 months from the date of issue.

1.3 Without prejudice to the other conditions of this license, the proponent shall implement and maintain an environmental management system, organizational structure and allocate resources that are sufficient to achieve compliance with the requirements and conditions of this license.

1.4 The Authority shall take appropriate action against the proponent in the event of breach of any of the conditions stated herein or any contravention to the Environmental Management and Coordination Act, 1999 and regulations therein.

1.5 This license shall not be taken as statutory defence against charges of environmental degradation or pollution in respect of any manner of degradation/pollution not specified herein.

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

1.7 The proponent shall submit an Environmental Audit report in the first year of occupation/operations/commissioning to confirm the efficacy and adequacy of the Environmental Management Plan.

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

1.9 The proponent shall provide the final project accounts (final project costs) on completion of construction phase. This should be done prior to project commissioning/operation/occupation.

2.0 Construction and Drilling Conditions

2.1 The proponent shall put up a project signboard as per the Ministry of Public Works standards indicating the NEMA EIA license number among other information.

2.2 The proponent shall ensure that adequate and appropriate sanitary facilities are provided for the workers during construction phase and that proper decommissioning of the facilities is carried out once construction is complete.

2.3 In the event that the project site borders a river to a stream, the proponent, pursuant to Regulation 6 (c) of the Water Quality Regulations of 2006, shall protect the riparian reserve by ensuring that **NO** development activity is undertaken within the full width of the river or stream to a minimum of six (6) meters and a maximum of 30 meters on either side, based on the highest recorded flood level.

2.4 The proponent shall ensure that no works are undertaken within 30 meters of Turkwel River.

2.5 The proponent shall prepare an Emergency Response Plan (ERP) prior commencement of works.

2.6 The proponent shall ensure that waste pits and landfills are constructed in such a manner so as not to cause water pollution and shall be done only by qualified and licensed contractors.

2.7 The proponent shall ensure that material safety data sheet of all potentially hazardous materials are well maintained.

2.8 The proponent shall ensure strict adherence to the provisions of Environmental Management and Coordination (Noise and Excessive Vibrations Pollution Control) Regulations of 2009.

2.9 The proponent shall ensure strict adherence to the Occupational Safety and Health Act (OSHA), 2007.

2.10 The proponent shall ensure that exploration workers are provided with adequate personal protection equipment (PPE), as well as adequate training.

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

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

3.0 Operational Conditions

3.1 The proponent shall obtain an abstraction permit from Water Resources Management Authority prior to drilling of the borehole.

3.2 The proponent shall prepare a waste management plan.

3.3 The proponent shall ensure that all waste water is disposed of as per the standards set out in the Environmental Management and Coordination (Water Quality) Regulations of 2006.

3.4 The proponent shall ensure that all drainage facilities are fitted with adequate functional oil water separators and silt traps.

3.5 The proponent shall ensure that appropriate and functional efficient air pollution control mechanisms are installed in the facility to control all air emissions.

3.6 The proponent shall ensure that all equipment used are well maintained in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations of 2009.

3.7 The proponent shall ensure that all solid waste is handled in accordance with the Environmental Management and Coordination (Waste Management) Regulations of 2006.

3.8 The proponent shall ensure that all workers are well protected and trained as per the Occupational Safety and Health Act (OSHA) of 2007.

3.9 The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of County Council of Turkana, Ministry of Public Health and Sanitation, Directorate of Occupational Health and Safety Services, Ministry of Energy, National Museums of Kenya, Mines and Geology, Ministry of State for Development of

Northern Kenya and Other Arid Lands, Water Resources Management Authority and other relevant Local Authorities.

3.10 The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as re-vegetation, soil conservation, cultural and ecological restoration, ground water contamination, oil/water separators, noise silencers are designed, constructed and employed simultaneously with the proposed project.

4.0 Notification Conditions

4.1 The proponent shall notify the Ministry of Energy of any accidents or incidents during the project phases within twenty-four (24) hours.

4.2 The proponent shall seek written approval from the Authority for any operational changes under this license.

4.3 The proponent shall ensure that the Authority is notified of any malfunction of any system within 12 hours on the NEMA hotline No. **020 6006041** and mitigation measures put in place.

4.4 The proponent shall keep records of all pollution incidences and notify the Authority within 24 hours.

5.0 Decommissioning Conditions

5.1 The proponent shall ensure that a decommissioning plan is submitted to the Authority for approval at least fourteen (14) days prior to decommissioning.

5.2 The proponent shall ensure that all pollutants and polluted material is contained and adequate mitigation measures provided during the phase.