

# ENVIRONMENTAL IMPACT ASSESSMENT PROJECT REPORT

FOR

PROPOSED EXPLORATORY OIL AND NATURAL GAS WELL DRILLING PROGRAMME  
IN BLOCK 10A: PARTS OF MARSABIT NORTH (CHALBI) AND LOYANGALANI  
DISTRICTS 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](mailto:earthview@geologist.com)

**AUGUST 2011**



# PROJECT REPORT

FOR

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROPOSED  
EXPLORATORY WELL DRILLING PROGRAMME IN BLOCK 10A:  
MARSABIT NORTH (CHALBI) AND LOYANGALANI DISTRICTS

AUGUST 2011

**Prepared By:**

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

**For:**

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

Submitted by           **Martin Mbogo**  
Position               **General Manager**  
Signed                   \_\_\_\_\_   
Date                      \_\_\_\_\_

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 natural gas well drilling programme in Block 10A: Marsabit North (Chalbi) and Loyangalani Districts

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

Dr. Daniel Olago  
(Lead Expert and Director)

Sign.....

Sign.....

Date.....

Date.....

## 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 a proposed exploratory oil and natural gas well drilling programme in the National Oil Corporation of Kenya (NOCK, 1987) exploration Block 10A (Marsabit North (Chalbi) and Loyangalani Districts). This project report has been prepared for the project proponent, Tullow Kenya B.V. (TKBV) by Earthview Geoconsultants 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.

Following the discovery of hydrocarbon deposits in the Muglad and Melut basins of the South Sudan rifts and, more recently, by Tullow Oil and Heritage Oil in Uganda within the western branch of the East African Rift, several oil companies have intensified exploration efforts in the related Mesozoic and Early Tertiary rift basins of Kenya with a view to meeting the local, regional and global demand for energy. This exploratory well drilling project follows the analysis, identification and delineation of potential hydrocarbon traps based on seismic data that was acquired during the recently completed seismic survey program.. 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, intends to drill an exploration well approximately 4200m deep at a selected site in Block 10A over a period of 60 to 120 days, once a licence is granted by NEMA. 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).

The detailed field-based environmental impact assessment study, which was preceded by extensive desk top studies, was undertaken from 4<sup>th</sup> June 2011 to 18<sup>th</sup> June 2011. 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 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. 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 campsite and access roads;
- Dust generation and exhaust emissions by vehicles and equipment;
- Waste generation at camp site and drilling rig area;
- Pollution of soil and water (surface and ground water) from waste streams generated at the campsite and drilling area; 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: active sand dune building and degradation; periodic ponding and flooding of inter-dune and desert areas; high dust loading in the air due to strong winds, low vegetation cover and loose surface soils; 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 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 well drilling operations are regarded, from an industry standpoint, as being of a small scale in both effort and the time to be taken to complete. In addition the majority of operations will be conducted significant distances away from any habitation, town or workplace so that the inhabitants will be largely insulated. The short-term duration (3-5 months) of the exploratory drilling programme and its small scale relative to natural processes acting on the environment in the area, and 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

<b>EXECUTIVE SUMMARY .....</b>	<b>I</b>
<b>CHAPTER 1 .....</b>	<b>1</b>
<b>INTRODUCTION .....</b>	<b>1</b>
1.1 INTRODUCTION .....	1
1.2 PURPOSE OF THE REPORT .....	1
1.3 DEVELOPER IDENTIFICATION .....	1
1.4 BRIEF SITE DESCRIPTION.....	2
1.5 PROJECT BACKGROUND, OVERVIEW, JUSTIFICATION AND OBJECTIVES .....	3
1.5.1 Project Background.....	3
1.5.2 Overview of the Project.....	4
1.5.3 Project Justification.....	6
1.6 PURPOSE OF THE EIA .....	6
1.6.1 Administrative and Legal framework.....	6
1.6.2 The Mandate of NEMA .....	7
1.6.3 Requirements and Scope of Work for the EIA .....	7
1.6.4 The EIA Review and Approval Process .....	8
1.7 THE EIA TEAM.....	8
1.8 OBJECTIVES OF THE EIA PROJECT REPORT.....	9
1.9 TERMS OF REFERENCE (TOR).....	9
1.10 STRUCTURE OF THE REPORT .....	10
<b>CHAPTER 2 .....</b>	<b>12</b>
<b>PROJECT DESCRIPTION.....</b>	<b>12</b>
2.1 INTRODUCTION .....	12
2.2 PROJECT LOCATION .....	12
2.3 QUALITY ASSURANCE OF DESIGN .....	12
2.4 OVERVIEW OF EXPLORATORY DRILLING PROGRAMME .....	12
2.4.1 Site preparation .....	16
2.4.2 Drilling rig specifications and crew facilities.....	16
2.4.3 Rigging-up.....	16
2.4.4 Drilling techniques .....	16
2.4.5 Casing operation.....	17
2.4.6 Well logging.....	18
2.4.7 Well control.....	18
2.4.8 Well testing.....	18
2.4.9 Flaring .....	19
2.4.10 Well completion or well suspension or abandonment and rig removal.....	19
2.5 DRILLING MUD SYSTEM.....	19
2.6 WATER SUPPLY .....	21
2.7 EMISSION AND WASTE MANAGEMENT .....	21
2.7.1 Emissions.....	21
2.7.2 Wastes .....	22
2.8 DECOMMISSIONING/ABANDONMENT .....	27
2.8.1 General activities .....	27
2.8.2 Demolition and site clean-up .....	28
2.9 OIL SPILL CONTINGENCY PLANNING.....	28
2.10 SUPPORT OPERATIONS .....	28

<b>CHAPTER 3</b> .....	<b>29</b>
<b>ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY</b> .....	<b>29</b>
3.1 APPROACH TAKEN FOR THE EIA .....	29
3.2 WORK EVALUATION FOR THE EIA .....	29
3.3 TOPICS ADDRESSED AND ISSUES CONSIDERED .....	29
3.4 COLLECTION OF BASELINE DATA .....	34
3.4.1 <i>Overview of Methods</i> .....	34
3.4.2 <i>Physiography and Geology</i> .....	34
3.4.3 <i>Soils</i> .....	34
3.4.4 <i>Climate</i> .....	35
3.4.5 <i>Air Quality</i> .....	35
3.4.6 <i>Surface and Ground Water Resources</i> .....	35
3.4.7 <i>Terrestrial Environment</i> .....	35
3.4.8 <i>Land and Lake Resources and National Parks</i> .....	35
3.4.9 <i>Visual Aesthetics</i> .....	36
3.4.10 <i>Noise and Vibrations</i> .....	36
3.4.11 <i>Solid and Liquid Wastes</i> .....	36
3.4.12 <i>Public Consultations and Socio-Economics</i> .....	36
3.4.13 <i>Health and Public Safety</i> .....	37
3.4.14 <i>Key informant interviews</i> .....	38
3.5 DEVELOPMENT OF THE ENVIRONMENTAL MANAGEMENT PLAN (EMP) .....	38
3.5.1 <i>The Five-Step Process</i> .....	38
3.5.1 <i>Assigning significance ratings</i> .....	39
<b>CHAPTER 4</b> .....	<b>40</b>
<b>POLICY, LEGAL, AND REGULATORY FRAMEWORK</b> .....	<b>40</b>
4.1 THE CONSTITUTION OF KENYA, 2010 .....	40
4.2 THE POLICY FRAMEWORK .....	40
4.2.1 <i>Environment and Development Policy</i> .....	40
4.2.2 <i>National Policy on Water Resources Management and Development (Sessional Paper No.1 of 1999)</i> ...	42
4.2.3 <i>Energy Policy (Sessional Paper No.4 of 2004)</i> .....	42
4.2.4 <i>Land Policy (Sessional Paper No. 3 of 2009)</i> .....	43
4.2.5 <i>Mining Policy</i> .....	43
4.2.6 <i>Health Policy</i> .....	43
4.2.7 <i>Economic Recovery for Wealth and Employment Creation Strategy</i> .....	44
4.2.8 <i>Kenya Vision 2030</i> .....	44
4.3 KENYA LEGISLATION AND REGULATIONS .....	45
4.3.1 <i>The Petroleum (Exploration and Production) Act, Cap. 308</i> .....	45
4.3.2 <i>The Petroleum (Exploration and Production) Regulations</i> .....	46
4.3.3 <i>The Energy Act, No. 12 of 2006</i> .....	46
4.3.4 <i>The Water Act, Cap. 372</i> .....	46
4.3.5 <i>The Water Resources Management Rules, 2007</i> .....	47
4.3.6 <i>The Local Government Act, Cap. 265 (Revised 2010)</i> .....	47
4.3.7 <i>The Physical Planning Act, Cap. 286</i> .....	47
4.3.8 <i>The Wildlife (Conservation and Management) Act, Cap. 376</i> .....	47
4.3.9 <i>The National Museums and Heritage Act, Cap. 216</i> .....	48
4.3.10 <i>The Public Health Act, Cap. 242</i> .....	48
4.3.11 <i>The Occupational Safety and Health Act, No. 15 of 2007</i> .....	48

4.3.13	<i>The Explosives Act, Cap. 115</i> .....	49
4.3.14	<i>The Explosives (Blasting Explosives) Rules</i> .....	49
4.3.15	<i>The Penal Code, Cap. 63</i> .....	50
4.4	<b>NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY - ACT AND REGULATIONS</b> .....	50
4.4.1	<i>The Environmental Management and Co-ordination Act, 1999</i> .....	50
4.4.2	<i>The EIA Guidelines and Administrative Procedures</i> .....	50
4.4.3	<i>The Environmental Management and Co-ordination (Water Quality) Regulations, 2006</i> .....	51
4.4.4	<i>The Environmental (Impact Assessment and Audit) Regulations, 2003</i> .....	51
4.4.5	<i>The Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit-Sharing) Regulations, 2006</i> .....	51
4.4.6	<i>The Environmental Management and Co-ordination (Wetland, Riverbank, Lakeshore and Seashore Management) Regulations, 2009</i> .....	52
4.4.7	<i>The Environmental Management and Co-ordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009</i> .....	52
4.4.8	<i>The Environmental Management Co-ordination (Fossil Fuel Emission Control) Regulations, 2006</i> .....	52
4.4.9	<i>The Environmental Management and Co-ordination (Waste Management) Regulations, 2006</i> .....	53
4.5	<b>INTERNATIONAL PRACTICES, STANDARDS AND CONVENTIONS</b> .....	53
4.5.1	<i>International Best Practices</i> .....	53
4.5.2	<i>International Conventions</i> .....	55
4.6	<b>TULLOW OIL PLC POLICIES</b> .....	56
<b>CHAPTER 5</b> .....		<b>59</b>
<b>BASELINE ENVIRONMENTAL AND SOCIAL PARAMETERS</b> .....		<b>59</b>
5.1	<b>INTRODUCTION</b> .....	59
5.1.1	<i>Project Location and Layout of the Chapter</i> .....	59
5.1.2	<i>Geographical Aspects and District Boundaries</i> .....	61
5.1.3	<i>Administrative Structure</i> .....	62
5.1.4	<i>Communications and Transport</i> .....	62
5.1.5	<i>Government, Non Governmental and Community-Based Organizations</i> .....	62
5.2	<b>BASELINE SURVEY</b> .....	63
5.2.1	<i>Physiography and Geology</i> .....	63
5.2.2	<i>Soils</i> .....	71
5.2.3	<i>Climate</i> .....	76
5.2.4	<i>Air Quality</i> .....	77
5.2.5	<i>Surface and Groundwater Resources</i> .....	77
5.2.6	<i>Water Quality</i> .....	80
5.2.7	<i>Terrestrial Environment</i> .....	81
5.2.8	<i>Land Resources</i> .....	87
5.2.9	<i>Archaeological, Historical and Cultural Sites</i> .....	87
5.2.10	<i>Visual Aesthetics</i> .....	88
5.2.11	<i>Noise and Vibrations</i> .....	88
5.2.12	<i>Solid and Liquid Wastes</i> .....	88
5.2.13	<i>Socio-economic Baseline</i> .....	89
5.2.14	<i>Economic Setting</i> .....	91
5.2.15	<i>Security and Public Safety</i> .....	92
5.2.16	<i>Community Views and Concerns</i> .....	93
5.2.17	<i>Corporate Social Responsibility</i> .....	94
<b>CHAPTER 6</b> .....		<b>95</b>
<b>ANALYSIS OF PROJECT ALTERNATIVES</b> .....		<b>95</b>

6.1 INTRODUCTION .....	95
6.2 PROJECT ALTERNATIVES .....	95
6.2.1 “No action” alternative .....	95
6.2.2 “Drilling” alternative .....	96
<b>CHAPTER 7 .....</b>	<b>100</b>
ENVIRONMENTAL IMPACT ASSESSMENT .....	100
7.1 INTRODUCTION .....	100
7.3 PROJECT ENVIRONMENTAL AND SOCIAL ASPECTS AND POTENTIAL IMPACTS .....	100
7.4 IMPACTS ASSESSMENT AND MITIGATION .....	102
7.4.1 <i>Physiography and Geology</i> .....	102
7.4.2 <i>Soils</i> .....	103
7.4.3 <i>Air Quality</i> .....	104
7.4.4 <i>Surface and Ground Water Resources</i> .....	105
7.4.5 <i>Water Quality</i> .....	106
7.4.6 <i>Terrestrial Environment (Habitats, Flora, and Fauna)</i> .....	107
7.4.7 <i>Land Resources</i> .....	107
7.4.8 <i>Archaeological, Historical and Cultural Sites</i> .....	108
7.4.9 <i>Visual Aesthetics</i> .....	108
7.4.10 <i>Noise</i> .....	108
7.4.11 <i>Solid and Liquid Wastes</i> .....	109
7.4.12 <i>Social Characteristics</i> .....	110
7.4.13 <i>Economic Characteristics</i> .....	110
7.4.14 <i>Occupational Health and Safety</i> .....	111
7.4.15 <i>Security and Public Safety</i> .....	112
7.5 CUMULATIVE IMPACTS .....	112
7.6 SIGNIFICANCE OF IMPACTS .....	113
<b>CHAPTER 8: .....</b>	<b>121</b>
ENVIRONMENTAL MANAGEMENT PLAN .....	121
8.1 INTRODUCTION .....	121
8.2 OBJECTIVES OF THE EMP .....	121
8.4 BRIEF PROJECT DESCRIPTION .....	121
8.5 APPLICABLE LEGISLATION AND REGULATIONS .....	122
8.6 TKBV POLICIES AND PROCEDURES .....	122
8.7 ROLES, RESPONSIBILITIES AND TRAINING .....	122
8.8 COMMUNICATION WITH STAKEHOLDERS AND GRIEVANCE MECHANISM .....	123
8.9 AUDITING .....	123
8.10 THE ENVIRONMENTAL (AND SOCIAL) MANAGEMENT PLAN (EMP) FOR THE PROPOSED OIL AND GAS EXPLORATORY DRILLING PROGRAMME .....	124
8.10.1 <i>Physiography and Geology</i> .....	125
8.10.2 <i>Soils</i> .....	125
8.10.3 <i>Air Quality</i> .....	127
8.10.4 <i>Surface and Groundwater Resources</i> .....	128
8.10.5 <i>Water Quality</i> .....	130
8.10.6 <i>Terrestrial Environment (Habitats, Flora, and Fauna)</i> .....	131
8.10.7 <i>Land Resources</i> .....	133
8.10.8 <i>Archaeological, Historical and Cultural Sites</i> .....	133
8.10.9 <i>Visual Aesthetics</i> .....	134
8.10.10 <i>Noise</i> .....	135
8.10.12 <i>Social Characteristics</i> .....	138
8.10.13 <i>Economic Characteristics</i> .....	139

8.10.14 Occupational Health and Safety .....	139
8.10.15 SECURITY AND PUBLIC SAFETY .....	141
8.11 OTHER GENERAL REQUIREMENTS AND TRAINING ISSUES .....	142
8.11.1 Occupational Health and Safety Plan .....	142
8.11.2 Vehicle Traffic Plan .....	142
8.11.3 Hazardous Materials Management Plan .....	142
8.11.4 Spills Prevention and Response Plan .....	143
8.11.5 Emergency Response Plan .....	143
8.11.6 Environmental Awareness Plan .....	144
8.12 COST OF THE EMP AND TIMEFRAME FOR THE ACTIVITY .....	144
<b>CHAPTER 9 .....</b>	<b>145</b>
CONCLUSIONS AND RECOMMENDATIONS .....	145
9.1 SUMMARY OF THE PROJECT COMPONENTS .....	145
9.2 RECOMMENDATIONS.....	146
<b>REFERENCES.....</b>	<b>148</b>
<b>APPENDICES.....</b>	<b>150</b>

## LIST OF FIGURES

Figure 1.1: Location map of the project area. ....	2
Figure 1.2: Location of the proposed well sites .....	5
Figure 2.1: Drilling rig showing key components. (Source: .....	14
Figure 2.2: Schematic structure of the proposed casing design of the exploration well. ....	15
Figure 2.3: Flow diagram of drilling fluid management options. ....	26
Figure 5. 1: Location of the project area. ....	60
Figure 5.2: Districts within the study area .....	61
Figure 5.3: Drainage patterns within the project area .....	67
Figure 5.4: Geology and physiography of the project area. ....	69
Figure 5.5: Soil map of the project area showing the exploratory drilling sites. ....	72
Figure 5.6: Vegetation map of the project area .....	82

## LIST OF TABLES

Table 1.1 Structure of the EIA Project Report .....	10
Table 2.1: Table of drill rig parts .....	14
Table 2.2: Technical specifications for the proposed well drilling to 4200m depth. ....	15
Table 2.3: Drilling techniques.....	17
Table 2.4: Composition of drilling muds. ....	20
Table 2.5: Special additives and their function in water based-drilling fluids.....	20
Table 2.6: The environmental impacts of different atmospheric releases.....	22
Table 2.7: Waste categories generated.....	23
Table 2.8: Waste management approaches. ....	24
Table 3.1: Public consultations schedule and areas covered.....	37
Table 3.2: Impact assessment criteria and rating scales.....	38
Table 4.1: International conventions that Kenya has ratified.....	55
Table 5.1: Rock types observed during the field survey that is significant for project logistics and EMP. .....	69
Table 5.2: Active geological processes observed during the field survey that is significant for project logistics and EMP. ....	70
Table 5.3: Soil Description within specified soil mapping units observed during the field survey that is significant for project logistics and EMP.....	76
Table 5.4: Water quality in the project area (BH–Borehole). WHO limits are for drinking water quality. Light grey shaded cells show the limits are exceeded. ....	80
Table 5.5: Cultural sites within the project area.....	87
Table 5.6: Population distribution (by district) in the project area district. ....	89
Table 5.7: Population distribution (by division) in the project area.....	89
Table 7.1: Project impact sources and prediction of impacts on environmental and social structure and characteristics of the project land area.....	100
Table 7.2: 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 3.2 for impact assessment criteria and rating). Note: Project Operations includes - site preparation, construction, exploratory drilling, decommissioning and rehabilitation. .....	114

## LIST OF PLATES

Plate 5.1: Southern margin of Chalbi playa, photo taken from Maikona area facing south.....	63
Plate 5.2: Mirage as a result of reflection of salt crust of the Chalbi playa. Note the presence of sand dunes in the background. ....	64
Plate 5.3: Degraded dune field south-east of the Chalbi playa. ....	64
Plate 5.4: Ponding of interdune depressions within the dune field, south-west of Chalbi playa, 6 km away from the proposed Sirius exploratory well site. ....	65
Plate 5. 5: Karoli desert, west of the proposed Bellatrix exploratory well.....	65
Plate 5.6: Volcanic Plateau, northwest of Maikona, looking west towards Chalbi playa. ....	66
Plate 5.7: Gritstone of the Maikona formation south of Maikona Town, 6 km away from the Paipai A proposed exploratory well. ....	70
Plate 5.8: Face cut of stabilising sand dune, 3 km away to the east of the proposed Paipai exploratory well.....	71
Plate 5.9: (1) Ponding in the unit after rains (2) Piedmont plain showing sandy soils and forming dunes (3) sealing surface soils (4) profile pit showing soil horizons and (5) prismatic soil structure connotative of Natric B diagnostic horizon and soil texture.....	73
Plate 5.10: 1) Vehicle stuck in the unit after rains (2) shallow interfluves that support vegetation (3) the complex unit showing dunes stabilized by Euphorbia cuneata (4) profile pit showing soil horizons and (5) prismatic soil structure in BW1 horizon and profile .....	74
Plate 5.11: (1) Lacustrine plain showing surface salt pan and ponded water (background) and inset surface sealing and crusting soils in the rest of the unit and sparse grass vegetation with rill forming around (2) Caliche layer at (25-61 cm) depth (3) Profile pit .....	75
Plate 5.12: Lugga Dambito, photo taken from south of Maikona Town.....	78
Plate 5.13: Spring water at Kalacha. ....	79
Plate 5.14: Shallow well fitted with hand pump and located near Chalbi playa, Maikona Town. Note the ponding of the playa.....	79
Plate 5.15: A moderately dense bushland next to the proposed Sirius well exploratory site. Balanites and Indigofera shrubs were the species responsible for stabilizing the dunes.....	83
Plate 5.16: Dense bushland in Bellatrix. ....	84
Plate 5.17: Dense bushland in the Bellatrix area. Note the dead logs in the foreground; the local community usually collect the dry logs for firewood. ....	84
Plate 5.18: Near barren vegetation at the Chalbi Desert save for the annual grasses growing in the mid and background (Red arrow). The Chalbi Desert did not support rigorous vegetation growth because of its high salinity levels as well as lack of moisture; however during the rainy season the desert would pond with water and support annual vegetation. Note ponding in the background (blue arrow).....	85
Plate 5.19: Fresh Dik dik midden. Plate 5.20: Silver back jackal footprint in the Chalbi.....	86
Plate 5.21: Vultures feeding on the carcass of a hyena in the Chalbi Desert and Ostrich foraging. ....	86
Plate 5.22: Schools within the project area. ....	90
Plate 5.23: Different housing types in the project area. A – permanent home constructed with stones; B – temporary home constructed with wood and other materials; C – permanent houses for commercial use. ....	90
Plate 5.24: Firewood collected for use by the casuals during the EIA study. ....	91
Plate 5.25: Watering livestock at Maikona. ....	92
Plate 5.26: Dispensary at Maikona.....	92

# CHAPTER 1

## INTRODUCTION

### 1.1 INTRODUCTION

This environmental impact assessment (EIA) project report presents baseline biophysical and socio-economic information, project mitigation measures, and an environmental management and monitoring plan for a proposed exploratory oil and natural gas well drilling programme in the National Oil Corporation of Kenya (NOCK, 1987) exploration Block 10A herein referred to as the project area, in Marsabit North (Chalbi) and Loyangalani Districts (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 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 well 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 in 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 a FTSE100 company. The Group has over 80 licences in more than 20 countries, with operations in Africa, Europe, South Asia and South America.

This EIA is carried out for TKBV (Pin P051340553U), a subsidiary company of Tullow Oil PLC, with respect to the proposed exploratory oil and gas well drilling in the project area.

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

Africa Oil Corporation and EAX (Afren) are the development partners. TKBV will engage an internationally experienced oil and gas well drilling contractor to carry out the drilling operations.

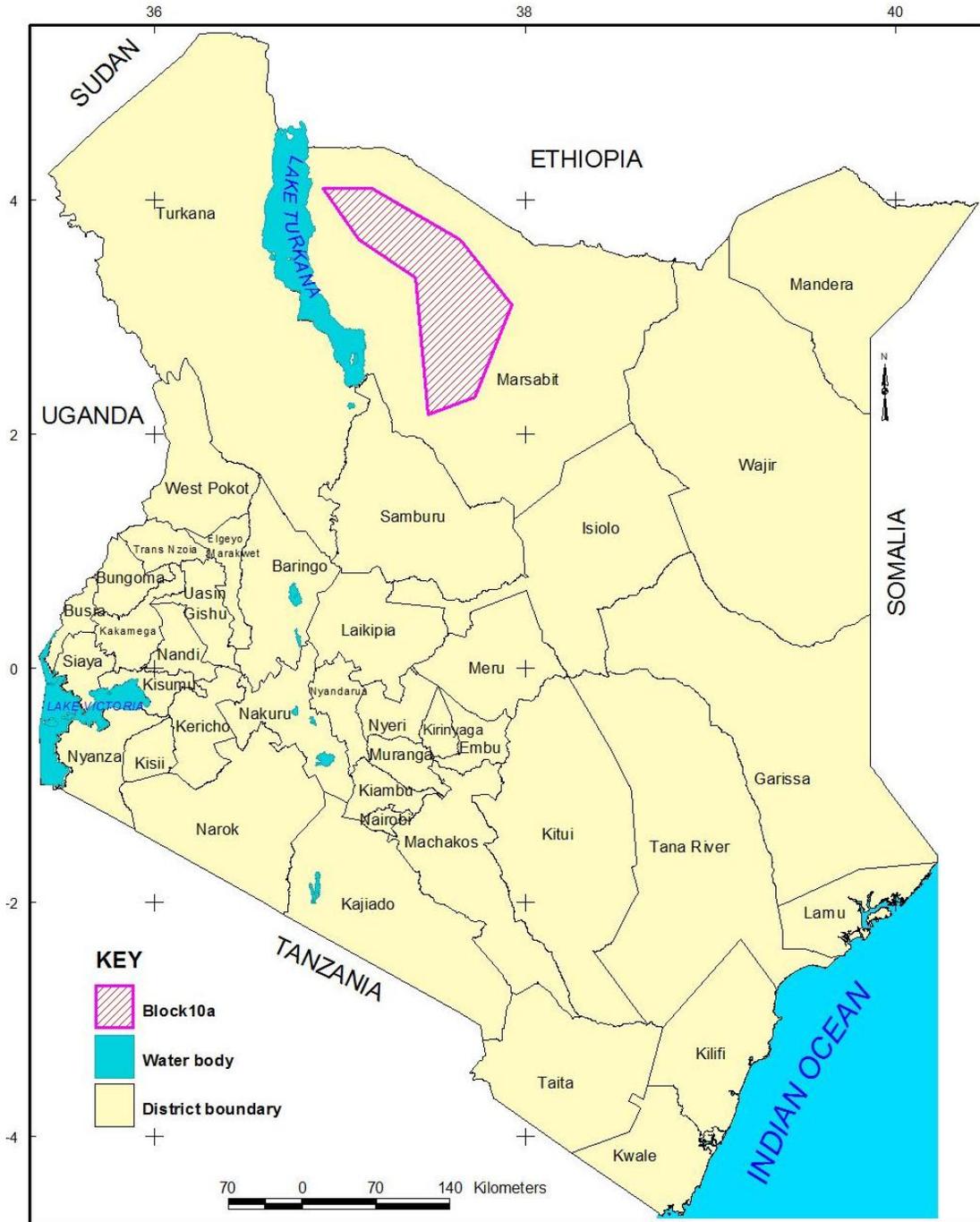


Figure 1.1: Location map of the project area.

#### 1.4 BRIEF SITE DESCRIPTION

The National Oil Corporation of Kenya (NOCK) has identified potential petroleum exploration regions in Kenya and demarcated them into blocks. The project area, classified as Block 10A by NOCK, covers parts of Chalbi District.

The project area is characterised by harsh climatic conditions with up to 90% of the landmass being arid while the remaining 10% can be classified as semi-arid. The most prominent physiographic features in the study area are the Chalbi and Koroli deserts (Charley, 1987; Key, 1987; Key and Watkins, 1988), which are characterised by relatively thick fluvial and lacustrine sediments and recent soils (Bosworth and Morley, 1994; Dindi, 1994). There is, however, no clear-cut demarcation between Chalbi and Koroli deserts and the two are collectively referred to as the Chalbi Desert. The highest population is concentrated in the major centres such as Kargi, Maikona and Kalacha.

Due to the harsh arid and semi arid climatic conditions existing in the project area, the vegetation cover is generally sparse and stunted, or completely lacking in the Chalbi and Koroli deserts. Rainfall is bi-modal with a general annual mean that ranges between 300-550 mm (the arid zones receive between 150-350 mm annually). The long rains are experienced in the months of March to May with a peak in April, while the short rains are experienced between the months of October and December with a peak in November (Sombroek et al., 1982). However, rainfall is extremely variable and unreliable with droughts and famine being common. During the dry season, the temperature ranges between 30 and 37°C while in the wet season, the temperature ranges between 20 and 25°C. The highest temperatures are experienced in the month(s) of August/September and may often exceed 37°C while the lowest temperatures are experienced in the months of November and December (Sombroek et al., 1982) with very low relative humidity.

The project area is predominantly home to the culturally rich Gabra and Rendille communities. The Gabra occupy Kalacha and Maikona areas, while the Rendille are found in the Kargi and Kurkum areas. Economic activities are minimal, with the main source of livelihood being pastoralism (up to 80% of the population). The livestock comprises of camels, goats, sheep, donkeys and a few cattle. Other economic activities in the project site include small-scale business, basketry and weaving, construction (brick making) and formal employment. There are no industrial activities. Minimal irrigation agriculture has been attempted at Kalacha area but faces challenges like crop destruction by wildlife, particularly baboons, and lack of capital. Tourism is a potential economic activity as the area hosts some of the world's rare and endangered animals such as the Grevy zebras, and various bird species. The communities also have rich cultures that can promote ecotourism. Aesthetic features include the oases found in the desert and the unique sand dunes and rocky outcrops that can be key tourist attractions.

The project area has a very poor road network and telecommunication facilities, with the only area covered by a mobile network (Safaricom) being Maikona. The road running north-west from Kargi, through the Chalbi Desert, to North Horr, Maikona and Kalacha is impassable during the wet season, while the other route north-east from Kargi to Maikona and the Huri Hills-Kalacha junction is rocky. Kalalcha and Maikona have well-maintained airstrips.

## **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 14747.57 km<sup>2</sup>, 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 partners, Africa Oil Corporation and EAX (Afren). TKBV is committed to ensuring that the activities that will be carried out to achieve the stated objectives will be done in a manner that is not detrimental to the natural environment or the local communities.

### **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 10A, intends to drill an exploration well approximately 4200m deep (Figure 1.2) once a licence is granted by NEMA.

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, storage areas (for fuel oil, bulk mud and cement, fresh/potable water, liquid mud, dry process materials, drilling water and pipe rack storage), 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 one well, of around 4200m deep and lasting approximately 60 days (excluding well testing). The specific project activities will include:

- Site and road preparation;
- Water borehole drilling;
- 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).

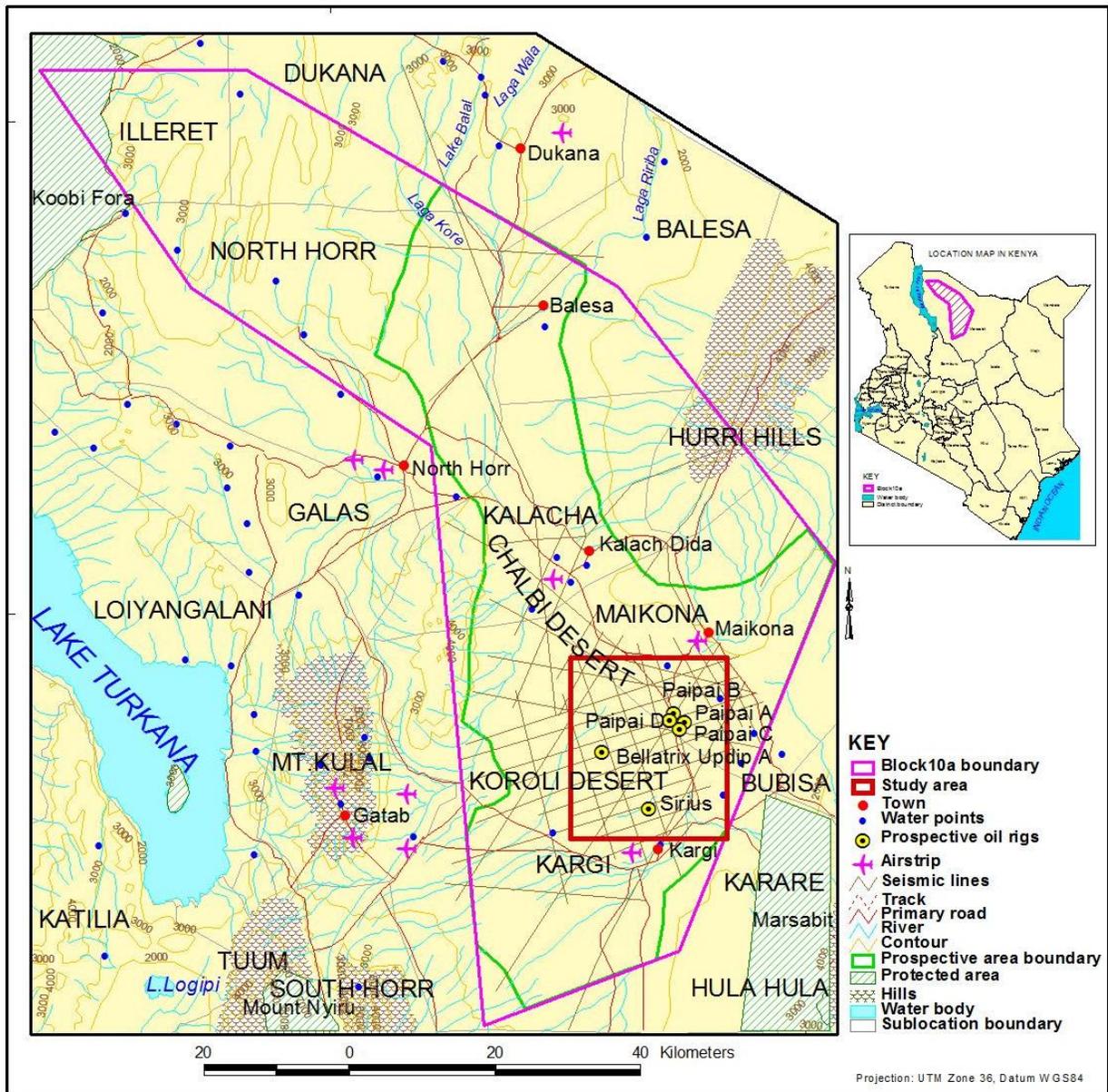


Figure 1.2: Location of the proposed well sites

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. A

close working relationship will be fostered with the local communities, and as far as is practicable, unskilled and semi-skilled workers will be recruited locally.

### **1.5.3 Project Justification**

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

Energy is an important factor in socio-economic development (GVEP Kenya, 2006). The 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 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 license 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 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 Environmental Management and Co-ordination Act, 1999. Section 58 requires that a proponent intending to carry out any undertaking listed in the Second Schedule to the Act must submit a project report to the National 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 4<sup>th</sup> June 2011 to undertake the EIA for the proposed exploratory oil and gas well 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.

Name	Role	Qualifications	Experience (years)
Prof. Norbert Opiyo-Aketch	Overall coordination/Geological issues	PhD	30
Dr. Daniel Olago	Coordination/Biophysical and Socio-economic issues	D.Phil.	20
Mr. Joseph Nganga	Soil and Waste Management	BSc	20
Mr. Adams Gakuo	Aquatic Ecology	MSc	4
Mr. Francis Aketch	Terrestrial and Wildlife Ecology	MSc	4
Mr. John Obunga	Geology, Hydrogeology, Water Resources	BSc	5
Ms. Mercy Kihonge	Socio-economist, Health and Socio-cultural issues	BSc	2
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 1.1 Structure of the EIA Project Report**

Chapter	Title	Contents
1	Introduction	Introduction to the project area; identification and activities of the project proponent in other regions; project background, objectives and justification; purpose of the EIA and objectives of the report; the EIA team; TORs for the report.
2	Project Description	The technology and processes to be used in the implementation of the project; workforce requirements; the materials to be used in the construction and implementation of the project; the products, by-products and waste generated by the project.
3	Methodology	Methods used in carrying out the assessment; identification of gaps in knowledge and uncertainties, 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 and processes available and reasons for preferring the chosen technology and processes.
7	Environmental Impact Assessment	Environmental effects of the project including the social, economic and cultural effects and the direct, indirect, cumulative irreversible, short-term and long-term effects anticipated.
8	Environmental Management Plan	Environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the, 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 certificates	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 proposing to undertake an exploration drilling programme initially consisting of a single well to explore for oil and natural gas in the project area (see Figure 1.1). The project area lies within the Chalbi and Karoli deserts and the surrounding environment.

The primary objective of the proposed activity is to check for the presence of hydrocarbons based on the delineation of potential hydrocarbon traps that have been shown to be present on the basis of analysis of recently acquired seismic data. Details are given in this report of the main project activities, from installation to decommissioning and the personnel and support requirements. Information on various discharges, emissions and wastes likely to emanate from the project activities are described and management policies put in place to mitigate any impacts that may arise from them. The project area has a very poor road network and telecommunication facilities. Maikona is the only area covered by Safaricom telecommunications network.

#### **2.2 PROJECT LOCATION**

The project area lies in parts of Marsabit North (Chalbi) and Loiyangalani districts as shown in Figure 1.1.

There are no tarmacked roads in the project site. The two main roads, one heading north-west from Kargi and traversing through the Chalbi Desert heading to North Horr, Maikona and Kalacha, and the other road north-east from Kargi towards the Maikona-Marsabit junction and the Hurri Hills-Kalacha junction, are impassable during the wet season. The latter road is rocky and bumpy though navigable during the rainy season. Kalalcha and Maikona have well-maintained airstrips.

#### **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 system must meet the performance requirements;
- Production availability;
- Environmental and safety considerations;
- Operability and maintainability;
- Life expectancy;
- Extendibility; and
- Use of innovative technology.

#### **2.4 OVERVIEW OF EXPLORATORY DRILLING PROGRAMME**

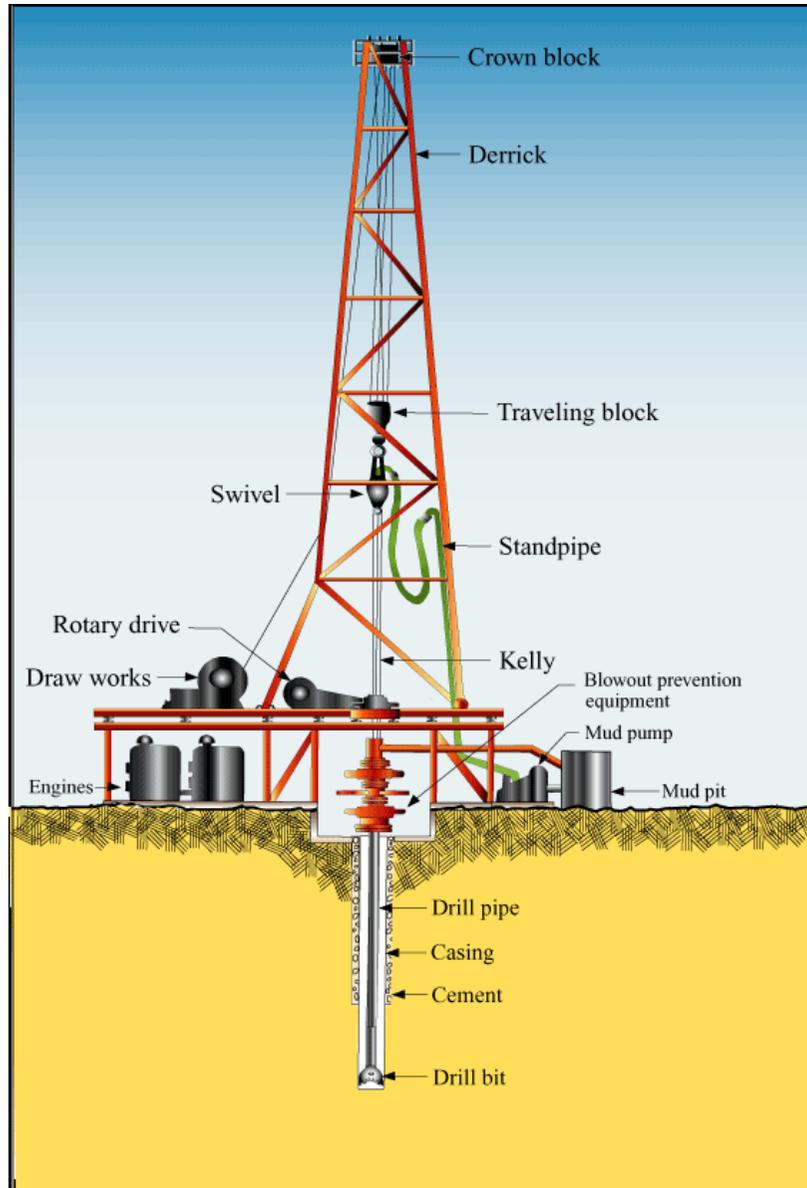
Exploratory drilling is undertaken to establish the presence of hydrocarbons indicated by seismic survey and interpretation of such data. Exploratory drilling is a temporary and short duration activity, taking between 3 to 4 months under normal conditions. The process

involves: drilling exploration wells to determine whether or not hydrocarbons are present and, if present, to measure the area and thickness of the oil and/or gas-bearing reservoir or reservoirs; well logging to determine the rock types, as well as to measure the permeability, porosity, and other properties of the geologic formation(s) encountered; completing construction of wells deemed capable of producing commercially viable quantities of oil and/or gas; and construction of associated facilities on site. In cases where the wells are deemed incapable of producing commercially viable quantities of oil and/or gas, they are abandoned and the well site is restored.

The drilling operation is conducted from a drilling rig (see Figure 2.1 and Table 2.1), with the depth of the well determining the size of the drilling rig, the number of employees, and duration of the drilling operation (in essence, the drilling duration exponentially increases with well depth). The rig is located on the drilling pad. A separate camp, located adjacent to the rig, will provide accommodation, kitchen facilities, domestic and sewage processing, etc. Power generation, storage areas (for fuel oil, bulk mud and cement, fresh/potable water, liquid mud, dry process materials, drilling water and pipe rack storage), medical and emergency response facilities, and secondary operations such as welding, painting and machining will be integral to the rig site.

The drilling process generally involves the use of drilling bits of different sizes to drill a series of concentric holes from the surface to the planned well total depth. A drilling fluid (drilling mud) is circulated through the inside of the drill string to the bit. The mud is either water-based, synthetic, or oil-based in nature. 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 mixing mud additives and chemicals on site to the desired concentrations in fresh water or sea water (for offshore drilling).

**Table 2.1: Table of drill rig parts**



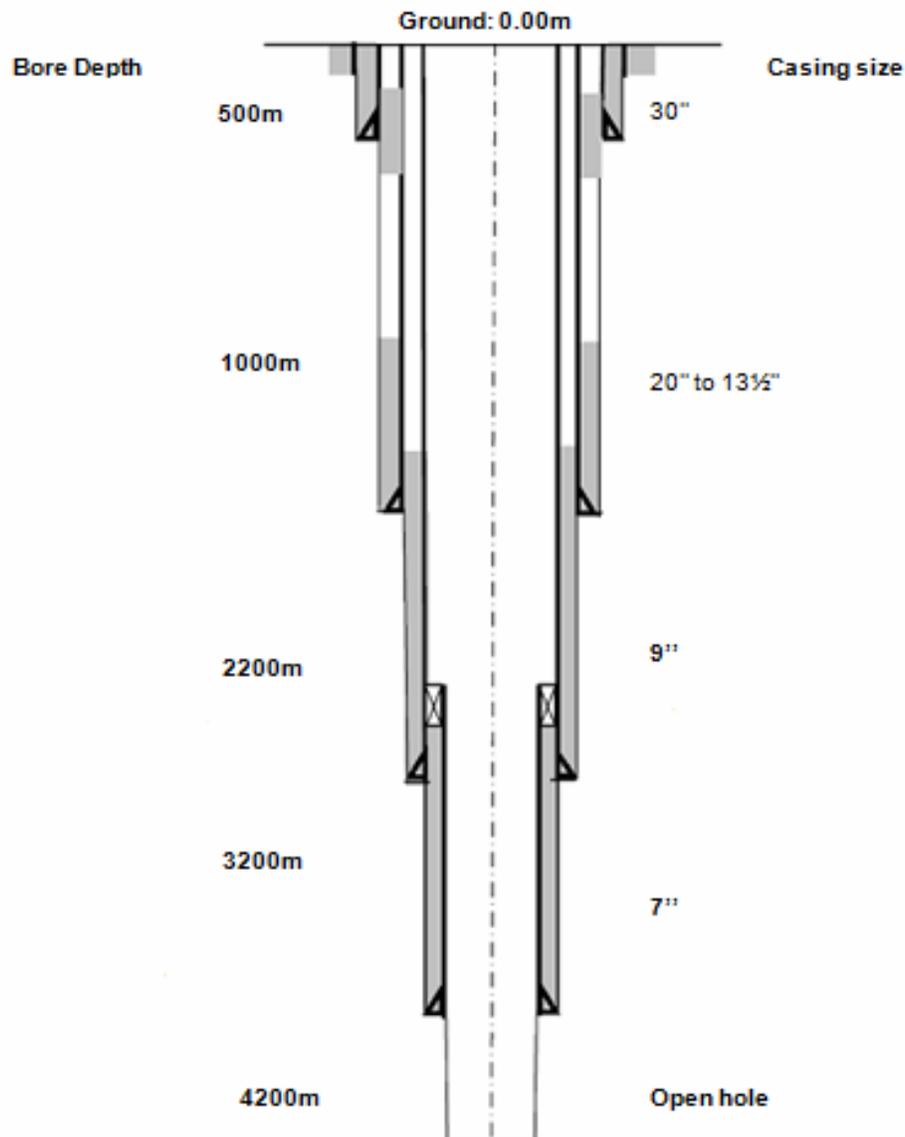
**Figure 2.1: Drilling rig showing key components. (Source: [http://www.consrv.ca.gov/dog/picture\\_a\\_well/Pages/gh\\_drill\\_rig.aspx](http://www.consrv.ca.gov/dog/picture_a_well/Pages/gh_drill_rig.aspx))**

PART	FUNCTION
<b>Crown block</b>	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.
<b>Derrick</b>	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.
<b>Travelling block</b>	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
<b>Swivel</b>	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.
<b>Standpipe</b>	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.
<b>Kelly</b>	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.
<b>Rotary drive</b>	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.
<b>Draw works</b>	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.
<b>Blowout prevention equipment</b>	The assembly of well control equipment including preventers, spools, valves, and nipples connected to the top of the well head to prevent the uncontrolled escape of oil or gas during drilling operations.
<b>Mud pump</b>	A large, high-pressure reciprocating pump used to circulate the mud on a drilling rig.
<b>Engines</b>	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.
<b>Mud pit</b>	Originally, an open pit dug in the ground to hold drilling mud or waste materials such as well bore cuttings or mud sediments.
<b>Drill pipe</b>	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.
<b>Casing</b>	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.
<b>Cement</b>	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.
<b>Drill bit</b>	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 well will be drilled in sections, with the diameter of each section decreasing with increasing depth, as shown in Table 2.2 and Figure 2.2 below.

**Table 2.2: Technical specifications for the proposed well drilling to 4200m depth.**

Hole size (in)	Average depth (m)	Casing Size (in)	Proposed mud system
36	500	30	Water with bentonite
26/ 17½	500 to 1000	20 to 13½	Water with bentonite
12¼	1000 to 2200	9	Water based mud
8½	2200 to 3200	7	Water based mud
6	3200 to 4200	open hole	Water based mud



**Figure 2.2: Schematic structure of the proposed casing design of the exploration well.**

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 the structural integrity of the well. The subsequent hole section is then drilled in a similar manner before cementing in place a further casing string. This allows installation of a wellhead and the necessary equipment. Once the wellhead and necessary equipments are installed, the subsequent well sections are drilled with circulating (either water-based, synthetic, oil) drilling mud and the cuttings returned to the rig for separation of the mud prior to discharge.

As each section is drilled, 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.

#### **2.4.1 Site preparation**

Site preparation activities would consist of opening up (or clearing if one exists) an access road. Clearing the access route may involve minimal removal of vegetation and topsoil disturbance within the existing Right of Way. The proposed access route will be surveyed prior to commencement of the clearance activities to ensure that options for the least possible disturbance to vegetation and soil are factored into the access road design and construction methods. Route clearance should be completed before the movement of the rig.

#### **2.4.2 Drilling rig specifications and crew facilities**

Tullow have 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. The rig was commissioned in 2008 and has been equipped with the latest, modern drilling technology. A one-page info sheet is included for further technical detail (section 6.2.2).

An accommodation camp site will be sited adjacent to the rig to facilitate the 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 are constructed of structural steel and 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, and using cranes. Before the rig is assembled, spudding-in of the starter hole will have been carried out.

#### **2.4.4 Drilling techniques**

There are a number of techniques used in oil and gas drilling. Classification according to trajectory includes: vertical drilling; directional drilling; and horizontal drilling (Table 2.3).

Generally, fluid-based drilling techniques are employed, but air drilling or foam drilling are alternatives (Table 2.3). In spite of the drilling technique used, a wellbore is typically drilled in a series of progressively smaller-diameter intervals with the wellbore exhibiting the largest diameter at the surface and smallest diameter at the end of the bore (see section 2.4: Overview of Drilling of Exploratory Drilling Programme).

**Table 2.3: Drilling techniques**

<b>DRILLING TECHNIQUE</b>	
<b>Straight Hole Drilling</b>	In this approach, the wellbore is vertical and deviates by no more than 3 degrees anywhere along the wellbore, and the bottom of the well deviates by no more than 5 degrees from the starting point of the wellbore at the drilling platform. With straight hole drilling, the drill bit may be deflected if it contacts fault zones or dipping beds of hard rock layers.
<b>Directional/Slant Drilling</b>	Directional/slant drilling involves the drilling of a curved well to reach a target formation. This technique is employed when it is not possible, practicable, or environmentally sound to place the drilling rig directly over the target area.
<b>Horizontal Drilling</b>	Horizontal drilling is a form of directional drilling in which a 90-degree turn in the well may be made within a few feet. There are three main types of horizontal wells, namely: short-radius, medium-radius wells and long-radius wells. Horizontal drilling is especially effective in accessing productive formations that are not thick but extend over a large lateral area. Prior to the advent of directional drilling, such formations were either uneconomical or required multiple wells to recover the hydrocarbons.
<b>Compressed air drilling</b>	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 wellbore. 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.
<b>Foam Drilling</b>	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.

The vertical drilling technique will be used for the project 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:

- 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 muds), 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: 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 downhole portion of the well to provide an estimate of the fluid content and characteristics of the various rock layers through which the well passes. Wireline logging entails the lowering of various devices into the wellbore to measure the electrical, acoustic, conductive or radiological properties of the rock and fluid layers. This is mainly performed across the target areas to provide an estimate of the fluid and rock type and characteristics. A number of different techniques are used during this phase of the operation with some of these devices requiring the use of a nuclear source to generate the required signal for measuring some of the rock properties.

#### **2.4.7 Well control**

A well control incident may occur if a geological formation's pressure overcomes the hydrostatic pressure applied by the column of well fluids. Potentially, high-pressure geological formations such as water sands and over-pressured shales may be encountered. Thus, well control awareness will be elevated throughout the entire drilling operation. Additional emphasis will be placed on the more critical sections, identified during the continuous well logging, where rapid pore pressure increase or regression and tight pore or fracture window will dictate a robust mud weight selection and equivalent circulating density management strategy to avoid a well control incident.

#### **2.4.8 Well testing**

If the results of logging indicate a potential for hydrocarbon-bearing formations the well may be tested. Testing will involve running a test string in the well. This string will include the

perforating guns. To position the guns at the correct depth a radioactive marker is placed in the casing (when it is run) and in a special sub in the test string. Logging tools (GR-CCL) is then used so that the string can be positioned on depth. 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. The separated gas and oil will be burned using compressed air and a flare system mounted in a flare pit.

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

#### **2.4.9 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 minimal emission into the atmosphere. Flare systems are used throughout the petroleum industry around the world during well testing.

Following testing, which includes separating the oil and gas (see section 2.4.8), 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.

#### **2.4.10 Well completion or well suspension or abandonment and rig removal**

If little or no hydrocarbons are detected in the well, 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 steel plate 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 completed or suspended to allow future production. 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 be circulated out at the time of possible future re-entry). The wellhead equipment will remain in place and 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 mud is circulated through the inside of the drill string, out of the bit nozzles, and all the way up from the borehole back to the active mud system. Functions of the drilling mud are:

- removal of cuttings from the well;
- control of formation pressures;
- sealing permeable formation;
- maintaining wellbore stability;
- cooling, lubricating and supporting the drill bit and assembly; and
- transmission of hydraulic energy to tools and bit.

There are two basic types of drilling fluids: water-based muds (WBMs) and non-aqueous drilling fluids or non-aqueous muds (NAFs or NAMs) (Table 2.4). 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 shales) often require the use of NAMs instead of WBMs for efficient, cost-effective operations.

The drilling fluid to be used for this project will be Water Based Muds (WBMs) prepared by mixing mud additives and chemicals on site to the desired concentrations in fresh water (Table 2.5). It is important to note that drilling mud formulations are highly variable, with barite ( $BaSO_4$ ) and bentonite ( $Al_2O_3 \cdot 4SiO_2 \cdot H_2O$ ) together comprising the majority of the insoluble components of most drilling fluids (GESAMP, 1993; Hurley et al., 2004) (Table 2.4). The bottom section of the wells will be drilled using a partially-hydrolyzed polyacrylamide (PHPA) water-based gel with KCl as the clay stabiliser and weighting agent. These gels have low toxicities, degrade rapidly in the environment, and are routinely accepted for use by the regulatory authorities (Hinwood et al., 1994).

**Table 2.4: Composition of drilling muds.**

Water Based Muds	Non Aqueous Fluids
Water Salts Barite Bentonite Special additives	Organic base fluid Barite Water/brine, and Special additives
<ul style="list-style-type: none"> <li>▪ <b>Barite</b>, a sparingly soluble mineral increases the density of the drilling fluid</li> <li>▪ WBMs and NAMs composition depends on the density of the fluid.</li> </ul>	

**Table 2.5: Special additives and their function in water based-drilling fluids.**

ADDITIVE	FUNCTION
Sodium bicarbonate	Eliminates excess calcium ions due to cement contamination
Sodium chloride	Minimises borehole washout in salt zone
Groundnut shells, mica of cellothane	Minimises loss of drilling mud to formation
Cellulose polymers of starch	Counters thick, sticky filter cake, decreases filter loss to formation
Aluminium stearate	Minimises foaming
Vegetable oil lubricant	Reduces torque and drag on drill bit string
Pill of oil base mud spotting fluid	Placed in the wellbore annulus to free differentially stuck pipe. Counters differential pressure sticking of pipe drilling string

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 that it can be re-circulated into the hole.

There are several technologies used to remove the solids from the drilling mud. Typically, SCE consists of the following components:

- Shale Shakers (remove the larger fragments);
- Degasser (removes any gas);
- Desanders (remove sand particles); and
- Desilters (remove silt particles).

Other devices used for enhanced separation include high velocity centrifuges, drying centrifuges, etc.

The amount of drilling fluids disposed of with cuttings is minimised by the SCEs at the rig, and will be around 15% of the total WBM volume used in the drilling program.

## **2.6 WATER SUPPLY**

The project area, being rural and undeveloped, lacks a mains, quality assured water supply network. Water is sourced from hand-dug shallow wells, shallow to deep boreholes (at Maikona and Kargi), springs (Kalacha), rivers and luggas. Its patchy distribution, and the low, erratic and unpredictable rainfall means that water is generally scarce in most of the area. Water will be required during the project operations for consumption (potable), domestic use, and drilling use. TKBV drilled a water well for the community at Maikona as part of its corporate social responsibility (CSR) during the earlier conducted seismic survey. Water can be sourced from this borehole for potable and domestic use, and can be supplemented with bottled drinking water. Drilling requires a lot of water, so TKBV will drill a deep water borehole at/close to the selected drilling site to be the main water source for the drilling operations. Quality levels for such water are not critical, so long as the water is not too saline. Any unforeseen water shortfalls can be met by having a contingency plan to truck in water from other parts of the region that can be stored on site and used when required. It is estimated that a water storage reservoir with a capacity of 2000m<sup>3</sup> will be required.

## **2.7 EMISSION AND WASTE MANAGEMENT**

The proposed exploration drilling operation will likely result in the following:

- Emissions to air
- Generation of operational and domestic waste.

### **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 emission will be from fugitive emissions such as chemical leaks, increased vehicle traffic, manufacturing emissions (necessary muds, chemicals, machinery, etc.).

The principal atmospheric emissions from these sources will include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), oxides of nitrogen (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>), carbon monoxide (CO) and volatile organic compounds (VOCs). CO<sub>2</sub> and CH<sub>4</sub> are two of the principal greenhouse gases (GHGs) (Table 2.6).

**Table 2.6: The environmental impacts of different atmospheric releases.**

Type of emission	Environmental Impact
Carbon dioxide (CO <sub>2</sub> )	A GHG that is believed to contribute to climate change
Methane (CH <sub>4</sub> )	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 <sub>2</sub> )	Contributes to acid deposition/acid rain and toxic gas
Volatile organic compounds (VOCs)	A range of potential impacts. Hydrocarbons may promote formation of photochemical oxidants. May also be known 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 lower levels of CH<sub>4</sub>, SO<sub>x</sub>, NO<sub>x</sub> 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. Noise will also be produced by rig power generators and support machinery such as motor vehicles, backhoes, cranes, and helicopters.

### **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**

Wastes during oil and gas exploration can be categorised as either domestic or operational wastes. Table 2.7 below shows the common wastes and their environmentally significant constituents.

**Table 2.7: Waste categories generated.**

CATEGORY	TYPE OF WASTE	MAIN WASTE COMPONENT	POSSIBLE ENVIRONMENTALLY SIGNIFICANT CONSTITUENTS
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 <sub>2</sub> S, CO <sub>2</sub> , hydrocarbons
		Flare gases	NO <sub>x</sub> , SO <sub>2</sub> , CO <sub>x</sub> , carbon particulate
		Blow down from bulk chemicals	Dust, well fluids
		Vapours	Hydrocarbons
		Fugitive gases	Volatile organic compounds (VOC)
	Exhaust gases from engines	NO <sub>x</sub> , SO <sub>2</sub> , CO <sub>x</sub> , carbon particulate	
	Drilling waste (from drilling muds)	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 muds	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	H <sub>2</sub> S 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 <sub>x</sub> , SO <sub>2</sub> , CO <sub>x</sub> , 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) Drilling waste management and disposal methods

Drilling waste management and disposal methods are largely dependent on the waste characteristics and regulatory requirements. Currently available methodologies are typically limited by ecological, technical or economic factors. Responsible waste management can be accomplished through a hierarchical application of the practises of source reduction, reuse, recycling, recovery, treatment and responsible disposal (E&P Forum, 1993).

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 2.8).

**Table 2.8: Waste management approaches.**

METHOD	DESCRIPTION AND APPLICATION
Surface discharge	<ul style="list-style-type: none"> <li>Used for low toxicity aqueous waste streams</li> </ul>
Injection	<ul style="list-style-type: none"> <li>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.</li> <li>Injection methods include mainly annular injection and downhole injection</li> </ul>
Biotreatment methods	<ul style="list-style-type: none"> <li>Involves the use of indigenous and/or enhanced bacteria for the remediation/breakdown of contaminants, and applies mostly to organic compounds. Biotreatment methods include landfarming, land spreading, compositing, biological treatment in tanks</li> </ul>
Thermal treatment methods	<ul style="list-style-type: none"> <li>Available options include incineration, used as Alternative Fuels and Raw Materials (AFR) in cement kilns, open burning and thermal desorption systems</li> </ul>
Solidification, stabilisation and Encapsulation	<ul style="list-style-type: none"> <li>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</li> </ul>
Landfills	<ul style="list-style-type: none"> <li>Designed to accommodate burial of large volumes of waste</li> </ul>
Pits, and burial	<ul style="list-style-type: none"> <li>Use of earthen or lined pits for on-site management of drilling solids, evaporation and storage of produced water, workover/completion fluids and emergency containment of produced fluids</li> <li>Once the operation concludes, pits are used to dispose of stabilised wastes from drilling and production processes.</li> </ul>
Solvent extraction	<ul style="list-style-type: none"> <li>Use of solvents (CO<sub>2</sub>, propane, hexane, triethylamine, methylene chloride, among others) to extract oil from oily solids or sludges</li> </ul>

The Plan will use the principles of Waste Management Hierarchy as its foundation, i.e., **Waste Reduction, Reuse, and Recycle**. On-site efforts will concentrate on reuse, recycling, minimization of packaging material, reduction in size of waste material and finally reduction of time spent on location via optimization of drilling efforts. Minimization of waste material centres on reducing packaging materials - use of large packaging such as bulk cement, barite or bentonite. The volume of the waste material will be reduced via on-site compaction. This will

reduce the number of vehicle movements required for waste removal, as well as reducing the size of the landfill required. Wherever possible, use of water will be minimized and recycled. Plastic containers, especially those used for fluid and cementing chemicals, are prime targets for use as water containers. As some of these may contain substances which can be harmful to humans, care will be taken to ensure that they are not removed from the drilling site intact. In general, after emptying chemical containers (which did not contain any substances) the containers will be punctured and eventually compacted and sent for disposal. The drilling site will not have facilities for rinsing chemical drum containers. These containers will be fully emptied, labelled with contents and removed off-site for further handling and disposal. Used medical wastes, inclusive of, but not limited to, bandage material, syringes etc., will be collected in a special collection drum to minimize manual handling. Contents of the drum will be labelled as biomedical waste and shipped off-site for incineration in an approved two-stage process,

The following options are highly feasible for waste disposal generated during the operation. However, it will be necessary to evaluate the suitability of various waste-specific technologies for the site and select an option that will cause minimum environmental impact on the surrounding:

**i. Integrated management of cuttings and spent drilling fluids**

A considerable volume of formation cuttings and spent drilling fluid will be generated from the well. Drilling muds will be separated at all times from the drill cuttings in order to minimize waste, and optimize the recovery and reuse of the drilling fluid. Excess WBMs will be dewatered, and the fluid phase will be treated to acceptable discharge standards. Solids (cuttings) will be discharged into a lined waste pit. The well is expected to generate about 2050MT of solid cuttings and an estimated 1100m<sup>3</sup> of liquid phase. Since cuttings are not completely dry (containing 15-18% of WBM in them), Solids Control Equipment will be used for recovering as much mud as possible.

Depending on its toxicity, the solids from the pit (drilled cuttings and solid mud products) will be buried or land farmed at the drilling site by working them into the much larger volume with native soil. The testing of the solids (cuttings) for heavy metals and TPH will be done to inform on the method of disposal.

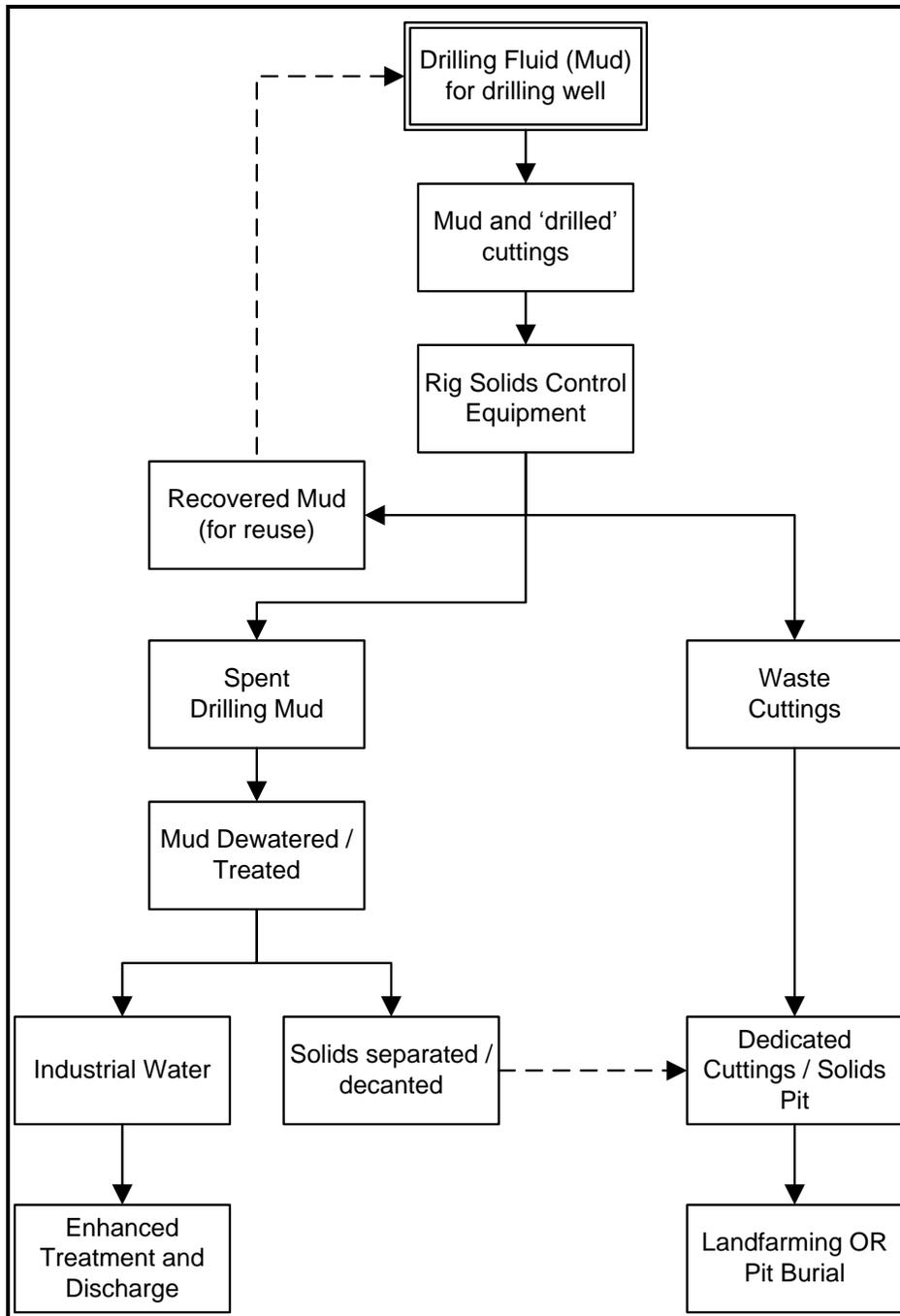


Figure 2.3: Flow diagram of drilling fluid management options.

**ii. Potential for emission of black smoke**

In the event of the well or wells discovering hydrocarbons that warrant a testing programme, the well will be temporarily abandoned and well testing will be carried out. The well will be connected to a separator, which will in turn be connected to a vertical

flare stack and hydrocarbon liquid storage tanks. If necessary, the flare will be air- and water-assisted to minimize the emission of black smoke. However, given that the most likely hydrocarbon to be found in these wells is gas, emission of smoke will not present a problem.

**iii. Landfill and/or pit burial**

Landfilling (in pits lined with impermeable membranes) is the most common onshore disposal technique used for disposing of inert unrecyclable materials and is also used for drilling wastes such as mud and cuttings. The solids may be mixed with native earth, soda ash or polymers, and will be buried in the same pit (the reserve pit) used for collection and temporary storage of the waste mud and cuttings after the liquid is allowed to evaporate. Landfilling, if approved by the County Council, is a low-cost, low-tech method that does not require wastes to be transported away from the well site, and, therefore, it is a very attractive option for the proponent. Once the pit locality is closed, the area will be graded to prevent accumulation of water. The sites will then be revegetated with native tree species.

**iv. Open burning:**

This method can be defined as the combustion of unwanted combustible materials such as paper and wood in open dumps, where smoke and other emissions are released directly into the air without passing through a chimney or stack. Proper strategies will be put into place to ensure that burning does not cause nuisance and that burning will take place during daytime.

**v. Off-site disposal:**

Wastes which cannot be handled at the drilling site will be removed to a designated off-site and suitably disposed of for reuse/recycling/municipal disposal.

**vi. Sewage treatment and disposal:**

A sewage disposal system will be established in the campsite during the drilling operation and since the exploration process is a temporary activity, the sewage will be diverted to a septic tank or soak pit. There will be clear separation of grey and black water which allows for proper disposal mechanisms to be put into place. The Contractor will ensure that the installed system meets national requirements and international industry standards.

## **2.8 DECOMMISSIONING/ABANDONMENT**

### **2.8.1 General activities**

It is envisaged that the drilling programme will be of a short duration (around 2 months). Upon completion of the drilling and testing, the rig will be decommissioned and mobilised to another well site and 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 is then removed and the drilling rig is stripped down for transportation.

As far as abandoning the well site, this will entail removing of all foreign material such as hard core, plastic liner, piping and fencing, and thereafter the land will be re-instated to its “as-found” state (revegetated). All clean-up activities will 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 spill 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. Wastes from the drilling rig that cannot be handled/disposed of on site shall be transferred, as necessary, to a specifically identified licenced site for appropriate disposal. Appropriate medical and transport facilities will be on site in the event that a medical emergency requires immediate evacuation of personnel, and a medevac procedure will be in place.

## CHAPTER 3

### ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

#### 3.1 APPROACH TAKEN FOR THE EIA

The approach that was taken for the EIA assessment included, with respect to the proposed exploratory oil and gas well drilling, 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 project is all about and to receive their views, perceptions, concerns and local expert knowledge and advice with respect to the proposed project;
3. Determination/evaluation of the significance of the potential project impacts and recommendation of mitigation measures; development of an Environmental Management Plan and Monitoring Programme; and decommissioning of the project;
4. Preparation of the EIA Study Report.

#### 3.2 WORK EVALUATION FOR THE EIA

The work evaluation for the EIA was based on the NEMA requirements (section 1.6.3) and customised for the project to be undertaken (outlined in Chapter 2), as per the objectives and terms of reference outlined in sections 1.8 and 1.9.

#### 3.3 TOPICS ADDRESSED AND ISSUES CONSIDERED

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

	affected parties, and environment protection	the authorizations required for the regulatory approval of the project <ul style="list-style-type: none"> <li>• Some legislation, regulations and guidelines have embedded mitigations relevant to the proposed exploratory oil and gas well drilling</li> </ul>	responsible <ul style="list-style-type: none"> <li>• International best practices in Oil and Gas industry</li> <li>• Company EHS, CSR and Code of Conduct</li> </ul>	
Geographical Aspects and Boundaries	<ul style="list-style-type: none"> <li>• Description of the project area</li> <li>• Identification of key features</li> </ul>	<ul style="list-style-type: none"> <li>• Determination of the context within which the work is to be done</li> <li>• Assessment of the scale and extent of the work</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Administrative set-up	<ul style="list-style-type: none"> <li>• Key administrative units and their roles in the project area</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of jurisdictions</li> <li>• Identification of key administrative contacts</li> <li>• Role in emergency situations (e.g. security threats) and response</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Communication and Transport	<ul style="list-style-type: none"> <li>• Road infrastructure</li> <li>• Air transport network</li> <li>• Telecommunications network</li> </ul>	<ul style="list-style-type: none"> <li>• These will determine the ease with which the project will be carried out</li> <li>• Identification of areas difficult to access</li> <li>• Inform on types of equipment/machinery that will be required for the project</li> <li>• Assist in development of contingency/emergency plans</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Governmental, Non-Governmental and Community Based Organisations	<ul style="list-style-type: none"> <li>• Activities and projects carried out in the area</li> </ul>	<ul style="list-style-type: none"> <li>• Identification of potential local partners particularly with respect to CSR</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Physiography and Geology	<ul style="list-style-type: none"> <li>• Physiography and geology</li> <li>• Assessment of terrain ruggedness</li> <li>• Assessment of susceptibility to landslides, earthquakes, subsidence and floods</li> <li>• Active surface processes</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Identification of potentially difficult areas to work in – terrain and accessibility by vehicles</li> <li>• Identification of areas requiring extra safety precautions</li> <li>• Identification of hazard-prone areas</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• Samples collected are representative of entire project site</li> </ul>
Soils	<ul style="list-style-type: none"> <li>• Soil condition</li> <li>• Areas subject to wind and water erosion</li> <li>• Soil texture and drainage characteristics</li> <li>• Soil chemical quality</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Ease of accessibility by vehicles</li> <li>• Identification of hazard prone areas (e.g. ponding/flooding)</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• Some areas were not accessible due to flooding and ponding after the rains of the Chalbi Desert especially the</li> </ul>

	<ul style="list-style-type: none"> <li>• Assessment of rehabilitation potential</li> </ul>	<ul style="list-style-type: none"> <li>• Drilling rig and campsite construction considerations</li> <li>• Disposal of domestic effluents, drilling mud and drill cuts</li> <li>• Identification and prioritisation of factors requiring mitigation</li> </ul>		Paipai B, C and D sites, hence data is incomplete but samples representative of the whole area were assessed
Climate	<ul style="list-style-type: none"> <li>• Temperature</li> <li>• Winds</li> <li>• Precipitation</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Information useful for project elements such as cooling of temperature-sensitive equipment and installations</li> <li>• Personnel safety from adverse weather and related conditions e.g. flooding</li> </ul>	<ul style="list-style-type: none"> <li>• Access roads</li> <li>• Selected camp sites and rig facilities</li> </ul>	<ul style="list-style-type: none"> <li>• No data available for trend analysis.</li> </ul>
Surface and Ground Water Resources	<ul style="list-style-type: none"> <li>• Ground and surface water sources</li> <li>• Ground and surface water use</li> <li>• Planned water use</li> <li>• Changes in quantity</li> <li>• Identification of project components that can affect water use</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Potentially high demand for water by project group in a water scarce region</li> <li>• Planned water uses that affect water quantity may be blamed on the project proponent</li> <li>• Identification and prioritisation of factors requiring mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Selected camp site and exploratory well drilling site and facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Inaccessibility of some areas due to flooding and ponding of the Chalbi Desert</li> </ul>
Air Quality	<ul style="list-style-type: none"> <li>• Ambient air quality</li> <li>• Generation of dust, smoke, odorous fumes, and other toxic gaseous emissions</li> <li>• Identification of project components that can lower air quality</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Assessment of project impacts on air quality</li> <li>• Identification and prioritisation of factors requiring mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Access roads</li> <li>• Selected camp sites and rig facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of air quality data on particulate loading, SO<sub>x</sub> and NO<sub>x</sub> 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).</li> </ul>
Terrestrial Environment (Habitats, Flora and Fauna)	<ul style="list-style-type: none"> <li>• Vegetation cover and classes</li> <li>• Habitat conditions</li> <li>• Floral and faunal communities which are uncommon,</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Physical disturbance of terrestrial environment during operations such as pit excavations, campsite</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• Old data, but the ecosystem structures are resilient to the effects of land degradation and</li> </ul>

	<p>threatened or endangered</p> <ul style="list-style-type: none"> <li>• Environmentally sensitive localities</li> <li>• Wildlife corridors</li> <li>• Pastoral areas</li> <li>• Assessment of ecosystem state</li> </ul>	<p>construction and drilling rig operation</p> <ul style="list-style-type: none"> <li>• Determination of pre-project endangered communities</li> <li>• Assessment of areas requiring special precautions</li> <li>• Avoidance of human-human and human-wildlife conflicts</li> <li>• Identification and prioritisation of factors requiring mitigation</li> </ul>		<p>deforestation. Land cover, for example, has become more patchy, but the species diversity within the various ecotones remains the same.</p>
Land Resources	<ul style="list-style-type: none"> <li>• Land use and designation</li> <li>• Existing activities in the area</li> <li>• Currently known and exploited mineral resources</li> <li>• Resource inventory</li> </ul>	<ul style="list-style-type: none"> <li>• The land resources are critical resources supporting livelihoods in the area.</li> <li>• Consideration of competing resources</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Archaeological, Historical and Cultural Sites	<ul style="list-style-type: none"> <li>• identification of archaeological, historical, cultural sites</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of currently known sites</li> <li>• Avoidance of such sites during the drilling operation</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Visual Aesthetics	<ul style="list-style-type: none"> <li>• Aesthetic or high scenic value</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Assessment of project impacts such as vegetation clearance along cut lines and at campsites</li> </ul>	<ul style="list-style-type: none"> <li>• Proposed drilling site</li> <li>• Access roads</li> <li>• Selected camp site and rig facilities</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Noise and Vibrations	<ul style="list-style-type: none"> <li>• Ambient noise and vibration levels in the area</li> <li>• Potential sources of noise and vibrations produced by project operations</li> <li>• Noise impacts on terrestrial fauna</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Noise and vibrations impacts on the project workforce and the neighbouring public</li> <li>• Impacts on nearby structures and facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Proposed drilling sites</li> <li>• Access roads</li> <li>• Selected camp and rig facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of studies on noise and vibration impacts on fauna</li> </ul>
Solid and Liquid Wastes	<ul style="list-style-type: none"> <li>• Disposal of sewage or domestic wastes</li> <li>• Damage to the environment through accidental spills of oil, fuel, cargo, waste or sewage</li> </ul>	<ul style="list-style-type: none"> <li>• Establishment of baseline conditions</li> <li>• Campsites will require to install waste discharge systems</li> </ul>	<ul style="list-style-type: none"> <li>• Campsites</li> <li>• Working areas</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Social Characteristics	<ul style="list-style-type: none"> <li>• Level of services available</li> <li>• Social support information</li> <li>• Identification of key community needs</li> </ul>	<ul style="list-style-type: none"> <li>• Quality of life baseline.</li> <li>• Ability to absorb change</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• Language barrier in some places</li> <li>• Unwillingness to adopt new social practices</li> </ul>
Economic Setting	<ul style="list-style-type: none"> <li>• Area targeted for growth</li> <li>• Labour and employment</li> </ul>	<ul style="list-style-type: none"> <li>• Quality of life baseline</li> <li>• Development level baseline</li> <li>• Willingness to adopt new economic activities</li> </ul>	<ul style="list-style-type: none"> <li>• Project area</li> </ul>	<ul style="list-style-type: none"> <li>• Unwillingness by the locals to adopt new economic opportunities</li> </ul>

Health Setting	<ul style="list-style-type: none"> <li>• Status of health facilities</li> <li>• Access to health services</li> <li>• Occupational health and safety hazards</li> <li>• Hazards due to the use, storage, disposal or transportation of flammable, explosive, or toxic substances</li> <li>• Emission of electromagnetic or other radiation which may adversely affect electronic equipment or human health</li> <li>• Traffic hazards</li> </ul>	<ul style="list-style-type: none"> <li>• Determination of the available health facilities in the area</li> <li>• Availability of officials in the available health facilities</li> <li>• Emergency preparedness</li> </ul>	<ul style="list-style-type: none"> <li>• Project area and the surrounding environment</li> </ul>	<ul style="list-style-type: none"> <li>• Inaccessibility of some areas</li> </ul>
Security and Public Safety	<ul style="list-style-type: none"> <li>• Public risks</li> <li>• Crime</li> <li>• Conflicts over resources</li> <li>• Fires</li> </ul>	<ul style="list-style-type: none"> <li>• Need to enhance security in the project area</li> <li>• Emergency preparedness</li> </ul>	<ul style="list-style-type: none"> <li>• Project area and surroundings</li> </ul>	<ul style="list-style-type: none"> <li>• Some areas are considered as high risk areas in terms of security (inter-tribe conflicts - Rendille vs Gabbra)</li> </ul>
Public Consultations	<ul style="list-style-type: none"> <li>• Awareness creation on the project</li> <li>• Environmental pressures in the area</li> <li>• Expert and indigenous knowledge of the area</li> </ul>	<ul style="list-style-type: none"> <li>• Involvement of all stakeholders</li> <li>• Information gathering on environmental issues and concerns in the project area</li> <li>• Acceptability of the project</li> </ul>	<ul style="list-style-type: none"> <li>• Project area and the surrounding environment</li> </ul>	<ul style="list-style-type: none"> <li>• Language barrier</li> </ul>
Corporate Social Responsibility	<ul style="list-style-type: none"> <li>• Community prioritisation of areas/projects for possible CSR assistance</li> </ul>	<ul style="list-style-type: none"> <li>• These were stated during the public consultations</li> </ul>	<ul style="list-style-type: none"> <li>• Project area and the surrounding environment</li> </ul>	<ul style="list-style-type: none"> <li>• High and sometimes unrealistic expectations</li> </ul>
Mitigation Measures	<ul style="list-style-type: none"> <li>• Mitigation hierarchy</li> </ul>	<ul style="list-style-type: none"> <li>• Avoiding or reducing at source</li> <li>• Abating on-site</li> <li>• Abating off-site</li> <li>• Repair or remedy</li> <li>• Compensate for loss or damage</li> </ul>	<ul style="list-style-type: none"> <li>• Proposed drilling site</li> <li>• Access roads</li> <li>• Selected camp sites and facilities</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Environmental Management Plan	<ul style="list-style-type: none"> <li>• Effective mitigations specified for the topics addressed</li> <li>• Costs</li> <li>• Responsibility</li> <li>• Management</li> <li>• Relevant legislation and regulations</li> <li>• Decommissioning</li> </ul>	<ul style="list-style-type: none"> <li>• Least possible interference with the environment</li> <li>• Compliance with principles, policies and legislation relating to conservation of environment</li> <li>• Decommissioning of campsite</li> </ul>	<ul style="list-style-type: none"> <li>• Proposed drilling site</li> <li>• Access roads</li> <li>• Selected camp site and rig facilities</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>

Environmental Monitoring Plan	<ul style="list-style-type: none"> <li>• Parameters to be monitored</li> <li>• Personnel required</li> <li>• Training needs</li> </ul>	<ul style="list-style-type: none"> <li>• Ease of monitoring</li> <li>• Effectiveness of monitoring method</li> <li>• Cost of monitoring</li> <li>• Frequency</li> </ul>	<ul style="list-style-type: none"> <li>• Proposed drilling site</li> <li>• Access roads</li> <li>• Selected camp sites and rig facilities</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
-------------------------------	--	---	--	--

### 3.4 COLLECTION OF BASELINE DATA

#### 3.4.1 Overview of Methods

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

- Scaling and scoping (determination of geographical and other boundaries; preliminary assessment).
- Review of existing regulatory framework and institutional arrangement.
- Detailed environmental assessment and community sensitization.
- Impact identification and development of suggested mitigation measures.
- Development of an Environmental Management Plan 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 between the 4<sup>th</sup> of June 2011 and 18<sup>th</sup> of June 2011. 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 well 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). Reference was also made to the NOCK oil blocks map for boundary delineation. TKBV provided the geographical locations of the project area which were superimposed on 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 pit descriptions. Profile pit 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, micro-relief like presence of salt puffs 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 presents 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 were 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 Ground Water Resources**

Water potential and quality baseline data was assessed through literature review and analysis of water samples collected from shallow wells and springs during the EIA field work. The locations of all sampling points were determined and recorded using a GPS receiver.

#### **3.4.7 Terrestrial Environment**

Baseline information for the terrestrial environment, including floral and faunal components, was acquired through 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 loss or biodiversity decline; and the potential impacts of the exploratory oil and gas well drilling project on the existing ecosystems, flora, and fauna. Field guide books 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 Land and Lake Resources and National Parks**

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

### 3.4.9 Visual Aesthetics

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

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

### 3.4.10 Noise and Vibrations

The potential disturbance caused by noise levels during the proposed exploratory oil and gas well drilling operations within the project area were taken into consideration during the fieldwork period.

### 3.4.11 Solid and Liquid Wastes

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

### 3.4.12 Public Consultations and Socio-Economics

Public consultation, which is an on-going process that began prior to the seismic survey, was accorded high priority so as to inform and create awareness about the proposed exploratory oil and gas drilling project, as well as to capture and address the issues and concerns of the communities and other stakeholders within the project area. Thus, these consultations have been designed to be a continuous process throughout the various phases of the oil and gas exploration activities, with a view to disseminating information to, creating awareness amongst, and sharing knowledge with, the communities and stakeholders on the project components and their potential impacts and mitigation strategies.

Public consultations were carried out with the following aims:

- To inform the local people and their leaders about the proposed exploratory oil and gas well drilling project and its objectives;
- To maintain effective communication between TKBV and the host communities;
- Obtain the consent of the people to undertake the project activities and to comply with mandatory statutory regulations;
- Being aware of stakeholders' views of the project with respect to the current environmental conditions in the area and any changes thereof in the future;
- To gather the concerns and views of the local people on the proposed project and the activities to be undertaken;
- To establish if the local people foresee any positive and/or negative impacts associated with the proposed exploratory oil and gas well drilling project, and

suggest ways of mitigating negative impacts and enhancing positive impacts arising from it;

- Considering effective participation of the host communities in maintaining and sustaining the beneficial impacts of the project;
- To identify and document the diverse socio-cultural and economic structures in the project area that could potentially be impacted by the project activities;
- Identify legacy issues associated with the previous activities in the project area and ways to tackle such issues; and
- Maintaining continuous interaction with the host communities to obtain early warning information on the physical, chemical, biological, health and social components of the environment in order to tackle any incidences during the project phases.

The public consultations for the exploratory well drilling in the project area were carried out as shown in Table 3.1 below:

**Table 3.1: Public consultations schedule and areas covered.**

	<b>DAYS &amp; DATES</b>	<b>TIME (Start/End)</b>	<b>AREAS COVERED</b>	<b>DISRICTS</b>	<b>GPS COORDINATES</b>
1	MONDAY 13/06/2011	12.00 P.M 12.35 P.M	Maikona Location Maikona Division	CHALBI DISTRICT	N03.93291 E037.6333
2	MONDAY 13/06/2011	2.40 P.M 3.58 P.M	Maikona Location Maikona Division	CHALBI DISTRICT	N03.93291 E037.6333
3	TUESDAY 14/06/2011	3.25 P.M 4.01 P.M	Kalacha Location Maikona Division	CHALBI DISTRICT	N03.13237 E037.42575
4	FRIDAY 17/06/2011	11.00 A.M 12.34 P.M	Kargi Location Loiyangalani Division	LOIYANGALANI DISTRICT	N02.50669 E037.57506
5	FRIDAY 17/06/2011	2.10 P.M 2.42 P.M	Kalacha Location Maikona Division	CHALBI DISTRICT	N03.93291 E037.6333

Other social and economic aspects that were addressed included livelihoods, cultures, education and health. The methodologies employed to assess these aspects included review of available literature, public meetings and consultation with local residents and their leaders, and administration of formal questionnaires and interviews with opinion leaders and at household level.

### 3.4.13 Health and Public Safety

This assessment was carried out through: literature review of the available health data; and a site-walk survey using a checklist of environmental health and public safety issues.

The main issues assessed include:

- General level of sanitation
- Sources of water and water supply;
- Types of sewage and waste disposal facilities;
- Types and quality of housing;
- Availability of health facilities;
- Interaction between environment and health, and;
- Potential health impacts related to the project.

### 3.4.14 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 practices;
- Religion and belief systems;
- Social amenities and infrastructure;
- Health facilities available within the project area;
- Common diseases;
- Community health concerns relating to the project;
- Views on employment of locals in the project, and;
- Security issues.

## 3.5 DEVELOPMENT OF THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)

### 3.5.1 The Five-Step Process

The general methodology utilised for impact assessment is a five-step process starting with identification of project activities (Chapter 2 and Table 3.2 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 and 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 an 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 3.2: Impact assessment criteria and rating scales.**

CRITERIA	RATING SCALES
<b>Intensity</b> (expected size or magnitude of impact)	<b>Negligible</b> <b>Low</b> - where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected <b>Medium</b> - 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 <b>High</b> - 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
<b>Extent</b> (predicted scale of impact)	<b>Site-specific</b> <b>Local</b> (immediate surrounding areas) <b>Regional</b> <b>National</b>
<b>Duration</b> (predicted lifetime of impact)	<b>Short-term</b> - 0 to 5 years <b>Medium-term</b> - 6 to 15 years <b>Long-term</b> - 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 <b>Permanent</b> - 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
<b>Probability</b>	<b>Improbable</b> – where the possibility of the impact materialising is very low

CRITERIA	RATING SCALES
(likelihood of impact occurring)	<p><b>Probable</b> – where there is a good possibility (&lt;50% chance) that the impact will occur</p> <p><b>Highly probable</b> – where it is most likely (50-90% chance) that the impact will occur</p> <p><b>Definite</b> – where the impact will occur regardless of any prevention measures (&gt;90% chance of occurring)</p>
Status of impact	<p><b>Positive</b> - a “benefit”</p> <p><b>Negative</b> - a “cost”</p> <p><b>Neutral</b></p>
Degree of confidence (specialist's level of confidence in predictions and/or information on which it is based)	<p><b>Low</b></p> <p><b>Medium</b></p> <p><b>High</b></p>

### 3.5.1 Assigning significance ratings

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

#### Significance is described as follows:

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

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

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

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

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

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

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

## **CHAPTER 4**

### **POLICY, LEGAL, AND REGULATORY FRAMEWORK**

#### **4.1 THE CONSTITUTION OF KENYA, 2010**

The Constitution provides that every person has the right to a clean and healthy environment (Article 42). The State is 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 a forestation 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:

- a) all citizens with 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 put into operation 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. 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 values transparency and accountability to the citizens of Kenya.

### 4.3 KENYA LEGISLATION AND REGULATIONS

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

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

#### **4.3.2 The Petroleum (Exploration and Production) Regulations**

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

It relates to interference with sensitive cultural, natural heritage sites, 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 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.

#### **4.3.4 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.

---

<sup>1</sup> “Contractor” here means the individual(s) or company undertaking the work or project.

#### **4.3.5 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 willful 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.

#### **4.3.6 The Local Government Act, Cap. 265 (Revised 2010)**

This Act gives local authorities the power to control or ban businesses, factories and workshops which may emit smoke, fumes, chemicals, gases, dust, smell, noise or vibration, and in so doing become a danger or annoyance to the 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.

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.

#### **4.3.7 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 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.

#### **4.3.8 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.

#### **4.3.9 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.

#### **4.3.10 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) 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.

#### **4.3.11 The Occupational Safety and Health Act, No. 15 of 2007**

This legislation applies to all workplaces. Every occupier must ensure the health, safety and welfare at work of all the people working in his workplace as well as protect other people from risks to safety and health occasioned by the activities of his workers. The occupier's duty to ensure the safety, health and welfare of all persons at work in his premises includes providing a working environment and work procedures that are safe. The likely emission of poisonous, harmful, or offensive substances into the atmosphere should be prevented, and where such incidents occur, they must be rendered harmless and inoffensive. Machinery, protective gear, and tools used in all workplaces have to comply with the prescribed safety

and health standards. Dust, fumes or impurity must not be allowed to enter the atmosphere without appropriate treatment to prevent air pollution or harm of any kind to life and property. Highly inflammable substances must be kept in a safe place outside any occupied building. Where dangerous fumes are liable to be present, there must be a means of exit and suitable breathing apparatus made available. Means for extinguishing fire must be available and easily accessible, and evacuation procedures tested regularly (Sections 6, 21, 47, 55, 64, 78, 79, 81, 82).

This covers activities that may be 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.

#### **4.3.12 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 that will be used to measure and characterise various well and geological formation parameters as the well is being drilled.

#### **4.3.13 The Explosives Act, Cap. 115**

There are restrictions on transport, storage and possession of both authorized and unauthorized explosives. A permit is required to purchase and use blasting materials as well as to convey explosives within Kenya (Sections 6, 7, 11, 13).

#### **4.3.14 The Explosives (Blasting Explosives) Rules**

The use of explosives in the vicinity of any public road is not permitted. Also prohibited is the use or transport of explosives in the working of a mine, quarry, excavation or other project, unless an "explosives manager"<sup>2</sup> 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 (Rules 78 – 80) in the context of the use of explosives. Also, such responsibility does not extend to a situation where the person was operating under the direct supervision or control of someone else who holds a valid permit to use explosive materials when the prevailing rules were contravened, or an accident occurred.

---

<sup>2</sup> "Explosives Manager" here means any person assigned to be responsible for the explosives.

#### **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 required to be submitted to NEMA for consideration. The EIA study review process and decision-making are also explained. The guidelines are mainly intended to assist project proponents, EIA practitioners, lead agencies and members of the public to understand the process and the basis on which decisions are made.

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

Everyone is required to refrain from any act which directly or indirectly causes water pollution, and no one may throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such material in or near it so as to cause pollution. No one is permitted to carry out any activity near lakes, streams, springs and wells that is likely to have an adverse impact on the quality of the water without 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.

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

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

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 ground water.

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

These Regulations aim to ensure the sustainable use of wetlands for ecological and aesthetic purposes and in addition seek to prevent and control pollution and siltation as well as other activities that may degrade the environment. All wetland resources must be used in a sustainable manner compatible with the continued presence of wetlands and their hydrological, ecological, social and economic functions and services. Some permitted uses of 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 bye-laws to manage solid waste and waste waters on lakeshores and riverbanks in accordance with the Public Health Act, Cap. 342 (Regulations 4, 5, 8, 11, 16, 17, 22, 24).

This 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 level (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 emit 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. Waste can also be minimized by incorporating environmental concerns in the design and disposal of the product. Every industrial undertaking must mitigate pollution by installing at its premises anti-pollution equipment for treating the waste it generates. Discharge or disposal of any waste in any form into the environment is not permitted without prior treatment. An Environmental Impact Assessment licence must be obtained by anyone intending to engage in any activity likely to generate hazardous waste. Anyone generating toxic or hazardous waste must have it treated according to the laid-down guidelines (Regulations 14, 15, 17).

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

### **4.5 INTERNATIONAL PRACTICES, STANDARDS AND CONVENTIONS**

#### **4.5.1 International Best Practices**

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. It is also 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: 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

(next two pages)

# Environmental, health and safety policy



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

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

We seek to achieve continual improvement in our EHS performance.

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

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

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

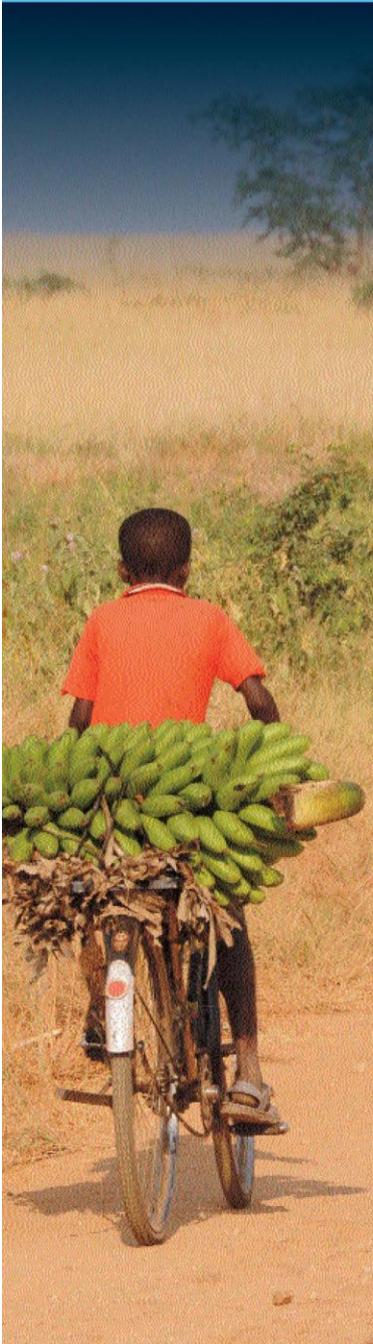
Whilst we provide a strong and visible leadership commitment to EHS, everyone in Tullow Oil has individual authority, responsibility and accountability for the safety of themselves and others, and an obligation to actively participate in promoting an effective EHS culture. We will regularly set and review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

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



TO-EHS-POL-001-Rev7

# Corporate social responsibility policy



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

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

---

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

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

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

A handwritten signature in black ink that reads "Aidan J Heavey".

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



TO-EHS-POL-001-Rev7

## CHAPTER 5

### **BASELINE ENVIRONMENTAL AND SOCIAL PARAMETERS**

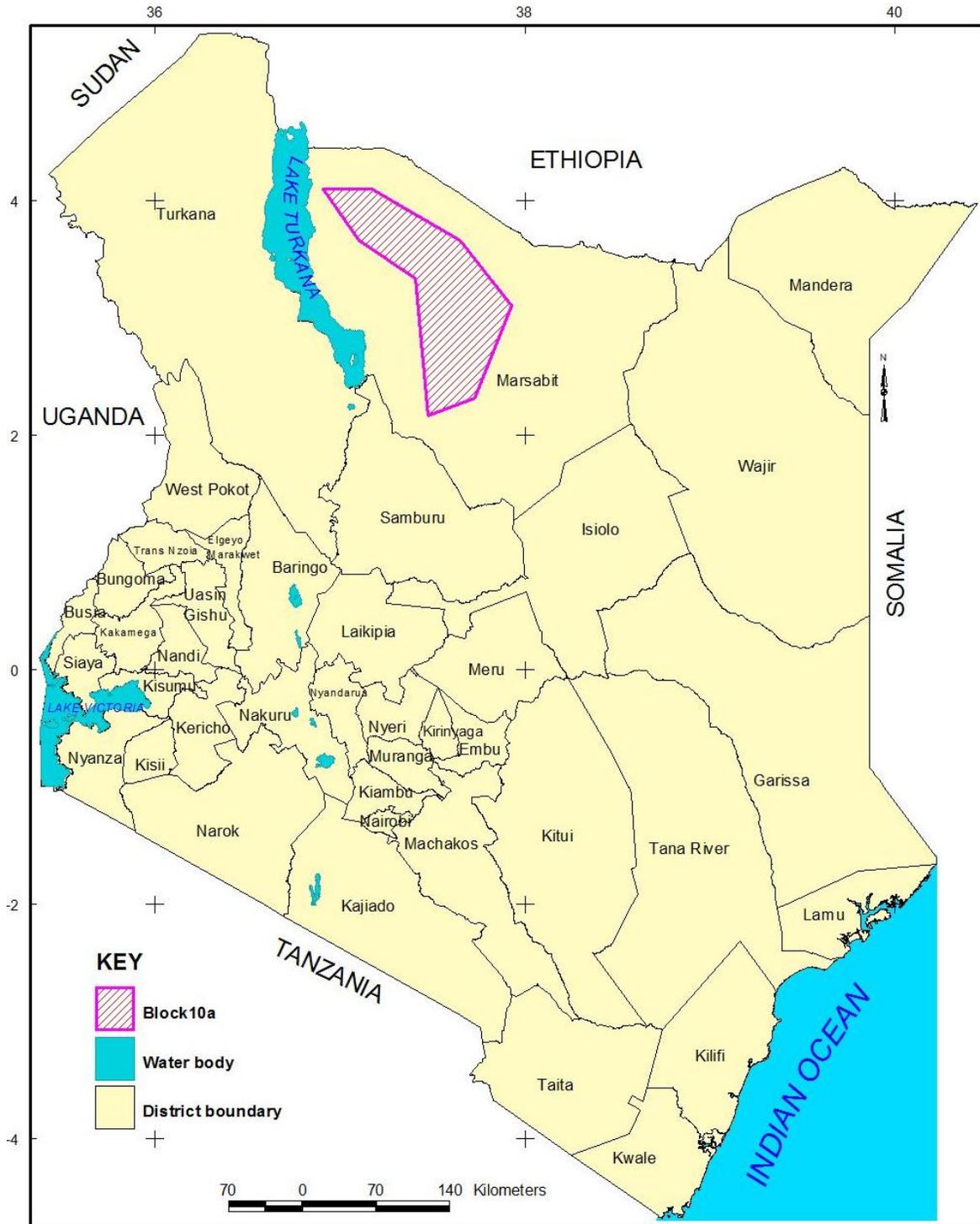
#### **5.1 INTRODUCTION**

This chapter provides a description of the current environmental and socio-economic situation against which the potential impacts of the proposed exploration well 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 exploration well sites (from which one site will be selected for drilling) and their surrounding areas which may be directly or indirectly impacted upon by the proposed drilling and associated activities.

##### **5.1.1 Project Location and Layout of the Chapter**

The project area lies in Marsabit North (Chalbi) and Loiyangalani districts (Figure 5.1). It is bounded by latitudes *ca.*3 °N and 5°N and longitudes *ca.*35°E and 36.5°E.

This Chapter describes the biophysical and socio-economic baseline environmental conditions which are required to be known in order to determine the pre-project (already existing) environmental pressures and impacts, the causes of these and the state of the environment. This information underlies the basis upon which potential project impacts on the biophysical and socio-economic environment can be assessed and evaluated, including residual and cumulative impacts, hence contributing to consideration of the best and most effective measures of mitigations that can be undertaken so that the project components cause no or very minimal disturbance to the environment.



**Figure 5. 1: Location of the project area.**

It should be noted that information provided in this chapter may be limited due to lack of previous research or published literature. However, many of these gaps have been in-filled to varying degrees by the field investigations that were carried out in the course of preparing the report, though some factors such as long-term trends in, e.g., local climate and air quality, were constrained by scarcity of data. The data inadequacies have been pointed out in Chapter 3,

section 3.3. It is recommended that TKBV undertake monitoring programs with the relevant authorities to ensure compliance to the environmental guidelines, especially in instances where baseline information is insufficient.

### 5.1.2 Geographical Aspects and District Boundaries

The key geographical aspects of the project area have been described in Chapter 1, section 1.4. The project area lies in Marsabit North (Chalbi) and Loiyangalani districts (Figure 5.2). The area is bordered by Moyale, Turkana, Samburu, Isiolo and Wajir Districts in Kenya to the north-east, west, south and east respectively. Marsabit District was recently sub-divided into three districts namely Marsabit South, Marsabit Central, and Marsabit North (Chalbi) Districts, which cover a total area of approximately 14,747.57 km<sup>2</sup> and all fall under one local authority namely the Marsabit County Council.

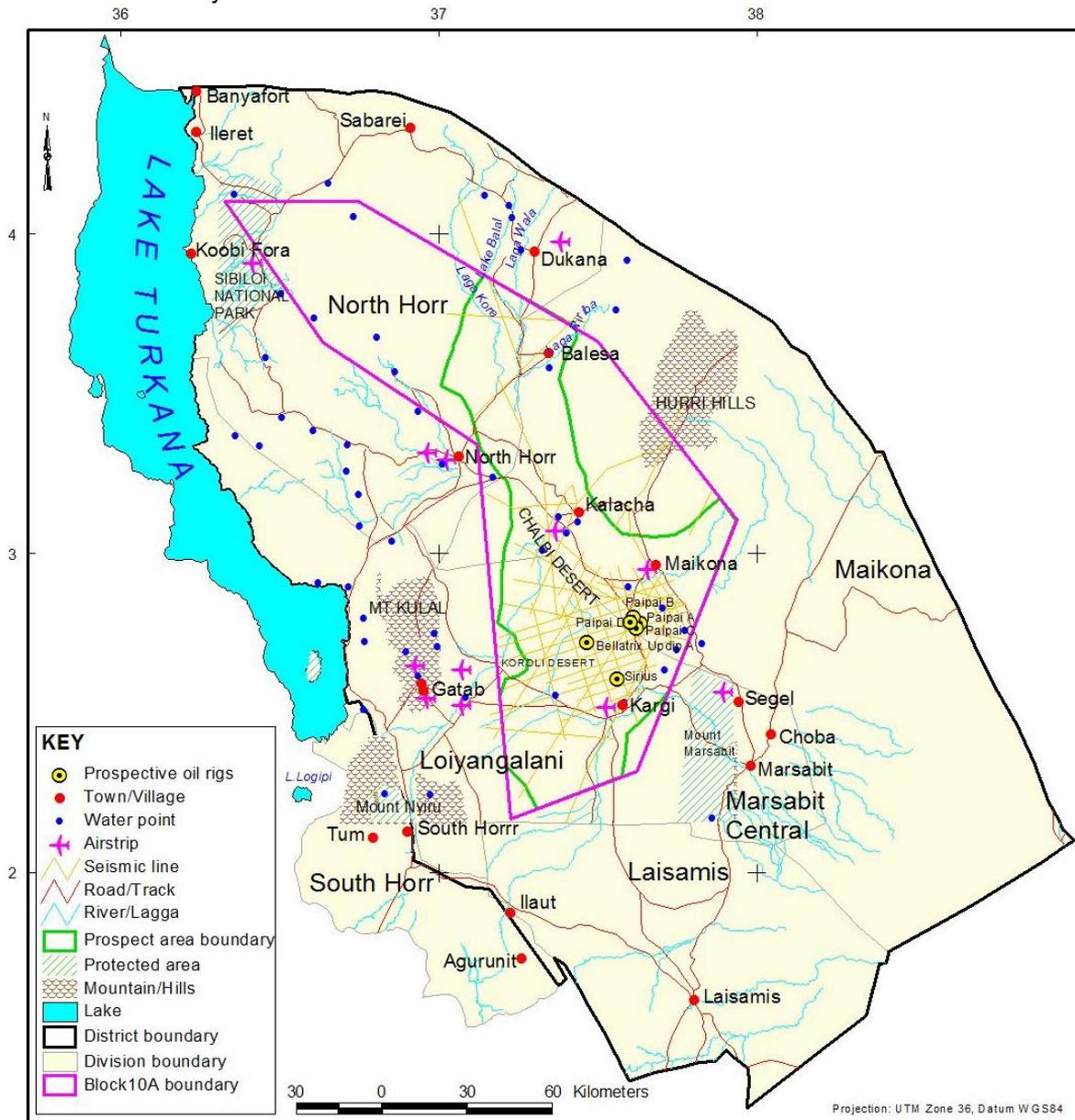


Figure 5.2: Districts within the study area

### 5.1.3 Administrative Structure

The three districts of Marsabit Central, Marsabit North (Chalbi), and Marsabit South have their administrative headquarters in Marsabit, Maikona and Laisamis Towns, respectively. Loiyangalani District, which was subsequently separated out of Marsabit South District, has its headquarters in Loiyangalani. Marsabit District has three constituencies namely Laisamis, Saku and North Horr, all served by the Marsabit County Council. Districts are headed by District Commissioners, constituencies by elected Members of Parliament, and County Councils by Mayors elected from amongst and by popularly elected Councillors. Since the implementation of the new constitution that was promulgated in August 2010 is still ongoing, the old structure where Districts fall under Provinces is still in place. The Districts of the area are in North Eastern Province, which is headed by a Provincial Commissioner whose headquarters is in Marsabit.

### 5.1.4 Communications and Transport

The main road to the project area is the Nairobi-Isiolo-Moyale highway, which is bitumen up to Isiolo Town and currently under construction to extend it to Laisamis Town. This highway, which is used by livestock dealers and small-scale business people to transport their wares to and from Nairobi, can be used to transport construction and exploration machinery to the project area. The project area itself is characterized by a poor murrum and earth road network; there are no tarmac roads. These roads are motorable, but are generally impassable during rainy seasons.

There are a number of airstrips close to the major towns of Maikona, Kargi, Marsabit and Kalacha. Marsabit airport is the airport of choice for larger aircraft as it has a tarmac runway that is approximately 1.6km long. Kalacha has an 800m long airstrip in town and another larger, but disused one, about 5km out of town. These airstrips do not, however, have management facilities or offices on site.

The project area is not well-covered by telecommunications services save for Maikona and Kargi which have Safaricom and Telkom wireless network coverage respectively, although the Telkom wireless network at Kargi is not very reliable. The land-based telephone network is extremely poor and unreliable. The mobile telephone network is much better and more reliable, though there are still vast areas that are not under coverage. Radio communications are not, as a rule, used by the public. They fall in the domain of security agencies (e.g. Kenya Police, Kenya Army), some governmental agencies and parastatals such as Kenya Wildlife Services (KWS), and tourist safari companies. These radio communications are not inter-linked, as they are run on different radio frequency bandwidths. Satellite telephones are therefore of prime importance for work in the region (covered by Thuraya), but are generally very expensive and therefore also not in use by the general public.

### 5.1.5 Government, Non Governmental and Community-Based Organizations

There are several non-governmental/religious-based organizations operating within the project area. These organizations, in collaboration with the government, assist the community through provision of essential socio-economic and cultural services. Some of the organizations that have had a positive impact in the area include the Catholic Church, Pastoralists Integrated Support Programme (PISP), Solidarities, Community Initiative Facilitation and Assistance (CIFA), African Inland Church (AIC), Food for the Hungry Kenya (FHK), Care Kenya, and Arid

Lands Resource Management Project (a community-focused drought management project of the Kenya Government that utilizes a credit facility from the World Bank).

## 5.2 BASELINE SURVEY

### 5.2.1 Physiography and Geology

#### 5.2.1.1 Physiography

The local and regional physiography of the project area can be divided into three major physiographic provinces (figure 5.4 below):

- Chalbi Basin
- Karoli desert
- Volcanic Plateau.

**Chalbi Basin:** The Chalbi Basin is an inland drainage basin surrounded by lava uplands. In its centre lies the Chalbi playa, a bare surface of mud subject to occasional flooding, at 370 m above sea-level. Chalbi Basin can be sub-divided into two smaller physiographic zones (playa and dune fields) that have the following characteristics:

**Playa:** This is a closed lacustrine basin at an elevation of only 370 m. The playa is usually dry, with salt encrusted mud flats and minor sand bars. During the rainy seasons, particularly in April, the playa floods and forms an extensive lake. Vegetation is entirely absent and there are no interior drainage channels. The entire SW margin of the playa is defined by relatively high (over 10 m) sand bars which preserve strandlines related to the original (Tertiary) lake. It is assumed that the development of the sand bars is related to the original lake where it formed a marginal 'barrier beach' deposit. It may have been caused by longshore drift (see Plates 5.1 and 5.2).



**Plate 5.1: Southern margin of Chalbi playa, photo taken from Maikona area facing south.**



**Plate 5.2: Mirage as a result of reflection of salt crust of the Chalbi playa. Note the presence of sand dunes in the background.**

*Dune fields:* Deflated sand-dune fields flank the playa to the north-east (in the area south-east of Maikona) and to the south-west behind the aforementioned sand bar (Plate 5.3). In the extreme north-east the dunes are rather complex polybarchans which indicate a wind direction from the north-east during the dune growth. Adjacent to the playa (on both sides), the dunes coalesce and lack any pronounced linearity. Interdune areas define numerous pans that are susceptible to flooding (Plate 5.4). To the south-east of the most southerly strand lines, the dunes are longitudinal and have a pronounced N-S orientation, indicating winds of that direction. A sparse grass (spear grass and *Austrostripa*) and scrub (*Indigofera*) cover presently stabilises the deflated dunes.



**Plate 5.3: Degraded dune field south-east of the Chalbi playa.**



**Plate 5.4: Ponding of interdune depressions within the dune field, south-west of Chalbi playa, 6 km away from the proposed Sirius exploratory well site.**

**Karoli desert:** Karoli desert borders the Chalbi Basin to the west and runs parallel to it in a N-S direction; it extends through Kargi area to the Asie Shield in the northern part of the project area (see Plate 5.5). The surface remains at 600 m above sea level and apart from the presence of basalt capped mesas and shields; the desert has a monotonous brown-light yellow sand-rich soil that mantles the flat desert floor. However, there are subdued sand mounds (parallel to the dunes of the Chalbi Basin dune field) which suggest that this area may formerly have been part of an extensive dune field. Around Kargi, reactivation of the sand is producing new dunes. These are relatively small longitudinal dunes parallel to the prevailing WNW-directed wind. The position of the proposed Sirius exploratory well lies within this physiographic unit and is about 300 metres away from the field dunes of the Chalbi Basin whilst the proposed Bellatrix exploratory well lies at the boundary between the Karoli desert and the dune field of the Chalbi Basin. Drought resistant vegetation such as *Acacia mallifera*, *Acacia reficiens* and *Tortillis eagyptae* are found in the area.



**Plate 5. 5: Karoli desert, west of the proposed Bellatrix exploratory well.**

**Volcanic Plateau:** The volcanic plateau borders the Chalbi Basin to the east and extends both northwards (towards Kalacha) and southwards (towards Kargi). A number of volcanic shields, e.g. the Huri hills, rest on the basalt plateau (Plate 5.6). On the southernmost extremity of the Huri shield is seen north of Maikona where it forms a rocky Plateau less than 30 metres higher than the Chalbi Basin. It is poorly drained with natural rock hollows infilled by a mixture of Aeolian sand and ponded silt.



**Plate 5.6: Volcanic Plateau, northwest of Maikona, looking west towards Chalbi playa.**

**Drainage:** Most of the rivers draining into the hydrologically closed Chalbi Basin are found on the western and southern parts and tend to be mostly east-west oriented; they originate from Mount Kulal to west (Balesa River) and Mount Nyiro to the south-west (Kargi Lugga). Others originate from Mount Marsabit to the south-east (Sangarta and Sangai Lugga) and Huri Hills to the north-east (Lugga Dambito). The ephemeral rivers on the western side of the project area flow in a west-east direction into the Chalbi playa (figure 5.3). The rivers may flood their channels during the wet seasons.

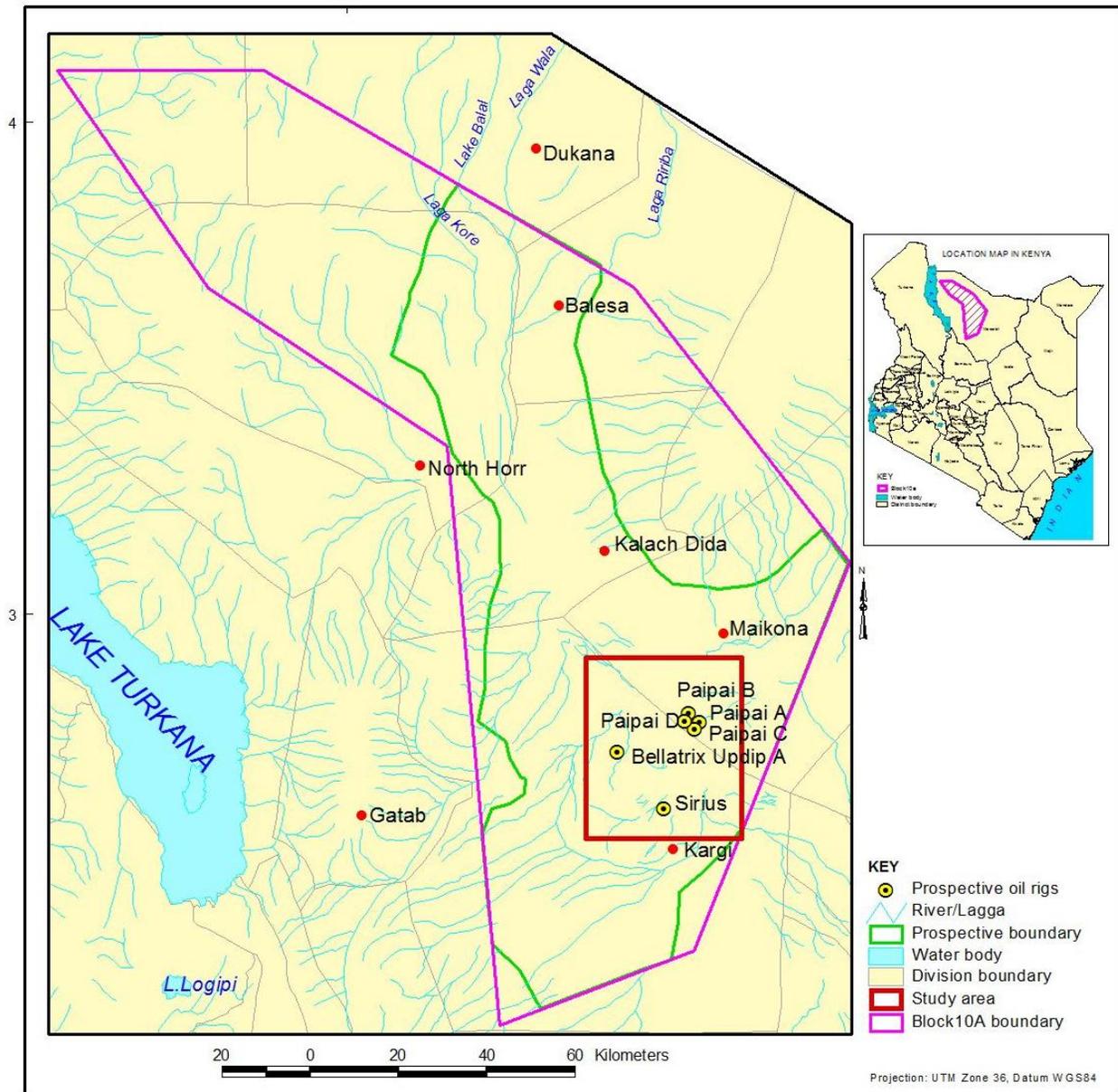


Figure 5.3: Drainage patterns within the project area

### 5.2.1.2 Geology

#### 5.2.1.2.1 Geological Setting

The project area is founded on Proterozoic sedimentary and volcanic rocks that were folded and metamorphosed during the Late Proterozoic-Cambrian Mozambiquian Orogeny and located within the Anza Graben. Post-Cambrian uplift or erosion produced a planar land surface upon which the coarse clastic sediments of the Maikona formation were deposited (MENRM, 1987). Sedimentation took place in a NW-trending graben across the north-east of the area, fed by braided streams from both the south-west and north-east. Lithologically, the sedimentary rocks are identical to the Cretaceous Turkana Grits west of Lake Turkana (Glennie, 1970).

They are economically important both as a major aquifer (as observed in the Kargi borehole) and as potential hosts to hydrocarbons (they fall within Anza Graben).

Further erosion and regional warping produced the regional sub-Miocene planar surface which defined the NW-trending Chalbi Basin. Fossiliferous lacustrine beds were deposited in this Basin during the Miocene (the Karole formation west of the project area) on top of the Maikona formation. Dune fields also surrounded the playa (Chalbi desert) (Muturi and Siambi, 1984).

Towards the end of the Miocene, contemporaneous with Rift System faulting, major alkali basalt volcanism with widespread outpouring of homogeneous, thin olivine-basalt lava floods took place. They subsequently flooded the major Plio-Pleistocene shield volcanoes (Kulal to the west, Huri to the north-east and Marsabit to the south-east) and possibly an older shield in the Koroli Desert west of the project area (Dodson, 1985).

Quaternary reworking of surface material, including the superficial mantles of the exposed sub-Miocene surface, overlapped with the cessation of volcanism that formed the shield volcanoes. Fluctuating climate caused lake level changes in the Chalbi Basin (IPAL, 1983).

#### **5.2.1.2.2 Surface Geology**

This section describes the geology of the area as mapped by previous researchers and verified during the field survey, and currently active geological processes observed, focusing on those rock-types and geological processes that are significant or relevant to the proposed exploration drilling operation in the project area.

The major rock types exposed within the project area are: Proterozoic sedimentary rocks, later volcanic series which are quite extensive (basalts and pyroclastics) interspersed with sedimentary materials, and Miocene sedimentary deposits consisting of a complex of alluvial fan, fluvial and lacustrine deposits exposed over the Chalbi Basin (Figure 5.4). Geologically and archaeologically, fossiliferous lacustrine beds were deposited in this Basin during the Miocene.

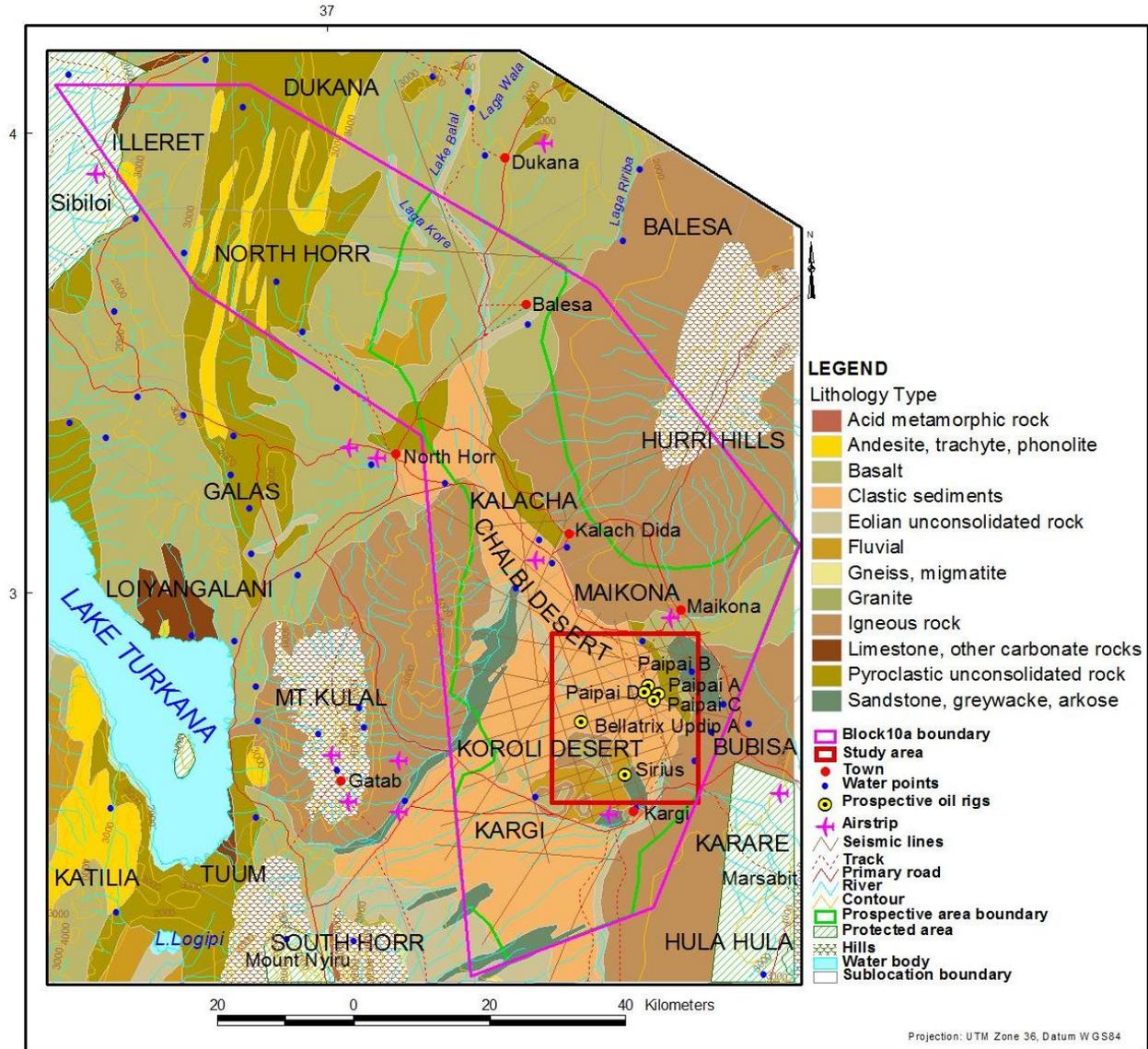


Figure 5.4: Geology and physiography of the project area.

Table 5.1: Rock types observed during the field survey that is significant for project logistics and EMP

Type of Rock	Locality	Brief Description	Natural Hazards	Implications for the Project and EMP
Gritstone	Maikona and west of Ramatrobi areas	Form rugged terrain with weak surfaces. Rock exposures break off easily along the weak zones (i.e. bedding planes (Plate 5.7)) from any little external mechanical disturbance.	<ul style="list-style-type: none"> <li>• Debris fall</li> </ul>	<ul style="list-style-type: none"> <li>• Access roads to the drilling site may have to be deviated.</li> <li>• Rugged terrain impeding accessibility.</li> <li>• Occupational safety relating to rock falls and topples during movement to the site.</li> <li>• Site access routes footprints will be long-lasting.</li> </ul>

<b>Olive Basalt</b>	Karole, North-east Kargi, north of Maikona and Kalacha	Form basaltic scarps and cliff faces. Heaped extruded loose basaltic boulders that form ridge .	<ul style="list-style-type: none"> <li>• Potential rock falls or topples</li> </ul>	<ul style="list-style-type: none"> <li>• Access routes may have to be deviated.</li> <li>• Rugged terrain.</li> </ul>
---------------------	--	--	---	---



**Plate 5.7: Gritstone of the Maikona formation south of Maikona Town, 6 km away from the Paipai A proposed exploratory well.**

**Table 5.2: Active geological processes observed during the field survey that is significant for project logistics and EMP.**

Feature	Locality	Brief Description	Natural Hazards	Implications for the Project and EMP
<b>Dune Sands</b>	West and south-east of Chalbi Playa	<p>Because of the prevailing westerly winds, field dunes formation is more prominent along the high-energy western side of the Playa.</p> <p>Field dunes have developed along a belt parallel to the playa, up to about 16km wide, entire west and south-east of the playa.</p> <p>The interdune depressions are composed of mixture of clay and sand that are prone to ponding during rainy seasons.</p>	<ul style="list-style-type: none"> <li>• Active windblown dust</li> </ul>	<ul style="list-style-type: none"> <li>• Sands will slow down vehicular movement</li> <li>• Windblown dust can jam sensitive equipment during the operation, and is a health hazard.</li> <li>• Interdune depressions are not accessible during the rainy seasons (Plate 5.4).</li> </ul>



**Plate 5.8: Face cut of stabilising sand dune, 3 km away to the east of the proposed Paipai exploratory well.**

## 5.2.2 Soils

### Soil Mapping Units

The exploratory well drilling sites are found in the piedmont plains (Mapping unit YV) complex of sedimentary plains and dunes (Ps2+D1) and lacustrine plains that form part of the Chalbi Desert (Mapping unit P13). The sites accordingly, are Sirius, Bellatrix and Paipai respectively (Figure 5.5). The mapping units within the exploratory 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.

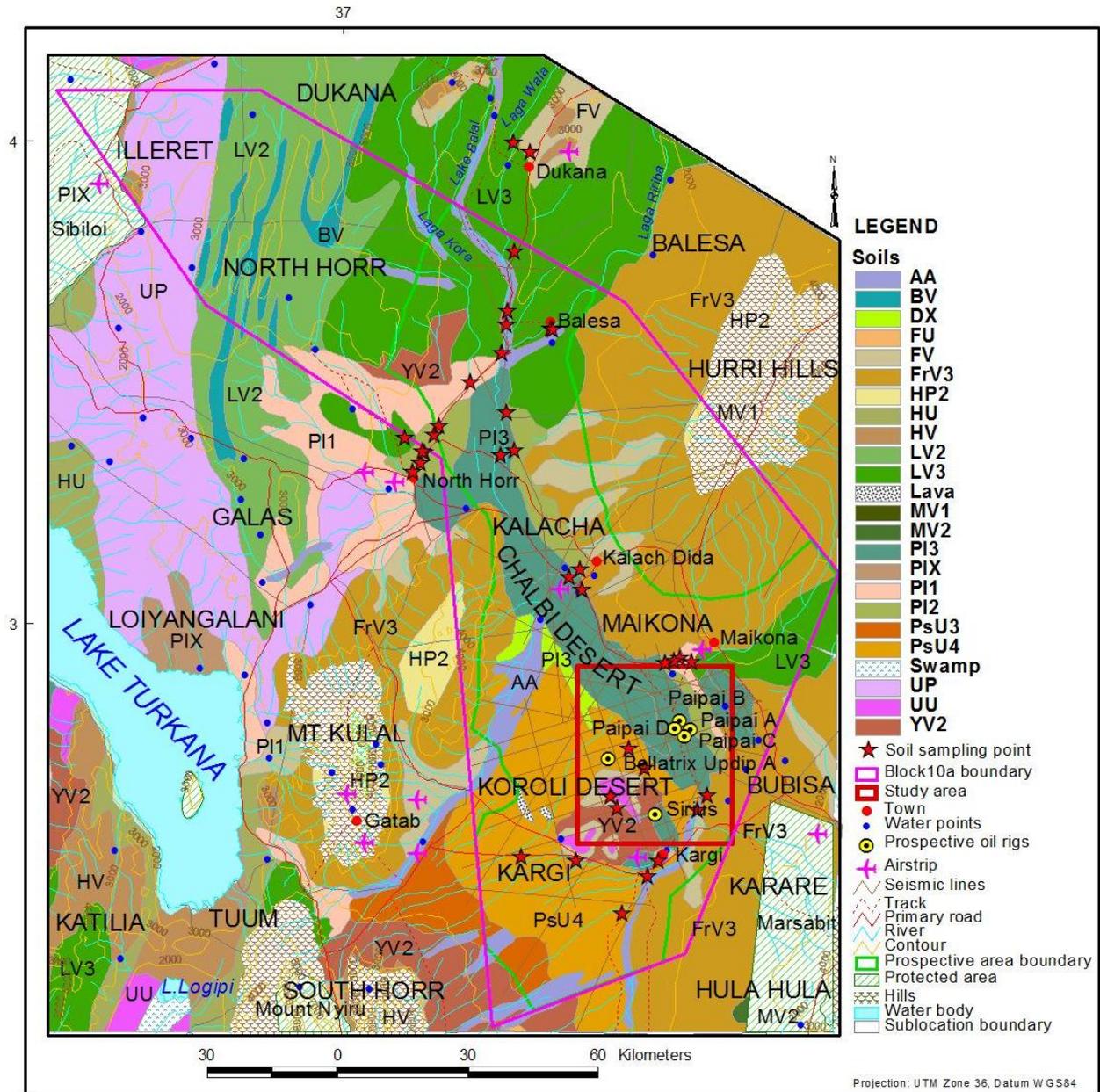
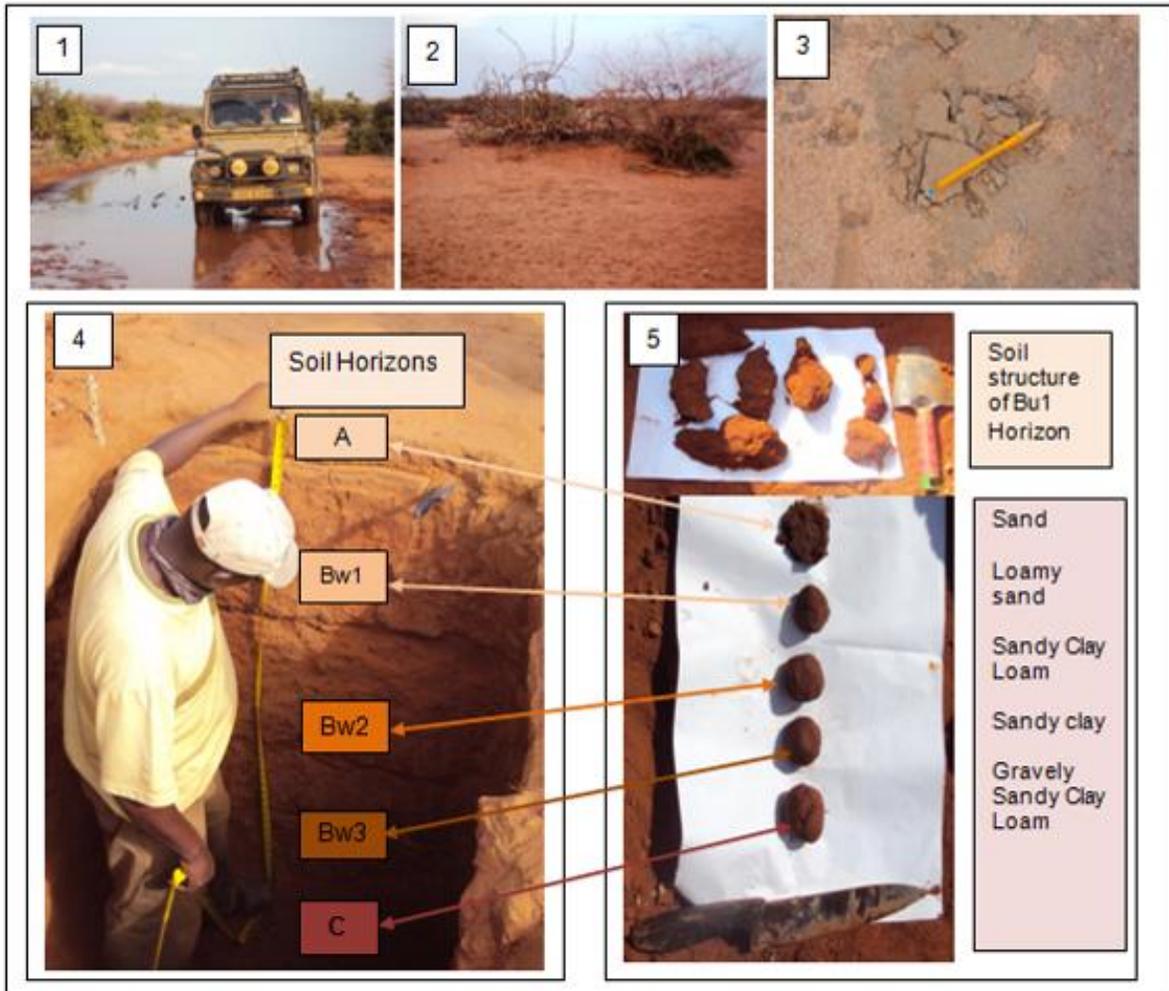


Figure 5.5: Soil map of the project area showing the exploratory drilling sites.

### Mapping unit YV

The piedmont plain (Mapping unit YV) is nearly level to gently sloping with a slope of 3-4% but with an undulating meso relief consisting of slowly developing dune (Plate 5.9). These dunes are < 1m and intense in distribution. The unit's geology is alluvium from various Tertiary/Quaternary volcanic rocks (mainly basalts). During the original mapping of the unit by Sombroek *et al* (1982) the dunes were probably absent or insignificantly formed not to warrant description. The dunes have been stabilized by vegetation, predominantly: *Indigofera spinosa* and *Commiphora Africana* and *Euphobia cuneata*. The unit has common bare patches where soils exhibit sealing and crusting. There was evidence of erosion overwash and ponding on depressions and roadways since the sampling was done after the rains. The ponding potential

sustains the life within the unit of vegetation and fauna. The unit also supports livestock (goats and camels) grazing, and wildlife browsing. The unit has degrading soils due to inadequate soil organic matter that causes surface sealing and capping. The surface sealing increases runoff incidences causing water to flow and pond in depressions and roadways. The unit has loose, surface sandy sodic soils that are susceptible to increased wind-caused erosion.

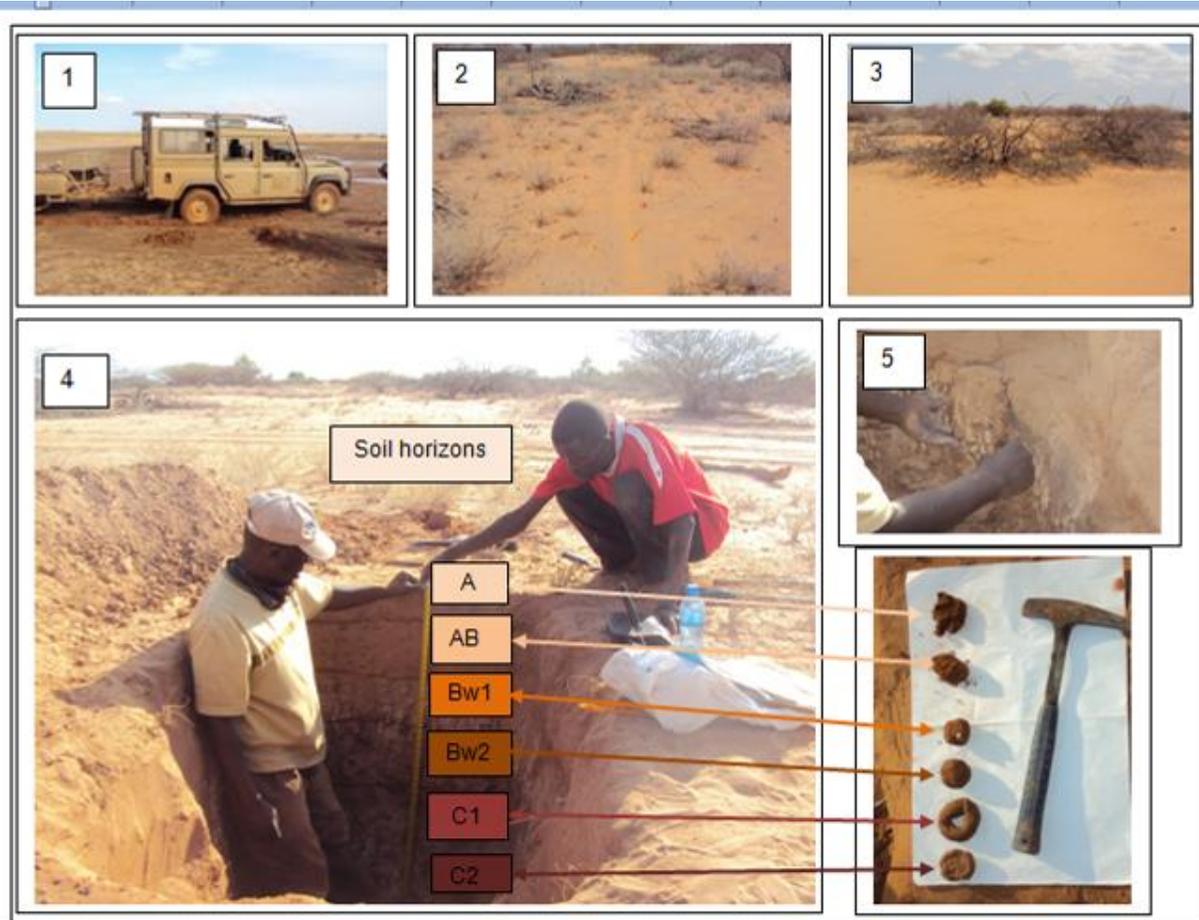


**Plate 5.9: (1) Ponding in the unit after rains (2) Piedmont plain showing sandy soils and forming dunes (3) sealing surface soils (4) profile pit showing soil horizons and (5) prismatic soil structure connotative of Natric B diagnostic horizon and soil texture.**

### Mapping unit Ps2 +D1

The sedimentary plain and dune complex (Mapping unit Ps2 +D1) is nearly level with a slope of 0-2% but with an undulating meso relief consisting of dunes (Plate 5.10). These dunes are about 1m in height, intense in distribution and active. The geology of the unit is a complex of sheetwash deposits from undifferentiated basic system rocks and Aeolian deposits. The dunes have been stabilized by vegetation, predominantly: *Indigofera spinosa*, *hirpicum spp* and *Euphobia cuneata*. The unit has sandy surface soils that are deep and soft locally. In between the dunes there are shallow interfluvies and evidence of erosion overwash and surface sealing on these depressions. The surface sealing increases runoff incidences causing water to flow

and pond in depressions and roadways. There was evidence of ponding on depressions and roadways since the sampling was done after the rains. The ponding potential sustains the life within the unit of vegetation and fauna. The unit also supports livestock (goats and camels) grazing, and wildlife browsing. The unit has loose, surface sandy soils that are susceptible to increased wind-caused erosion.

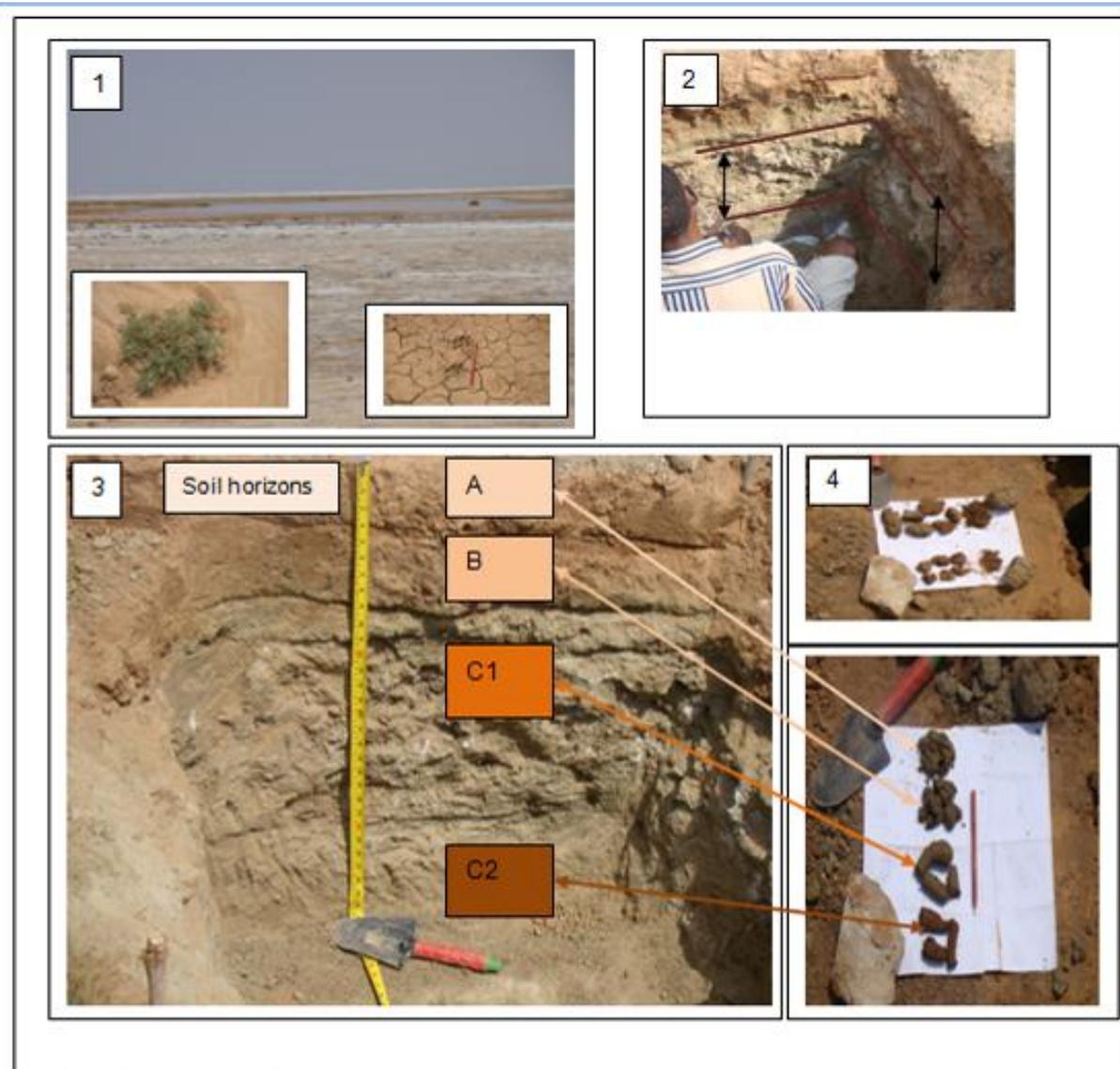


**Plate 5.10: 1) Vehicle stuck in the unit after rains (2) shallow interfluves that support vegetation (3) the complex unit showing dunes stabilized by *Euphorbia cuneata* (4) profile pit showing soil horizons and (5) prismatic soil structure in BW1 horizon and profile.**

### Mapping unit PI3

The lacustrine plain (Mapping unit PI3) is level to nearly level with a slope of 0-2% and bounded by undulating meso relief consisting of dunes (Plate 5.11). The geology of the unit is sediments from various sources. The unit has sandy surface soils with quartzite primary minerals that exhibit sealing and crusting. The unit also has abundant localized salt puffs that are whitish in colour. Salt crystals in common shallow salt pans can be seen in much of the unit. The surface is nearly barren with sparse vegetation consisting of *Astrotripa* and spear grass varieties. There was surface ponded water at the time of study, following recent rains. The unit is bound on the western side by PI2 unit which has common sandunes that support *Acacia tortilis*, *Commiphora africanas* and *Indigofera spinosa* vegetation. These dunes are common in

distribution and active with loose, surface sandy soils that are susceptible to increased wind-caused erosion.



**Plate 5.11: (1) Lacustrine plain showing surface salt pan and ponded water (background) and inset surface sealing and crusting soils in the rest of the unit and sparse grass vegetation with rill forming around (2) Caliche layer at (25-61 cm) depth (3) Profile pit.**

**Table 5.3: Soil Description within specified soil mapping units observed during the field survey that is significant for project logistics and EMP**

Unit	Locality	Brief Description	(*)Natural Hazards	Implications for the Project and EMP
<b>Piedmont Plain YV</b>	Found in the south- west of The project area around Kurkum	The soils are moderately well-drained, deep, brown, friable to firm, calcareous, saline and sodic sandy clay loam to sandy clay. They classify as <i>haplic Solonetz</i> (Sombroek et al., 1982)	<ul style="list-style-type: none"> <li>• Sealing and crusting soils</li> <li>• Wind erosion</li> <li>• Common bare patches</li> <li>• Surface ponding</li> <li>• Compact B-soil horizon</li> </ul>	<ul style="list-style-type: none"> <li>• Mechanical excavation of soil may expose the soil and encourage wind erosion and further degrade the unit</li> <li>• Ponding potential may impede certain activities to be carried out during the rains</li> <li>• Campsites may be placed on bare patches without disrupting vegetation</li> <li>• Compact subsurface layer will require appropriate tools/equipment if pits are to be excavated</li> </ul>
<b>Sedimentary plain and dune complex (Mapping unit Ps2 +D1)</b>	Found in the south of the Chalbi Desert and around Kargi and bordering the Y5 unit and Korole desert	The soils are moderately well drained, deep, brown, firm, calcareous, saline and sodic gravely sandy clay. The soil classifies as <i>haplic Solonetz</i> (Sombroek et al., 1982).	<ul style="list-style-type: none"> <li>• Wind erosion</li> <li>• Sealing soils</li> <li>• Surface runoff and ponding on depressions and roadways</li> <li>• Deep surface sandy soils (dunes)</li> <li>• Compact B-soil horizon</li> <li>• Calcium carbonate concretions at the subsurface</li> </ul>	<ul style="list-style-type: none"> <li>• Mechanical excavation of soil may expose the soil and encourage wind erosion and further degrade the unit</li> <li>• Runoff and ponding potential may impede certain activities to be carried out during the rains</li> <li>• Dunes with deep sandy soils may require levelling/removal if campsites are to be established</li> <li>• Compact subsurface layer and layer with calcium carbonate concretions will require appropriate tools/equipment if pits are to be excavated</li> </ul>
<b>Lacustrine plain (Mapping unit P13)</b>	Found to the west of the Chalbi Desert and south of Maikona	The soils are poorly drained, moderately deep to deep, dull yellow orange, friable to firm, calcareous, overlying a <i>caliche</i> layer, saline sandy clay (The soil classifies as <i>haplic Solonchak</i> (Sombroek et al., 1982).	<ul style="list-style-type: none"> <li>• Potential soil structure degradation due to high salt content</li> <li>• Surface flooding and ponding</li> <li>• <i>Caliche</i> layer at 25 cm</li> <li>• Denuded unit with very little vegetation</li> </ul>	<ul style="list-style-type: none"> <li>• Mechanical excavation of soil may expose the soil and encourage degradation eg, gully formation during the rainy season</li> <li>• Runoff and ponding potential may impede certain activities to be carried out during the rains</li> <li>• Compact subsurface layer and the indurate <i>caliche</i> layer will require appropriate tools/equipment if pits are to be excavated</li> <li>• Further surface disruption may denude the existing scanty and sparse vegetation</li> </ul>

### 5.2.3 Climate

The project area is characterized by two types of climatic conditions: dry and wet, and hot and dry; it is an arid to semi-arid zone. The mean annual rainfall for the arid and semi-arid zones ranges between 300-550 mm, but may significantly be lower, ranging between 150-350 mm annually for the very arid zones such as Chalbi desert. The relative humidity is very low. The bi-modal rainfall distribution is extremely variable and unreliable and drought is a constant threat.

The long rainy season is between the months of March to May with a peak in April, while the short rainy season is during October to December with a peak in November (Sombroek et al., 1982). During the dry seasons (January to February; June to September), the temperature ranges from 30–37°C, while in the wet seasons it ranges from 20-25 °C. The highest temperatures are experienced in August/September and may often exceed 37°C while the lowest temperatures are experienced in November and December (Sombroek et al., 1982).

#### Relationship to Project and EMP

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

- Due to the high temperatures, the project team should have adequate water supplies;
- Erratic, unpredictable and torrential rains that result in flash floods can pose a danger to crew especially at lugga crossings. 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.

### 5.2.4 Air Quality

The project area is sparsely populated, undeveloped and in a rural setting far from major towns, cities, agricultural and industrial centres that are the major contributors of air pollution. Despite this, the area is arid and semi-arid and is characterized by strong winds and whirlwinds that move significant amounts of dust and soils from one area to another, and this has resulted in formation of sand dunes and other types of aeolian deposits. Thus, the air “pollution” in the area relates to the significant quantities of air-borne dust. Minimal and transient air pollution also occurs as a result of the few 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 point to another.

#### Relationship to Project and EMP

Strong winds within the Chalbi and Karoli deserts often whip up dust storms that can reduce visibility and pose accidents and health problems, as well as jam sensitive machinery and electronic equipment.

Abatement of these effects is considered in the mitigations in Chapter 7.

### 5.2.5 Surface and Groundwater Resources

#### 5.2.5.1 Surface Water Resources

The surface water potential is extremely low, particularly during dry seasons (for water quality results refer to section 5.2.6). Permanent supplies of surface water in the area are rare and confined to a limited number of spring-fed pools, oases, water pans, earth dams and luggas. Other sources of surface water are the rather erratic, mostly transient rivers (luggas) that flow only for a few hours or days after rain, draining into the Chalbi Basin and recharging the ground water (Plate 5.12).



**Plate 5.82: Lugga Dambito, photo taken from south of Maikona Town.**

During the field work, a small earth dam, newly constructed by the National Water Corporation was found at Kargi Township area, otherwise the surface waters rapidly disappear by natural seepage and evaporation.

#### **5.2.5.2 Groundwater Resources**

Groundwater resources form the most available source of water supply in the project area. It is exploited through shallow wells (excavated in luggas) that are either open or fitted with hand pumps. Many hand-dug shallow wells exist in Kargi area along the luggas; out of 6 wells, only one has a good source of drinking water. The water is used both for domestic purposes and watering livestock.

The peripheral springs appear to have two sources: (1) water confined within the volcanic shield flows radially and downwards away from the summit areas for eventual discharge at the interface of the thin peripheral lavas and underlying sedimentary rocks; and (2) low-pressure artesian water that is held in sedimentary rocks where they are overlain by shields, discharging where the confining volcanic overburden ends (e.g. a spring in Kalacha, Plate 5.13).



**Plate 5.13: Spring water at Kalacha.**

There are two boreholes at Kargi, one is located to the east of the town, dry and abandoned at a depth of 32 metres due to hard rock, while the other one to the west of town has saline water at a depth of 97.5 metres with a tested yield of 10.9m<sup>3</sup>/hr. At Maikona, only one borehole was encountered; this borehole was stopped at a relatively shallow depth (32 m) and has a low yield of good quality groundwater (Plate 5.14).



**Plate 5.14: Shallow well fitted with hand pump and located near Chalbi playa, Maikona Town. Note the ponding of the playa.**

### Relationship to Project and EMP

Due to the scarcity of water resources, TKBV should source its own water supply (e.g. drill a borehole) for the drilling operation and personnel residing in the camp and working within the project area, rather than share an already existing resource with the neighbouring community. Such a borehole will likely need to be supplemented with water trucked in using water bowsers due to the low groundwater yields of already drilled holes and high community sensitivity to alternative uses of the resource for fear of it not being sufficient for their own and livestock requirements. The borehole could be handed over to the neighbouring community at the end of the project. An unlikely potential project impact on water resources (quantity) would be the possible compaction of near-surface aquifers, particularly close to where springs emerge, by heavy vehicles and/or machinery. Compaction would reduce the aquifer storage capacity and transmissivity, resulting in lower yields at the spring outlet.

## 5.2.6 Water Quality

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 site (see Chapter 2) and unplanned leakages of oils and/or chemicals at the drilling rig site.

Baseline water samples were collected for physico-chemical analysis (Table 5.4) at the localities indicated in Figure 5.8 below. Microbiological analysis of both surface and groundwater was not undertaken due to technical logistics relating to sample preservation time (only six hours maximum before they are analysed) and lack of water analytical laboratories in the project area, therefore, only physio-chemical analysis was carried out.

**Table 5.4: Water quality in the project area (BH–Borehole). WHO limits are for drinking water quality. Light grey shaded cells show the limits are exceeded.**

PARAMETERS	Analytical values for water quality parameters			
Lab Sample Nos.	034	033	035	
Source	Maikona B/W	Kargi SW	Kalacha Spring	WHO limits
pH	7.46	7.49	7.6	6.5-8.5
Colour (mgPt/l)	<5	<5	<5	15
Turbidity (NTU)	3	2	2	5
PV (mgO <sub>2</sub> /l)	< 0.4	7.9	0.79	<100
Conductivity (25°C) (µS/l)	81.8	2070	1248	
Fe (mg/l)	< 0.01	<0.01	<0.01	0.3
Mn (mg/l)	< 0.01	<0.01	< 0.01	0.1
Ca (mg/l)	4	264	48	<100
Mg (mg/l)	2.43	34.17	60.8	
Na (mg/l)	9.5	106.2	114	200
K (mg/l)	0.1	1.4	2.2	<10
Total Hardness (mgCaCO <sub>3</sub> /l)	20	800	370	500
Total Alkalinity (mgCaCO <sub>3</sub> /l)	24	80	290	<500
Cl (mg/l)	3	300	120	250
F (mg/l)	0.14	1.0	0.53	1.5
Nitrate (mg/l)	0.98	160	2.1	10
Nitrite (mg/l)	< 0.01	< 0.23	< 0.01	

Sulphate (mg/l)	7.71	231.4	148.6	<b>400</b>
Free Carbon Dioxide (mg/l)	8	12	16	
Total Dissolved Solids (mg/l)	50.7	1283	774	<b>1000</b>

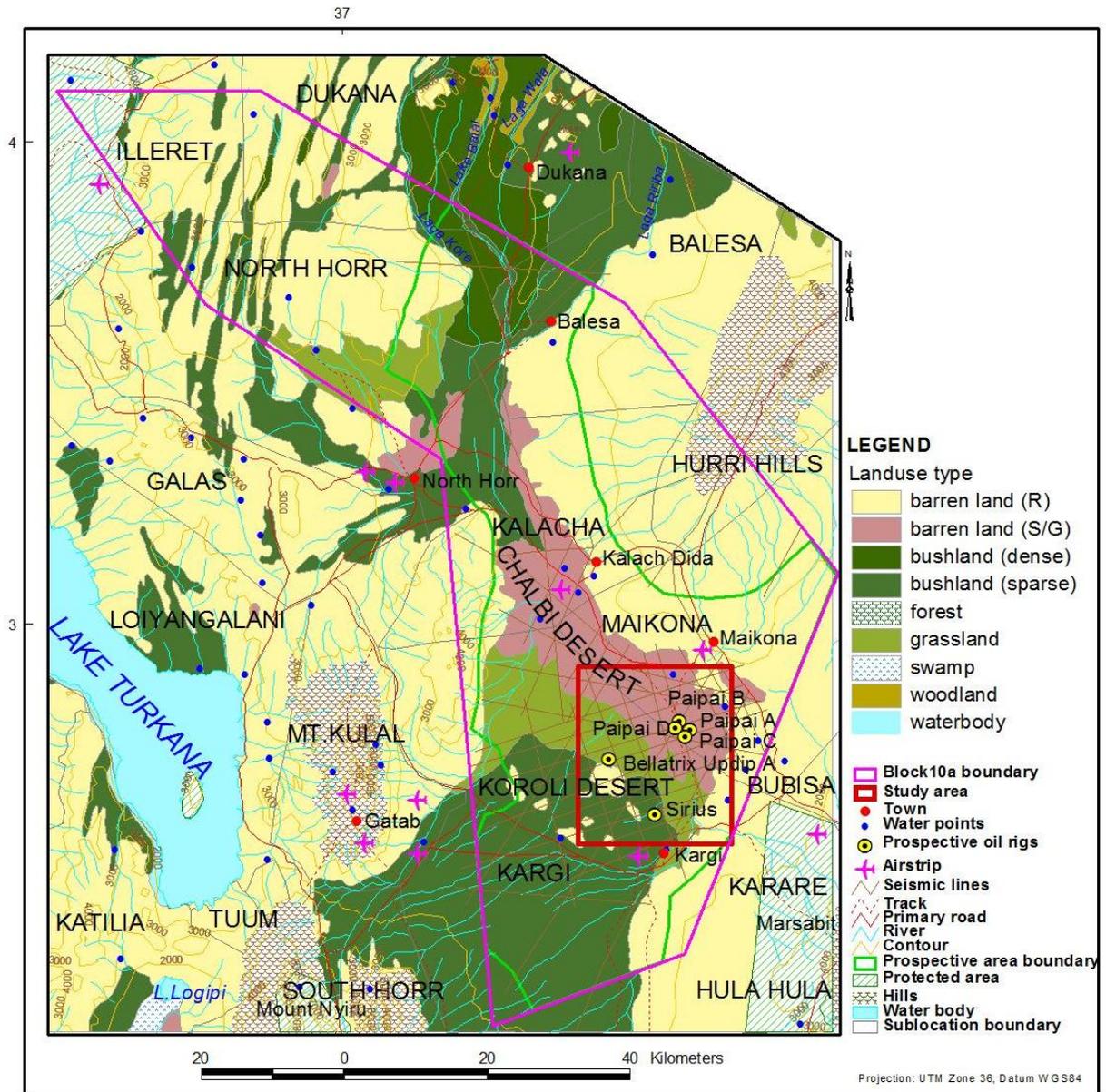
Most of the groundwater in the area is suitable for human consumption except for the shallow well in Kargi which is marginally above WHO limits for Ca, Cl and TDS, and very high above the limits with respect to nitrates (Table 5.4). The nitrate concentration renders this water unfit for human consumption. The high nitrate content in the water of Kargi borehole cannot be explained by contamination by livestock alone: the exploited aquifer may be leaky and interacting with an organic-rich sedimentary rock layer or palaeosol at depth. This water also has an unpleasant and bitter taste, forcing the locals not to use it for domestic purposes but only for watering their livestock.

### 5.2.7 Terrestrial Environment

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

The area belongs to the larger ‘Somali-Masai regional centre of endemism’ ecoregion (northern part of Kenya and south-west Ethiopia) (White, 1983), which is moderately rich in species, but has a low level of endemism. The grasses, shrubs and trees of the ecoregion are fire-tolerant because fires are frequent in the dry season. In years of high rainfall, huge areas of semi-desert annual grasslands are found. *Aristida adscensionis* and *Aristida mutabilis* dominate, but during droughts these species and the grasslands can be absent for many years. The next most extensive vegetation types are dwarf shrublands, dominated by *Duosperma eremophilum* on heavier, wetter sedimentary soils and *Indigofera spinosa* on stabilized dunes (White 1983).

The habitats in Block 10A range from barren landscapes (parts of Maikona, Chalbi and Karoli Deserts), to near-barren landscapes interspersed with pockets of dwarf shrubs and *Acacia* spp in areas such as North Horr, Balesa, Kalacha, Dukana, and Kargi (Figure 5.4). Dense bushland of *Salvadora persica* and *Acacia tortilis* occur in hilly areas of Maikona and Kurkum respectively. The areas of North Horr (Dabandable Hills), Ririma area of Kargi, and Kurkum have sparse bushland habitat types dominated by *Acacia* spp, *Balanites aegyptica*, and/or *Cadaba* sp. Dwarf shrublands of *Indigofera spinosa* and *Euphorbia cuneata* are found in parts of North Horr, Elgade and Balesa. Along the luggas and water courses, there are pockets of riverine woodlands occurring in cohort with shrubs of *Salvadora persica* and *Calotropis procera* (Figure 5.6).



**Figure 5.6: Vegetation map of the project area**

Amongst the animals that can be found in this region are the arid-adapted mammalian fauna which include: Burchell's zebra (*Equus burchelli*), Grevy's zebra (*Equus grevyi* - a species listed by IUCN as endangered), Beisa oryx (*Oryx beisa beisa*, listed by IUCN as of least concern), Grant's gazelle (*Gazella granti*), Topi (*Damaliscus lunatus*), Lion (*Panthera leo*), Cheetah (*Acinonyx jubatus*, Vulnerable), Leopard (*Panthera pardus*), Reticulated giraffe (*Giraffa camelopardalis reticulata*), and Elephant (*Loxodonta africana*). Among the small mammals there is also a near-endemic Gerbil, *Gerbillus pulvinatus*. The populations of large wild mammals are greatly reduced. In particular, the Black rhino (*Diceros bicornis*, critically endangered) used to occur here, but has been exterminated through over-hunting (Boitani, 1999 and East, 1999).

The common terrestrial birds include: Black-faced sandgrouse, Kori bastard, Heuglin's bastard, Black bellied bastard, Helmeted guinea fowl, Vulturine guinea fowl, Taita fiscal, Superb starling,

white crowned starling, Brown necked crow, Mourning dove, White bellied cuckoo, Abyssinian roller, white browed sparrow weaver, crested lark, shinning sunbird, speckled pigeon, Namaqua dove, White headed buffallo weaver, White browed sparrow weaver, Eastern pale chanting goshawk, Sacred ibis, Yellow billed hornbill, Egyptian vulture, Griffon vulture, Lapet faced vulture and Somali ostrich.

### 5.2.7.1 Habitat Types

The habitat types that are outlined in Figure 5.4 were corroborated in the field and are described below.

#### a) Moderately dense bushland - Piedmont plain

This type of habitat was found in areas adjacent to Kargi and areas around the proposed Sirius exploratory well site. The habitat type is primarily composed of woody vegetation that makes up 30% - 50% of the vegetal matter observed. The bushes tended to be less than 2 metres in height with the dominant species being *Balanites glabra*, *Euphorbia cuneata*, *Acacia reficiens*, *Acacia mellifera* and *Commiphora spp.* In addition, the habitat floor is further carpeted with species of *Indigofera spinosa* and *Hirpicum diffusum* dwarf shrubs (Plate 5.15).



**Plate 5.15: A moderately dense bushland next to the proposed Sirius well exploratory site. *Balanites* and *Indigofera* shrubs were the species responsible for stabilizing the dunes.**

#### b) Dense bushland

This type of habitat was found in areas around the Bellatrix proposed exploratory well site area (Plate 5.16). The habitat has a typical composition of numerous low level dunes that are less than a metre in height with shallow interfluves that cross its surface supporting the dense woody growth that is observed in the area. Bushes in the area are generally less than 2 m in height and occupy more than 50% of the habitat area. Major bush species are *Euphorbia cuneata*, *Acacia reficiens*, *Acacia tortilis*, *Commiphora spp* and *Salvadora persica* along the interfluves. In areas that are bare the habitat is carpeted by *Indigofera spinosa*, *Hirpicum*

*diffusum* and *Duosperma spp* dwarf shrubs. Dead trees/shrubs in the area are utilized by the locals for firewood (Plates 5.16 and 5.17).



**Plate 5.16: Dense bushland in Bellatrix.**



**Plate 5.17: Dense bushland in the Bellatrix area. Note the dead logs in the foreground; the local community usually collect the dry logs for firewood.**

## c) Near barren

This habitat type can be found at the proposed Paipai (A, B, C and D) sites, where less than 20% of the landscape has vegetation cover save for perennial *Duosperma spp* dwarf shrubs and annual *Austrostripa* and *Aristida spp* grasses that constitute the vegetal cover that fringes the Chalbi desert (Plate 5.18).



**Plate 5.18: Near barren vegetation at the Chalbi Desert save for the annual grasses growing in the mid and background (Red arrow). The Chalbi Desert did not support rigorous vegetation growth because of its high salinity levels as well as lack of moisture; however during the rainy season the desert would pond with water and support annual vegetation. Note ponding in the background (blue arrow).**

#### Relationship to Project and EMP

Sirius and Bellatrix proposed exploratory well sites are located in areas of relatively dense vegetation, with the majority of the vegetation being less than 2 metres 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. However, at the PaiPai exploratory well sites, the issue of vegetation clearance will not arise as the exploratory well sites are located in the Chalbi Desert which is devoid of vegetation.

The activities of TKBV are not expected to significantly alter the flora of the region as the drilling operation and facilities will be site specific and highly localised (covering not more than 3Ha of land area), and the impacts are expected to be short to medium-term. The area has sound ecosystem integrity, species diversity and is capable of regenerating itself once drilling activities are complete. Where impacts are likely to be severe, it is recommended that TKBV reclaims the land by levelling the land and re-planting indigenous trees.

#### **5.2.7.2 Terrestrial Fauna**

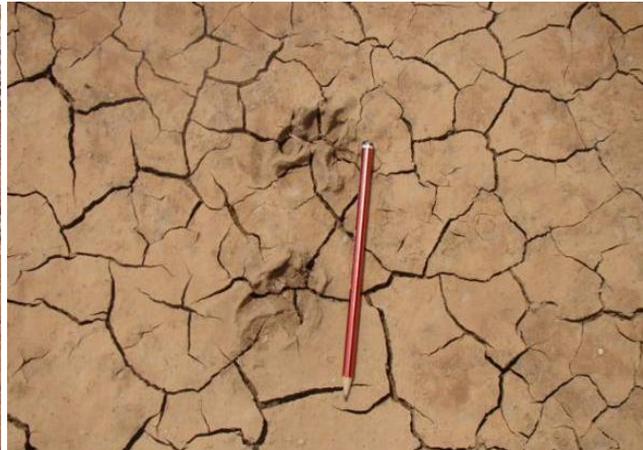
Faunal species that can be found in this ecosystem include the Grevy's zebra which is the biggest and wildest of Africa's three zebra species, and is endemic to northern Kenya and Ethiopia. Their numbers have fallen sharply in recent years - from about 15,000 in the 1970s to an estimated 2,500 in 2005. They are now classified as endangered as a result of habitat loss, competition with livestock, and hunting. The major threats to the ecoregion are overgrazing, habitat modification and insecurity that makes it difficult to carry out conservation and research activities.

### 5.2.7.2.1 Mammals

Many mammals hide or seek shelter during the daylight hours and are therefore hard to see. Signs of their activity, such as footprints and burrows, were observed during the course of this fieldwork. The mammals that can be found in the project area include: Olive baboon (*Papio anubis*), Black backed jackal (*Canis mesomelas*), Guenther's dik dik (*Madoqua quentheri*), Spotted hyaena (*Crocuta crocuta*), Porcupine (*Hystrix cristata*), Grant's gazelle (*Gazzella granti*), Gerenuk (*Litocranius walleri*), Ground squirrels (*Xerus inauris*), Cape hare (*Lepus capensis*), Grevy's Zebra (*Equus grevyi*), Warthog (*Phacochoerus africanus*), Reticulated giraffe (*Giraffa camelopardalis reticulata*), and Beisa oryx (*Oryx gazella beisa*) (Plates 5.19 and 5.20).



**Plate 5.19: Fresh Dik dik midden.**



**Plate 5.20: Silver back jackal footprint in the Chalbi Desert.**

### 5.2.7.2.2 Birdlife

Birdlife in the area is supported by the varied habitats and includes Spotted thick-knee, Spur winged plover, Crowned plover, Egyptian vulture, Lapet faced vulture, Griffon vulture, Brown necked crow, Chestnut sandgrouse, Yellow-billed hornbill, Yellow throated spur fowl, Common bulbul, Egyptian goose, and White-faced whistling duck (Plate 5.21).



**Plate 5.21: Vultures feeding on the carcass of a hyena in the Chalbi Desert and Ostrich foraging.**

### 5.2.7.2.3 Arthropods

Arthropods present represent several orders: Odonata (Dragon flies), Orthoptera (Grasshoppers and Crickets), Isoptera (Termites), Coleoptera (Beetles), Lepidoptera (Butterflies and Moths), Diptera (Flies and Mosquitoes), Hymenoptera (Wasps and Bees), Blattodea (Cockroaches) and Phasmida (Walking sticks). Arachnids present include ticks, spiders and scorpions.

#### Relationship to Project and EMP

TKBV needs to carry out its activity with the mitigations outlined in the EMP in Chp 8 to avoid polluting and modifying the habitat of the endangered Grevy's zebra, the vulnerable Gerenuk, and more generally, that of the ecosystem. Areas of Kalacha Dida and Kalacha Goda springs should be avoided as it supports the endangered Grevy Zebra.

### **5.2.8 Land Resources**

The main land resource in the project area is livestock that forms the backbone of the local people's livelihood. The main livestock in the area are camels, goats, sheep, donkeys, and a few herds of cattle. Water resources are scarce, with certain areas experiencing acute water shortage. Areas like Kalacha and Maikona have adequate supply of water for both domestic and livestock use. Along the luggas in the area, duom palms grow and are used for basketry and thatching temporary houses.

#### Relationship to Project and EMP

The nature and scale of the project will not significantly affect the land resources: Minimal vegetation will be cleared.

### **5.2.9 Archaeological, Historical and Cultural Sites**

The proposed project area is home to the culturally rich Gabra and Rendile communities. The Gabra occupy Dukana, Balesa, North Horr, Kalacha and Maikona area while the Rendille are found in Kargi. While no site has been officially gazetted, there are historical and cultural sites within the block which the communities do not want disturbed. These sites are listed in the Table 5.5 below:

**Table 5.5: Cultural sites within the project area**

AREA	SITE TYPE	IDENTIFICATION CRITERIA/ LOCATION	COMMENTS
1. Kargi	1. Livestock Ritual/ Cleansing Site	Fare and Algas	Livestock are cleansed here to keep off any invaders.  The sites have stacked stones and signify the origin of the Rendille community.
	2. Livestock Watering Point	Koroli Oasis within the Chalbi Desert	This a very important livestock-watering point for the community.
2. General	1. Cultural/Religious (Yaa) Sites	Found on hilly areas only.	Yaa are the community's elders' shrines where the traditional religious elders intercede for the community. Each of the five

			Gabra clans has its shrine. These sites are revered and should not be interfered with. whatsoever.
3. Kalacha Area	Artifact Site (Not gazetted yet)	Afkaba found in a gorge about 12 kilometres from Kalacha town centre	These are community guarded caves that have ancient drawings depicting the origin of the Gabra community.

### 5.2.10 Visual Aesthetics

The project area has an immaculate scenic beauty with ridges and rugged hills, expansive desert and extensive plains, traversed by several sand rivers and streams (luggas). This landscape includes interesting surface exposures of basalts, carbonates and the Dida Galgalla lava plain which forms a volcanic terrace - the Kalacha terrace. Wind deposits in form of sand dunes (barchans) and dust deposits are common on the plains where vegetation cover is sparse or stunted. The presence of birdlife, especially around springs and oases, and wildlife augment the aesthetic effect of the environment.

#### Relationship to Project and EMP

Principles of “green” architecture and eco-friendly technologies and considerations should be employed when setting up the drilling rig and during the entire drilling process.

### 5.2.11 Noise and Vibrations

Ambient noise in the project area is low as it is in a rural setting where there are neither industries nor significant traffic. Prior work in the project area reported noise level variations that ranged between 47.1-89.6 dB which was attributed to fluctuations in wind speeds and lack of vegetation cover (see Block10A seismic survey EIA report of November 2008).

#### Relationship to Project and EMP

Principles of “green” architecture and eco-friendly technologies and considerations should be employed when setting up the drilling rig and during the entire drilling process.

### 5.2.12 Solid and Liquid Wastes

There are no activities within the project area that generate solid waste or oil waste at present. It is however expected that the operations of the company will generate some solid and liquid wastes as described in Chapter Two, section 2.6.2.

#### Relationship to Project and EMP

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

### 5.2.13 Socio-economic Baseline

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

#### 5.2.13.1 Demography

The project area is sparsely populated, being mainly inhabited by nomadic pastoralists from the Gabra, Rendille Burji and Borana communities. Tables 5.6 to 5.7 below show the population distribution for the Marsabit North (Chalbi) and Loiyangalani Districts according to the Kenya National Bureau of Statistics, 2009 (Source: 2009 Kenya Population and Housing Census, KNBS).

**Table 5.6: Population distribution (by district) in the project area district.**

NO.	Districts	Male	Female	Total	Total No. of household	Area in sq. Km.	Density Per Km <sup>2</sup>
1	CHALBI	41,318	33,878	75,195	15,586	39,248.0	2
2	LOIYANGALANI	12,888	13,223	26,111	5,944	11,730.5	2

Source: Population census data, 2009

**Table 5.7: Population distribution (by division) in the project area.**

No.	Divisions	Male	Female	Total	Total household	Area in sq. Km.	Density
1	MAIKONA	10,157	9,068	19,225	3990	9,864.8	2
2	LOIYANGALANI	12,888	13,223	26,111	5,944	11,730.5	2

Source: Population census data, 2009

#### 5.2.13.2 Education

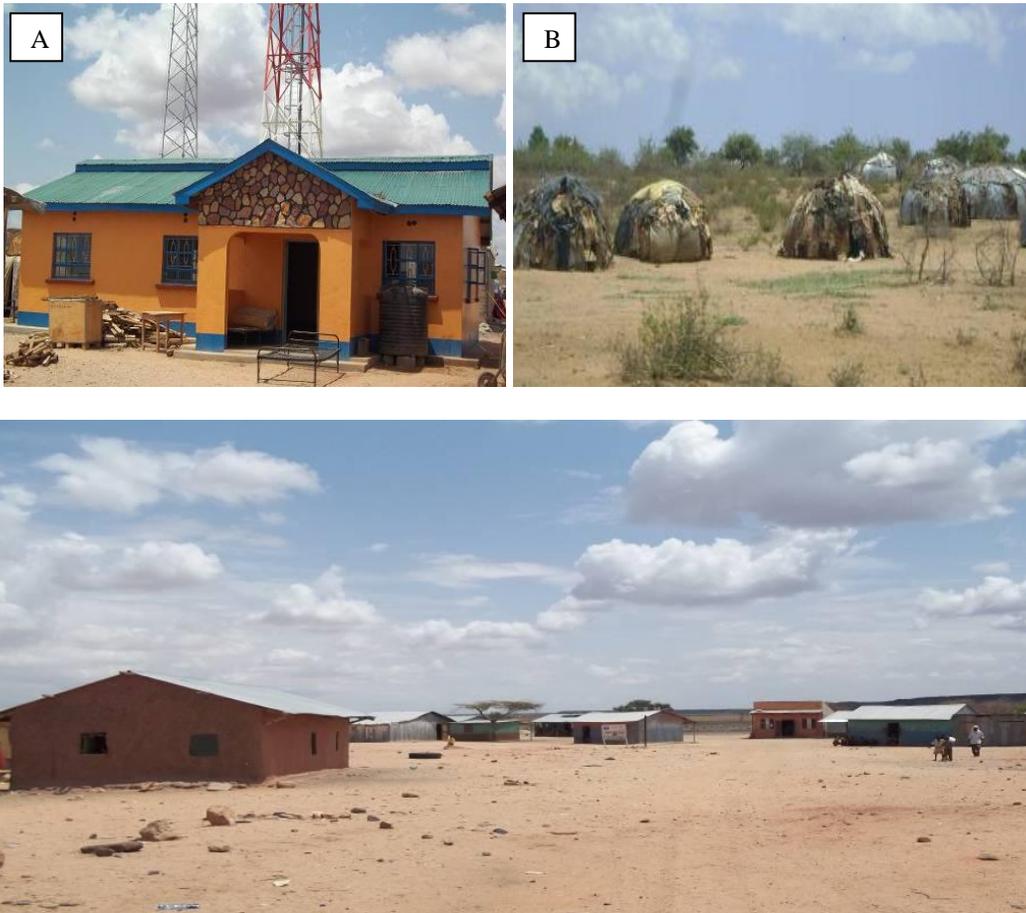
There are few learning institutions within the area. The lack of an adequate infrastructure, the nomadic nature of the population, and the fact that children are often introduced into herding at a young age have all contributed to the very high levels of illiteracy and the situation that most children do not attend school. Non-governmental organizations such as the Catholic Church, in collaboration with the Government, have helped establish learning institutions in areas like Maikona, Kalacha and Kargi. Maikona town has two secondary schools: Maikona Girls Secondary and Bonaya Godana Memorial Boys' Secondary School. There is also a Youth Polytechnic in Kalacha (Plate 5.22).



**Plate 5.22: Schools within the project area.**

### 5.2.13.3 Housing

Permanent houses are mainly concentrated within towns and are used primarily for commercial purposes. There are also semi-permanent and temporary houses in the rural areas (Plate 5.23).



**Plate 5.23: Different housing types in the project area. A – permanent home constructed with stones; B – temporary home constructed with wood and other materials; C – permanent houses for commercial use.**

### **5.2.13.4 Energy Sources**

The main source of energy is wood fuel, which is used by many households in the community (Plate 5.24). Solar energy is utilised by a few households while wind energy is only utilised at the mobile service provider's BTS mast.



**Plate 5.24: Firewood collected for use by the casuals during the EIA study.**

### **5.2.13.5 Land Tenure System**

Most of the land in the area is government owned or trust land. Only a minimal amount of land is privately owned. Most of the land is not utilized due to its rocky nature, but some is used for grazing.

### **5.2.14 Economic Setting**

#### **5.2.14.1 Labour Force**

The area is sparsely populated. Due to low levels of literacy within the area, the available labour force consists mainly of unskilled labourers; most of the locals focus on subsistence livestock as their source of livelihood.

#### **5.2.14.2 Livestock and Crop Production**

Livestock keeping is the main economic activity of the communities in the area (Plate 5.25). The livestock are camels, goats, donkeys, sheep and cattle. Challenges faced by this sector include inadequate pastures and water, mainly due to drought, livestock overgrazing and poor infrastructure, as well as inaccessibility to markets.

Crop production is generally not undertaken in the area due to unfavourable climatic conditions (very hot and dry with minimal unreliable rainfall) . Their nomadic way of life has also contributed to low levels of crop growing.



**Plate 5.25: Watering livestock at Maikona.**

### **5.2.14.3 Health Setting**

The churches together with the government have contributed immensely towards the provision and support of several healthcare facilities in the area like dispensaries (Plate 5.26) which are located in the town centres: Kalacha, Maikona and Kargi dispensaries. However, there is a need to increase health facilities in the area in order to enhance better health and make it possible for residents to have options for medical care.



**Plate 5.26: Dispensary at Maikona.**

### **5.2.15 Security and Public Safety**

There are a few intermittent security incidents in the project area due to conflicts over grazing land, water points and livestock rustling between communities (especially those at the borders). The government has put in place some security measures in the area; there are a number of chiefs' camps and police posts with administration police who have enhanced security.

Although it was not noted during the field study, there are also a good number of locals, some of whom serve as Kenya Police Reservists (KPRs), with weapons.

### 5.2.16 Community Views and Concerns

Several views of the proposed project, both positive and negative, were raised by the community.

#### a) Potential Positive Impacts

1. Temporary job creation: the proposed project will provide the locals with job opportunities
2. Some roads may be improved, thus assisting the transport network
3. The economy in the area will be boosted
4. Drilling of boreholes, thus making additional water available
5. Building of social facilities such as schools and hospitals
6. Availability of food aid in the area
7. Assistance with scholarships and sponsorships for needy students
8. Reduced cost of living
9. Increased small-scale business enterprises in the area

#### b) Potential Negative Impacts

1. Environmental degradation by cutting trees
2. Reduction of grazing land due to project activities
3. Pollution of water and air
4. Imbalances in the sharing of perceived benefits from oil, if found, may lead to insecurity between communities
5. Insufficient community involvement in the proposed project could cause conflict
6. Location of the site could lead to displacement of people
7. People might migrate into the area leading to a population increase
8. Social set up in families may be affected with men moving out of their homes in search of employment

Most of the community concerns are based on perceptions of the potential effects without proper evidence of experience on the ground, as no negative effects were realised during other exploration drilling e.g. Bogal-1 well which was drilled by CNOOC in Isiolo District recently. However, mitigations will be put in place to ensure that both the negative and positive community perceptions are properly managed as laid out in the EMP.

#### Relationship to Project and EMP

The social, cultural, health, and the economic situation in the project area will be given careful thought and consideration during all TKBV relations and communications with the communities within the area. Although the communities have strong social and cultural networks, the area is one of the least developed and isolated regions of Kenya. The communities live in a harsh environment, and are faced with frequent and recurrent droughts, coupled with widespread and frequent water shortages, that make their daily lives very difficult. Almost annually they require relief and emergency services to provide food, healthcare and shelter. Despite these difficult conditions, they do have a pastoral-livestock system, which is unfortunately further challenged by ethnic and cross-border conflicts related to cattle rustling. There are several NGOs active in the area to assist local communities.

### **5.2.17 Corporate Social Responsibility**

The community, through public barazas and questionnaires, requested the company to give consideration to supporting them in the following projects:

- Provision of job opportunities to the locals;
- Building of social amenities such as schools and hospitals;
- Drilling boreholes to enhance availability of water;
- Provision of security in the area during oil exploitation so as to avoid conflict between communities;
- Support for women and youth community based projects.

## 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 for sure whether oil and gas are present, what these quantities are, and whether the hydrocarbons could 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 ALTERNATIVES

The proposed project (described in detail in Chapter 2) entails the drilling of an exploratory well to a depth of approximately 4200 m in Block 10A at one of the six potential locations (Paipai A, Paipai B, Paipai C, Paipai D, Bellatrix and Sirius) identified from seismic data. As per NEMA EIA/EA regulations which require an analysis of alternatives, this report 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, the 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

- In October 2007, Lundin Kenya B.V. signed a Production and Sharing Contract (PSC) with the Kenyan Government for Block 10A and obtained Exclusive Prospecting Rights (EPR) for the Block. Africa Oil acquired the Block from Lundin Kenya B.V. After the Block was acquired by Africa Oil, it sold shares to Tullow Kenya B.V. and EAX (AFREN) respectively, with TKBV assuming the responsibility of operating partner. 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 and Africa Oil in Block 10BB Turkana South and Turkana Central) have shown that impacts are localized and mitigatable;
- The proposed project will be vital in opening up the Northern and 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 revenues (adding to the Gross National Product) and FOREX;
- The project has the possibility for long-term technology and knowledge transfer, bringing economical development and improving the quality of life; and
- No irreversible negative impacts that would render the project unfeasible have been found as a result 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 10A 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 deposit 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 from an environmental point of view.

##### 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, and is more costly than vertical drilling.

The proposed well will be drilled vertically to a target depth of approximately 4,200 m. For this project, a standard medium duty land drilling rig will be used, most likely the Weatherford Rig 804 which will be available in Kenya at the time required. See rig specifications on the following page.



## Rig 804 Medium Duty, 1,500 HP



<b>General Description</b>	
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 .....	1,600 HP
Input power .....	1 x 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/Switch

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

### Well Control

Divterer .....	Not available
Low-pressure annular .....	Not available
Low-pressure ram preventer .....	Not available
High-pressure annular .....	1 x Sheffer, 11 in., 5,000 psi
High-pressure ram preventer .....	1 x Sheffer, type LXT, 11 in., 5,000 psi, double
Choke-end-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 x 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 x Ml 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 500  
Houston, Texas 77027 USA  
Tel: 713-693-4000  
weatherford.com

Weatherford products and services are subject to the Company's standard terms and conditions, available on request or at weatherford.com. For more information contact an authorized Weatherford representative. Unless noted otherwise, trademarks and service marks herein are the property of Weatherford. Specifications are subject to change without notice. Weatherford sells its products and services in accordance with the terms and conditions set forth in the applicable contract between Weatherford and the client.  
© 2008 Weatherford. All rights reserved. 8008.80

## **ii. Drilling fluids selection**

There are two basic types of drilling fluids: water-based muds (WBM) and non-aqueous drilling fluids or non-aqueous muds (NAFs or NAMs). WBM 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 shales) often require the use of NAMs instead of WBM 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. Oil-based mud (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. Synthetic-based muds (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 WBM. Again, these can be prohibitively expensive and are not the mud-system of choice as a result.

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. Campsite design**

The campsite will be built and equipped in such a manner that it can comfortably accommodate up to 150 personnel on site at any one time. It shall be sited (without compromising oil target) and constructed with advice from professional security personnel and local community leaders. It 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 well 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 between 3-4 months, and are considered to be a low impact activity that generally permits the immediate return of the operational site to its previous land use. 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) areas of Kenya, and no adverse or long-lasting impacts have been reported from these activities. All such exploratory oil and gas drilling programme EIA project reports that have previously been submitted have been approved by NEMA.

This Chapter identifies the potential environmental and social impacts of the proposed project, based on the components of the proposed survey (Chapter 2), 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.

#### 7.3 PROJECT ENVIRONMENTAL AND SOCIAL ASPECTS AND POTENTIAL IMPACTS

The components of the exploratory oil and gas well drilling programme 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.	<ul style="list-style-type: none"> <li>▪ Physiography and Geology</li> </ul>	<ul style="list-style-type: none"> <li>• Clearing of access roads using bulldozer</li> <li>• Development of well site</li> </ul>	<ul style="list-style-type: none"> <li>• Access roads to the site leave long-lasting residual impacts (tracks and/or scarring on surface rocks)</li> <li>• Transfer of geological materials (cuttings) from the sub-surface to the surface</li> </ul>
2.	<ul style="list-style-type: none"> <li>▪ Soils</li> </ul>	<ul style="list-style-type: none"> <li>▪ Construction of access road using bulldozers and associated equipment</li> <li>▪ Construction of drill well pad and rig</li> <li>▪ Construction of campsite and associated facilities</li> </ul>	<ul style="list-style-type: none"> <li>▪ Compaction of soils in the working area and access ways changing percolation rates and drainage patterns</li> <li>▪ Disturbance of soil through construction and excavations</li> <li>▪ Possibility of enhanced gulleying and erosion (wind and water) in constructed</li> </ul>

		<ul style="list-style-type: none"> <li>▪ Vehicular movement during project operations</li> <li>▪ Oil or chemical leaks from vehicles and machinery, garage and storage areas</li> <li>▪ Effluent leaks and/or contamination from waste pits</li> <li>▪ Development of well site</li> </ul>	<ul style="list-style-type: none"> <li>area and access roads</li> <li>▪ Rutting in loose soils</li> <li>▪ Contamination of soils</li> <li>▪ 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</li> <li>▪ Disposal of cuttings in soil environment</li> </ul>
3.	<ul style="list-style-type: none"> <li>▪ Air Quality</li> </ul>	<ul style="list-style-type: none"> <li>▪ Power generators and associated machinery</li> <li>▪ Vehicles</li> <li>▪ Sanitary systems</li> <li>▪ Waste disposal points</li> <li>▪ Flaring</li> </ul>	<ul style="list-style-type: none"> <li>▪ Pollution from exhaust emissions</li> <li>▪ Fugitive dust generation from traffic</li> <li>▪ Offensive odours</li> <li>▪ Health risks</li> <li>▪ GHG</li> </ul>
4.	<ul style="list-style-type: none"> <li>▪ Water Quality</li> </ul>	<ul style="list-style-type: none"> <li>▪ Liquid effluent discharges from sanitation systems at the campsite</li> <li>▪ Oil or chemical leaks from garage and storage areas, vehicles and machinery</li> <li>▪ Subsurface circulation of drilling mud</li> <li>▪ Inappropriate waste pit design and waste disposal protocols</li> <li>▪ Accidental discharge of solid and liquid wastes on soil</li> <li>▪ Casing and cementing of the well</li> </ul>	<ul style="list-style-type: none"> <li>▪ Contamination of water supply source for the camp</li> <li>▪ Contamination of underlying aquifers</li> <li>▪ Contamination of surface water</li> </ul>
5.	<ul style="list-style-type: none"> <li>▪ Terrestrial Environment (Habitats, Flora, and Fauna)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Clearing of vegetation for construction of campsite, well pad and other facilities</li> <li>▪ Noise from drilling operations, generators, vehicles and other machinery</li> <li>▪ Presence of the workforce</li> <li>▪ Exotic weed and pest contamination of vehicles and equipment used outside the region and then imported to the project area</li> <li>▪ Development of well site</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reduced vegetation cover</li> <li>▪ Disturbance of wildlife (physical presence and noise)</li> <li>▪ Introduced weeds and pests</li> </ul>
6.	<ul style="list-style-type: none"> <li>▪ Land Resources</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drill rig and ancillary equipment</li> <li>▪ Campsite</li> <li>▪ Vehicles</li> <li>▪ Presence of humans</li> </ul>	<ul style="list-style-type: none"> <li>▪ Man made structures may lower aesthetic value of landscape</li> <li>▪ Disturbance of animals and flora</li> </ul>
7.	<ul style="list-style-type: none"> <li>▪ Archaeological, Historical and Cultural Sites</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drill rig and ancillary equipment</li> <li>▪ Campsite</li> <li>▪ Vehicles</li> <li>▪ Presence of humans</li> </ul>	<ul style="list-style-type: none"> <li>▪ Compaction by heavy vehicles and machinery may damage or deface cultural sites</li> </ul>
8.	<ul style="list-style-type: none"> <li>▪ Visual Aesthetics</li> </ul>	<ul style="list-style-type: none"> <li>▪ Campsite design</li> </ul>	<ul style="list-style-type: none"> <li>▪ Poor campsite design does not blend in with the environment</li> </ul>
9.	<ul style="list-style-type: none"> <li>▪ Noise and Vibrations</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drilling rig and operations</li> <li>▪ Generators</li> <li>▪ Support vehicles</li> </ul>	<ul style="list-style-type: none"> <li>▪ Disturbance to humans, animals and livestock</li> <li>▪ Disturbance to workers</li> <li>▪ Health risks</li> </ul>
10.	<ul style="list-style-type: none"> <li>▪ Solid and Liquid Wastes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drill rig and campsite</li> <li>▪ Workplaces in the field</li> </ul>	<ul style="list-style-type: none"> <li>▪ Pollution of surface soils, waters and groundwaters</li> <li>▪ Offensive odours</li> <li>▪ Health risks</li> <li>▪ Litter</li> </ul>
11.	<ul style="list-style-type: none"> <li>▪ Social Characteristics</li> </ul>	<ul style="list-style-type: none"> <li>▪ Workforce influx.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Possible increase in crime rate</li> </ul>

		<ul style="list-style-type: none"> <li>▪ Activities along the proposed project site</li> </ul>	<ul style="list-style-type: none"> <li>▪ Possible increase in school drop-out by individuals searching for jobs</li> <li>▪ Erosion of culture and social values as a result of intermingling with workers</li> <li>▪ Conflict between community and immigrants</li> <li>▪ Increased pollution: waste and air</li> <li>▪ May interfere with grazing lands</li> </ul>
12.	<ul style="list-style-type: none"> <li>▪ Economic Characteristics</li> </ul>	<ul style="list-style-type: none"> <li>▪ Employment opportunities</li> <li>▪ Tenders and supplies</li> <li>▪ Technology used in the project</li> </ul>	<ul style="list-style-type: none"> <li>▪ Improved livelihood</li> <li>▪ Improved short-term business opportunities for the locals</li> <li>▪ Boost economy</li> <li>▪ Technological installation and advancement</li> </ul>
13.	<ul style="list-style-type: none"> <li>▪ Occupational Health and Safety</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drilling rig site and fieldwork environment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Injuries to workers, visitors and area residents arising from project operations</li> <li>▪ Fire hazard</li> <li>▪ Other health risks such as respiratory diseases due to dust</li> </ul>
14.	<ul style="list-style-type: none"> <li>▪ Security and Public Safety</li> </ul>	<ul style="list-style-type: none"> <li>▪ Workforce influx</li> </ul>	<ul style="list-style-type: none"> <li>▪ Petty crimes</li> <li>▪ Improvement in security due to security enhancement for project activities</li> <li>▪ Acquisition of skills</li> </ul>

## 7.4 IMPACTS ASSESSMENT AND MITIGATION

During the mobilisation (and demobilisation) period, including transportation of materials to (from) the site, accidental spillage of fuel, lubricants, chemicals, etc. may occur, and the mitigation of the potential impacts of these activities are 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.

### 7.4.1 Physiography and Geology

The sites that are being considered for exploratory well drilling are very small in area (less than 3 Ha) and the access road 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. It is important to note that a large portion of the Chalbi Desert is inaccessible during the wet seasons (March to May; October to December) due to flooding. The area is generally a seismic so earthquake risk is very low.

#### **Mitigation:**

- Use existing access roads to the drilling site 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 5.1);
- Avoid oases in the Chalbi Desert by at least a 500m detour to avoid compaction of shallow aquifers that feed them so as not to impact on their yields.

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

#### 7.4.2 Soils

In the areas where the surface soils have high sand content, especially in Ps2+D1 and YV units near Kargi and Kurkum respectively, compaction by vehicles and machinery will be slight. Soils of PI3 unit near Maikona and that form part of the north-western and south-western fringes of the Chalbi Desert 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, 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.

The drainage characteristics of soils with a higher sand content in Ps2+D1 and YV units near Kargi and Kurkum, respectively, are moderate and surface discharge of re-circulated/treated and decontaminated waste water should not affect the soil drainage characteristics adversely, if done in phases to allow percolation into the soil. However, the PI3 soils are poorly drained and surface discharge of water may not be appropriate, as ponding for long periods is normal in these soils. The soils are susceptible to erosion by wind and water: evidence of erosion overwash and ponding has been observed on roadways in the area.

All the soil units are sodic in nature at various thresholds (see Appendix 2) 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/subsidence of soil material. The soils may also be contaminated by (mostly) accidental spillages of liquid effluents, oils, fuels, and chemicals.

#### **Mitigation:**

- Mitigations in section 7.4.1 above apply, and in addition;
- Construct drainage channels on access ways where natural drainage may be affected;
- 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;
- 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 Ps2 +D1 and YV units whose drainage characteristics and soil texture allow for pit establishment. These pits should be lined with suitable PVC geo-membranes since the soils are sodic and may erode easily on contact with water. The PI3 unit is of moderate soil depth and has 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 instead of pits for this particular unit is recommended;
- Pits for containment and/or disposal of drill cuttings, spent drilling fluids, domestic and sanitary effluents should be sited and designed by a competent and licenced contractor and based on consideration of the geological and soil characteristics of the area to avoid soil contamination;
- Well drilling is best carried out during the dry seasons (July to September and December to February) to avoid delays in project operations due to flooding and ponding in the area;
- Ensure that all vehicles and machinery do not have any oil leaks that could contaminate the soils;
- Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available;
- All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures;
- Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks; and
- Installation and proper management of camp sanitation facilities.

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

#### **7.4.3 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, moreso 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 drill site will be in operation 24 hours a day to power the drilling rig. Emissions from the generators will consist mainly of CO<sub>2</sub> and water, and contain traces of NO<sub>x</sub>, SO<sub>2</sub> and suspended particles. The concentration of SO<sub>2</sub> 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.
- 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;
- 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. Volumes of hydrocarbons flared should be recorded; 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.

There shall not be any residual impacts.

**7.4.4 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 oases 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 borehole for use during drilling;
- It is recommended that a policy on efficient water use is drawn up and adopted prior to commencement of the project operations in order to minimise wastage of water during all phases of the project (section 4.2.2);
- The storm water drainage system will be efficiently designed and maintained;
- The company should use proper engineering techniques during the drilling, cementing and casing of the exploratory well;
- Efforts will be made to reduce water requirement, and recycling will be practiced wherever possible; and
- Heavy vehicle and equipment movement to and from the campsite/drilling area should detour known groundwater supply points (e.g. wells, springs, oases) by at least 500m.

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

#### **7.4.5 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 ground water. 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 is 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 potential water pollutants from domestic effluents (section 4.4.3);
- Pits for containment and/or disposal of drill cuttings, spent drilling fluids, domestic and sanitary effluents should be sited by a competent and licenced 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;
- Ensure that all vehicles and machinery operating in the field (and in the campsite) do not have any oil leaks that could contaminate the soils (section 4.3.10);
- 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;
- An efficient sanitation system should be put in place in the campsite to handle effluents (section.4.3.7);
- 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;
- Refuelling areas must be underlain with spill-proof hard-standing or bund, with spill kits readily available and operatives trained in their use;
- 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 daily tool-box talks.

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

#### **7.4.6 Terrestrial Environment (Habitats, Flora, and Fauna)**

The mixture of habitats encountered in Block 10A in areas where TKBV proposes to do exploratory well drilling ranges from near barren landscapes at the Pai Pai A-D sites, through moderately dense bushland in the Sirius site, to dense bushland at the Bellatrix site.

Impacts on habitats will be minimal as they will be constrained to the selected access road and campsite/drilling areas (which have very small (<3Ha) areal extent), and for which appropriate mitigations have been outlined in sections 7.4.1 and 7.4.2 above. Potential impacts to livestock and wildlife could arise due to the physical disturbance (relating primarily to noise, and possible animal-vehicle collisions) during the construction and operation phases. The floral and faunal density of the area is, however, generally low, and the campsite/ drilling area, in terms of size, is an insignificant feature on the landscape that will not obstruct animal movement.

Indirect (secondary and higher order) impacts relating to pollution of the environment and that may thereby impact on fauna and flora are mitigated by the actions outlined in sections 7.4.2, 7.4.5, 7.4.6 above and section 7.4.11 below. However, care needs to be taken to avoid the introduction of invasive species and pests through importation of non-sanitised vehicles and machinery that have been used in other parts of the world.

#### ***Mitigation:***

- Mitigations relating to sections 7.4.1 and 7.4.2 (directly), and 7.4.5, 7.4.6 and 7.4.11 (indirectly) apply;
- Avoid clearing/altering any land unless necessary, e.g. un-vegetated patches can be used for siting of camps and associated facilities; if unavoidable, use best practices that minimise disturbance of the land resources, flora and fauna;
- In areas where vegetation clearing is unavoidable for campsite and drilling facility construction (estimated to be a coverage of not more than 3 Ha), the area should be levelled and restored where appropriate;
- Ensure that equipment are in perfect working order and cause minimal or no noise/air pollution nuisance to fauna.
- Hunting, fishing, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. All workers to be briefed regularly on this issue;
- The risk of introduction of weed and pests species to the region via contaminated vehicles and equipment will be mitigated by the wash-down of all vehicles and ancillary equipment at a designated location prior to mobilisation of vehicles and equipment to the project site.

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

#### **7.4.7 Land Resources**

Pasture and browsing are the major land resource in the area and supports the pastoral lifestyle of the local community.

**Mitigation:**

- Mitigations in sections 7.4.1, 7.4.2, 7.4.4, and 7.4.6 apply.

**7.4.8 Archaeological, Historical and Cultural Sites**

The proposed project area is predominantly home to the culturally rich Gabra and Rendille communities. The Gabra occupy Dukana, Balesa, North Horr, Kalacha and Maikona area while the Rendille are found in Kargi within the block. While no site has been gazetted, there are historical and cultural sites within the block, which the communities would like the exploration activity not to interfere with. There are no documented archaeological sites.

**Mitigation:**

- Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites during the exploration programme 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 historical, or sacred material will not be permitted.

No residual impacts are expected.

**7.4.9 Visual Aesthetics**

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

**Mitigation:**

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

**7.4.10 Noise**

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 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; and
- Engage local leaders in sensitising the communities in the vicinity of the drilling area about the project and its possible noise impacts.

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

#### **7.4.11 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 7.4.5 apply, and in addition;
- 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, solid and liquid wastes generated in the course of rolling out the project should be properly selected, installed, managed and decommissioned according to national legislation, regulations, and international best practices in order to minimise or eliminate their potential environmental impacts;
- 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;
- A Hazardous Materials Management Plan (HMMP) will be developed for the project, 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 bunded;
- 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 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 blackwater will be covered in the waste management plan in order to protect the general health of the workers and the general public;

- Ensure that solid waste is removed from site for recycling/disposal only by an authorised waste handler, ideally a handler licensed under the Waste Management Regulation, 2006;
- Servicing of equipment should be carried out in a designated garage area which has regularly maintained oil drainage traps and readily available spill kits. Workers in this area will be regularly briefed on spill prevention;
- Sound sanitation, solid and liquid waste management will be ensured to influence prevention of outbreak of diseases detrimental to the general health of the workers and the general public; and
- The EHS officer shall consult with the local authorities in Maikona, Kargi and Marsabit to determine where and how the different types of wastes that will be generated during the project can be disposed of.

#### **7.4.12 Social Characteristics**

The local communities are conservative with respect to their culture. Due to influx of many people in the area, both business people and employees, these cultures may be compromised. Owing to poverty levels in the area, school dropout rates may also increase as the students seek to earn an income in order to better their livelihood. The proposed will lead to an improved livelihood through supported social projects such as schools, availability of water through drilling of boreholes, improved medical care in hospitals and increased security, etc. Some of the issues that were raised by the local communities in relation to the project include:

- Displacement residents and loss of grazing land;
- Potential interference with family structures if those employed would be separated from their families during the operations phase of the project;
- Conflict over scarce resources due to influx thus security in the area will be compromised; and
- There will be a new source of income which will substitute their pastoralist way of life.

#### ***Mitigation:***

- Have an ongoing, continual, sensitization of the community on the project objectives, activities and scheduling, and potential impacts. Communication will be essential in carrying out the project activities;
- Awareness campaigns to be undertaken by the proponent both within the local communities and the company employees;
- The company should cooperate and liaise with the government departments in the area and involve also the community members, leaders and elders in the project activities;
- The company employees should respect the local cultures of the community in order to enhance a harmonious relationship;
- The company and the government police department in the area should work together to ensure there is proper security.

#### **7.4.13 Economic Characteristics**

The proposed project area has very minimal economic activity going on. The mainstay economic activity is livestock keeping. The proposed project is anticipated to be of great economic impact in the area as it may offer limited, short-term, unskilled and semi-skilled employment opportunities to the locals. However, the project activity may result in influx of

people from other areas in search of employment and business opportunities and it could lead to recruitment-related conflicts if not properly handled.

Issues attributed to economic impact may include:

- Employment opportunities which will lead to improved livelihood in the area;
- Improved short-term business opportunities for the locals;
- Technological advancement;
- Insecurity; and
- Lack of transparency and discrimination in gender.

***Mitigation:***

- Liaise with local community leaders during the recruitment process;
- A proportion of unskilled and semi-skilled manpower to be sourced locally;
- Gender should be factored into the employment criteria; 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 the potential for short-term employment opportunities and infrastructure improvements if access roads are designed in a manner that they would be useful to the communities post-project.

#### **7.4.14 Occupational Health and Safety**

During the proposed project operation there are several anticipated health and safety hazards relating to the operation of machinery and equipment and their emissions, the dwelling, office and other work environment and wastes generated, and operation and management of various campsite facilities such as storage and garage areas and materials handling.

***Mitigation:***

- All operations will be conducted in compliance with Tullow's EHS policy, international best practices and Kenya Government requirements (as set out in the Occupational Health and Safety Act and the Public Health Act; see also sections 4.3.11 and 4.3.12 of this report);
- All hazardous materials and equipment will be properly labelled and handled only by trained and certified personnel using appropriate and approved safety gear – the contractor shall ensure that the use of such materials and/or equipment is licenced by the relevant Authority, and that all necessary legislation and regulations (both national and international) are adhered to with respect to the import, export, handling and disposal of the materials or equipment;
- 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 4.3.11);
- Job-specific personal protective equipment to be provided to the workers, training should be given, and their use made mandatory in designated areas (section 4.3.9);
- Environmental safety and health regulations and policies/plans must be adhered to (see sections 4.2.4 (Health Policy), 4.3.3 (Energy Act), 4.3.6 (Local Government Act), 4.3.7 (Physical Planning Act), 4.3.10 (Public Health Act), and 4.4 – NEMA Regulations);

- A Camp Clinic is to be provided, manned by suitably qualified field medical staff, licenced 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 17<sup>th</sup> edition regulations; and
- Only properly trained, licenced and authorised employees shall operate equipment or machinery or vehicles.

#### **7.4.15 Security and Public Safety**

There are quite a number of insecurity incidents within the project area due to recurrent conflicts over grazing land and watering points involving the Rendille and Gabra communities.

##### ***Mitigation:***

- Ensure that all workers have staff uniform and badges and are accompanied by a local (tour guide) during operations so as to avoid going to forbidden areas that may bring about conflict;
- Adequate security measures should be provided, like perimeter fencing and manning at the campsites during the day and at night;
- The company should liaise with the Provincial Administration, the Kenya Police, Kenya Police Reservists and other agencies to provide adequate security during the exploratory drill operation.

### **7.5 CUMULATIVE IMPACTS**

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

The areas 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 (<3 Ha) and the associated access road 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 well 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, 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. A borehole drilled recently by the project proponent in Maikona during the seismic survey has improved on this situation at least for this town. 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 gaseous emissions generation 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 the area, and the mitigations that have been proposed.

The scope for cumulative impacts on items or sites of cultural heritage significance remain absent from the proposed activity. Consultation with available heritage databases indicates that no known sites of significance will be impacted by the proposed activity.

## **7.6 SIGNIFICANCE OF IMPACTS**

The exploratory oil and gas well 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 to be taken to complete. 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 (3-5 months) of the exploratory drilling programme and its small scale 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.

**Table 7.2: 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 3.2 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)	<ul style="list-style-type: none"> <li>- Periodic flooding of the Chalbi playa</li> <li>- Active sand dune building and degradation</li> <li>- Periodic ponding of interdune areas</li> </ul>	Medium	Regional	Permanent	Definite	Neutral	High	Low	Low
	Project Operations	<ul style="list-style-type: none"> <li>- Access roads to the site leave long-lasting residual impacts (tracks and/or scarring on surface rocks)</li> </ul>	Low	Site-specific	Long-term	Highly probable	Negative	High	Low	Low
		<ul style="list-style-type: none"> <li>- Transfer of geological materials (cuttings) from the sub-surface to the surface</li> </ul>	Low	Site-specific	Short-term	Definite	Negative	Medium	Low	Low
Climate	Baseline (Pre-project)	<ul style="list-style-type: none"> <li>- Climate change leading to higher frequency and intensity of droughts and floods</li> </ul>	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

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
Surface and groundwater	Baseline (Pre-project)	<ul style="list-style-type: none"> <li>- Freshwater shortage</li> <li>- Uneven distribution of resource</li> <li>- High demand for water resources</li> </ul>	High	Regional	Permanent	Highly probable	Negative	Medium	Low	Low
	Project Operations	<ul style="list-style-type: none"> <li>- Compaction of near-surface aquifers such as springs, reducing yield</li> <li>- Downward draining of groundwater through well drilling</li> <li>- Contamination of water supply source for the camp</li> </ul>	Low	Site-specific to local	Short-term	Improbable	Negative	Medium	Medium	Low
Soils	Baseline (Pre-project)	<ul style="list-style-type: none"> <li>- Soil particulates erosion and deposition generated by wind and enhanced by low vegetation cover</li> <li>- Water ponding and erosion via runoff</li> <li>- Soil compaction by grazing animals and livestock</li> </ul>	Medium	Regional	Long term	Highly probable	Negative	High	Medium	Low

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
	Project Operations	<ul style="list-style-type: none"> <li>- Dust generated by vehicles/machinery movement</li> <li>- Soil compaction by vehicles/machinery</li> <li>- Soil erosion via wind and water through runoff</li> </ul>	medium	Local	medium	probable	Negative	High	Medium	Low
Terrestrial environment	Baseline (Pre-project)	<ul style="list-style-type: none"> <li>- Land degradation from overgrazing</li> <li>- Desertification</li> <li>- Local extinction threat of species</li> </ul>	Low	Local	Permanent	Probable	Negative	Low	Low	Low
	Project Operations	<ul style="list-style-type: none"> <li>- Clearing of vegetation, thereby modifying habitats</li> </ul>	Medium	Local	Long-term	Probable	Negative	Medium	Medium	Low
Water Quality	Baseline (Pre-project)	<ul style="list-style-type: none"> <li>- High sediment loads in rivers</li> <li>- Point-source pollution of springs and wells from stock and locals</li> </ul>	Low	Site-specific to local	Permanent	Probable	Negative	Medium	Low	Low
	Project Operations	<ul style="list-style-type: none"> <li>- Contamination of water supply source for the camp</li> </ul>	Low	Site-specific to local	Short-term	Probable	Negative	Medium	Low	Low
Land resources	Baseline (Pre-project)	<ul style="list-style-type: none"> <li>- Overgrazing</li> </ul>	High	Regional/Local	Long-term	Highly probable	Negative	Medium	High	High

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
	Project Operations	- Loss of pasture	High	Local	Permanent	Probable	Negative	High	Medium	Low
Archaeological, Historical and Cultural Sites	Baseline (Pre-project)	- Loss of cultural and heritage	Medium	Local	Permanent	Highly probable	Negative	High	Low	Low
	Project Operations	- Disturbance to cultural heritage.	Medium	Local	Permanent	Highly probable	Negative	High	Medium	Low
Visual aesthetics	Baseline (Pre-project)	- Land degradation	Medium	Local	Short-term	Probable	Negative	Low	Low	Low
	Project Operations	- Land degradation	Medium	Local	Short-term	Probable	Negative	Low	Medium	Low
Noise	Baseline (Pre-project)	- Natural strong winds - Anthropogenic (but not excessive) noise localised in small towns and centres	Medium	Local	Permanent	Definite	Negative	Low	Medium	Medium
	Project Operations	- Noise from machinery and vehicular movement	Medium	Local	Short-term	Definite	Negative	Low	Medium	Low

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
Liquid and Solid Wastes	Baseline (Pre-project)	- Poor liquid and solid waste management in major centres, e.g. in Maikona and Kargi	Low	Local	Long-term	Highly probable	Negative	Low	Low	Low
	Project Operations	- Poor solid waste management at the drill rig and campsite.	Medium	Local	Short-term	Probable	Negative	Medium	Medium	Low
Social Characteristics	Baseline (Pre-project)	- Low education levels - Low literacy levels - Few health facilities (inadequate, understaffed and under-equipped)	Medium	Local	Long-term	Definite	Negative	Medium	Medium	Medium
	Project Operations	- No facilities will be provided by the proponent	NA	NA	NA	NA	NA	NA	NA	NA
Economic factors	Baseline (Pre-project)	- Few job opportunities - Poor access to markets - Slow economic growth rate	High	Local	Long-term	Definite	Negative	Low	High	High
	Project Operations	- Improved chances of employment - Improved access to markets - Improved economic growth rate	Medium	Local	Long-term	Probable	Positive	Low	High	Low

Parameter assessed		Pressures/Impacts	Intensity	Extent	Duration	Probability	Status	Degree of confidence	Significance without mitigation	Significance with mitigation
Occupational Health and Safety	Baseline (Pre-project)	- None								
	Project Operations	- Accidents - Health related problems	Medium	Local	Short- term	Probable	Negative	Medium	High	Low
Security and public safety	Baseline (Pre-project)	- Frequent cattle rustling - Illegal guns - Resource conflicts -	High	Regional	Long-term	Definite	Negative	High	High	Low
	Project Operations	- Resource conflicts - Illegal guns	Medium	Regional	Short-term	Improbable	Negative	Medium	High	Low

## **CHAPTER 8:**

### **ENVIRONMENTAL MANAGEMENT PLAN**

#### **8.1 INTRODUCTION**

An environmental management plan (EMP) is usually prepared as part of EIA reporting. It serves as a tool to ensure adherence and future compliance with legislation, good environmental performance, and integration of environmental issues into the project decision. The EMP translates recommended mitigation and monitoring measures into specific actions that will be carried out by the proponent. The EMP should contain commitments that are binding on the proponent. It can be translated into project documentation and provide the basis for a legal contract that sets out the responsibilities of the proponent. In turn, the proponent can use the EMP to establish environmental performance standards and requirements for those carrying out the works or providing supplies. An EMP can also be used to prepare an environmental management system for the operational phase of the project.

#### **8.2 OBJECTIVES OF THE EMP**

- The objectives of an EMP should include (Hill, 2000, Lochner, 2005.):
- Ensuring compliance with regulatory authority stipulations and guidelines which may be local, provincial, national and/or international;
- Ensuring that there is sufficient allocation of resources on the project budget so that the scale of EMP-related activities is consistent with the significance of project impacts;
- Verifying environmental performance through information on impacts as they occur;
- Responding to changes in project implementation not considered in the EIA;
- Responding to unforeseen events; and
- Providing feedback for continual improvement in environmental performance.

#### **8.4 BRIEF PROJECT DESCRIPTION**

The proponent, TKBV, is proposing to undertake drilling of an exploratory oil and natural gas well in Block 10A northern Kenya. A large portion of the project area lies within the Chalbi and Karoli Deserts.

Exploratory drilling is a temporary and short duration activity taking between 3 to 4 months under normal conditions. The process involves construction of wells and site facilities; drilling exploration wells to determine whether hydrocarbons are present and to measure the area and thickness of any oil and/or gas bearing reservoir or reservoirs; logging and coring of the well to measure the permeability, porosity, and other properties of the geologic formation(s) encountered; completion of the well should it be deemed capable of producing commercially viable quantities of oil and/or gas; and abandonment of wells deemed incapable of producing commercially viable quantities of oil and/or gas; and finally restoration of the well site after demobilisation of the rig.

The drilling operation is conducted from a drilling rig with the depth of the well determining the size of the drilling rig, the number of employees, and duration of the drilling operation (in

essence, the drilling duration exponentially increases with well depth). The rig is located on the drilling pad., A separate camp, located adjacent to the rig, will provide accommodation, kitchen facilities, sewage processing etc., Power generation, storage areas (for fuel oil, bulk mud and cement, fresh/potable water, liquid mud, dry process materials, drilling water and pipe rack storage), medical and emergency response facilities and secondary operations such as welding, painting, machining will be integral to the rig site

The workforce, who will reside in the separate fully-equipped base camp, will be between 100 and 150 in number. The health and safety of the crew and the general public at large will be ensured by the company in compliance with both with the relevant national legislation, its own in-house environmental health and safety (EHS) policies, international best practices for such activities, and this EMP. A close working relationship will be fostered with the local communities; and as far as is practicable, unskilled and semi-skilled workers shall be recruited locally.

### **8.5 Applicable Legislation and Regulations**

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

- Environmental Management and Co-ordination Act, 1999 and associated regulations and guidelines;
- Petroleum (Exploration and Production) Act, Cap. 308;
- Energy Act, No. 12 of 2006;
- Radiation Protection Act, Cap. 243
- 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.

### **8.6 TKBV Policies and Procedures**

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

### **8.7 ROLES, RESPONSIBILITIES AND TRAINING**

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

TKBV may sub-contract certain aspects of the activities. In such cases, the contractor will be responsible for the implementation and monitoring of the EMP in their related work contract activity (and this condition should be built into the terms of reference for tendered work and the contract document), but the oversight on compliance will rest with TKBV. Each contractor will also be responsible for the occupational health and safety of the workers and others who may be carrying out both related and un-related activities within and around the work sites. With respect to its oversight role, TKBV will be responsible for 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 employees in order to equip them to carry out their duties under the scope of the EMP. Contractors will likewise be required to do the same for their employees and in relation to the work component that they have been given to carry out (see the EMP below). The workers shall be regularly informed on, and assessed for, their understanding of the various policies and plans that relate to their work environment. TKBV will constitute a competent and effective workforce, taking into account the skills required for each work component, and giving priority to the locals for employment opportunities in the semi-skilled and unskilled work categories. Suitable training and skill transfer will be provided, where required.

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

## **8.8 COMMUNICATION WITH STAKEHOLDERS AND GRIEVANCE MECHANISM**

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

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

## **8.9 AUDITING**

It is a requirement by law that any project activity being undertaken be audited each year. The proposed exploratory drilling project is, however, of a much shorter duration. Auditing will, therefore, be done upon completion of the project activities.

Besides the regulatory framework, TKBV and the drilling contractor 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.

## **8.10 THE ENVIRONMENTAL (AND SOCIAL) MANAGEMENT PLAN (EMP) FOR THE PROPOSED OIL AND GAS EXPLORATORY DRILLING PROGRAMME**

The EMP for the exploratory oil and gas well drilling addresses the following components:

- 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:

- 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).
- Identification of Desired Outcomes: The desired outcomes reflect what the project proponent and stakeholders would like to see once the operation has been completed.
- Objective Indicators: The objective indicators indicate how the desired outcomes can be measured, and their success determined (either qualitatively, quantitatively, or both).
- Monitoring: The monitoring aspect is based on assessment of project operations *vis à vis* the Objective Indicators and the Desired Outcome, Responsibilities and Management.

### 8.10.1 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
<ul style="list-style-type: none"> <li>• Access roads to the site leave long-lasting residual impacts (tracks and/or scarring on surface rocks)</li> <li>• Transfer of geological materials (cuttings) from the sub-surface to the surface</li> </ul>	<ul style="list-style-type: none"> <li>• Use existing access roads to the drilling site to the extent possible;</li> <li>• Pre-survey possible access routes, and use the selected route(s) rather than accessing the work site through free-ranging driving across the open country;</li> <li>• Movement of the crews and the vehicles should be restricted to the existing roads and within the operation site to avoid creating unnecessary tracks and trampling of pasture around the drilling site;</li> <li>• Avoid making roads on steep slopes susceptible to rock fall (see Table 5.1);</li> <li>• Avoid oases in the Chalbi Desert by at least a 500m detour to avoid compaction of the shallow aquifers that feed them so as not to impact on their yield.</li> </ul>

<i>Desired Outcomes, Objective Indicators and Monitoring</i>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with mitigation (High, Medium, or Low)
<ul style="list-style-type: none"> <li>▪ Impacts of new access roads minimized to the extent possible</li> <li>▪ Landslips, rock topples and dune interference do not occur in the course of the drilling operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ 100% pre-survey of existing access roads on the ground</li> <li>▪ Actions taken to minimise new access roads impacts are recorded</li> <li>▪ No project-related landslips, dune interference or rock topples recorded</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continuous, daily.</li> <li>▪ One time assessment and site selection</li> </ul>	<ul style="list-style-type: none"> <li>▪ The field operations supervisor will be responsible for the day-to-day monitoring and management, and will report to the Drilling Exploration Manager on a weekly basis, or immediately in case of an incident occurring</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.2 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, garage and storage areas.

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Compaction of soils in the working area and access ways changing percolation rates and drainage patterns</li> <li>▪ Disturbance of soil through construction and excavations</li> <li>▪ Possibility of enhanced gulleying and erosion (wind and water) in constructed area and access roads</li> <li>▪ Rutting in loose soils</li> <li>▪ Contamination of soils</li> <li>▪ 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</li> <li>▪ Disposal of cuttings in soil environment</li> </ul>	<ul style="list-style-type: none"> <li>• Construct drainage channels on access ways where natural drainage may be affected;</li> <li>• 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;</li> <li>• Minimize vegetation clearance as much as possible when clearing the area for well pad and campsite construction;</li> <li>• 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;</li> <li>• The establishment of drill cuttings pits and wastewater pits should be confined to Ps2 +D1 and YV units whose drainage characteristics and soil texture allow for pit establishment. These pits should be lined with suitable PVC geo-membranes since the soils are sodic and may erode easily on contact with water. The PI3 unit is of moderate soil depth and has 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 instead of pits for this particular unit is recommended;</li> <li>• Pits for containment and/or disposal of drill cuttings, spent drilling fluids, domestic and sanitary effluents should be sited and designed by a competent and licenced contractor and based on consideration of the geological and soil characteristics of the area to avoid soil contamination;</li> <li>• Well drilling is best carried out during the dry seasons (July to September and December to February) to avoid delays in project operations due to flooding and ponding in the area;</li> <li>• Ensure that all vehicles and machinery do not have any oil leaks that could contaminate the soils;</li> <li>• Ensure that any in-field refuelling or maintenance is performed while using a drip tray with a spill-kit available;</li> <li>• All fuels and other non-aqueous fluids to be stored in suitable bunded enclosures;</li> <li>• Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks; and</li> <li>• Installation and proper management of camp sanitation facilities.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with mitigation (High, Medium, or Low)
<ul style="list-style-type: none"> <li>▪ Minimal, (if any) , compaction of soils where applicable</li> <li>▪ Minimal disturbance of soils especially on waterways</li> </ul>	<ul style="list-style-type: none"> <li>▪ 100% of existing routes and possible alternatives pre-surveyed on the ground</li> <li>▪ Soils characterized and pre-surveyed on the ground</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continuous, duration of pre-survey route checking, adjusting and opening bypasses where appropriate</li> <li>▪ Pre-survey checking and actual</li> </ul>	<ul style="list-style-type: none"> <li>▪ TKBV EHS field representative will be responsible for the day-to-day monitoring and management, and will</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

<p>and natural drains</p> <ul style="list-style-type: none"> <li>▪ Protection of surface soil from subsidence</li> <li>▪ Zero spillage of chemicals and hazardous material on soils</li> </ul>	<ul style="list-style-type: none"> <li>▪ Appropriate campsites surveyed and selected</li> </ul>	<p>exploratory well site ground truthing</p> <ul style="list-style-type: none"> <li>▪ One time assessment and site selection of base-camp and pit sites</li> <li>▪ Continuous monitoring and safeguard mechanisms established to check spillage</li> </ul>	<p>report to TKBV Operations Manager on a weekly basis, or immediately in case of an incident occurring.</p>	
--	---	--	--	--

### 8.10.3 Air Quality

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

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Pollution from exhaust emissions</li> <li>▪ Fugitive dust generation from traffic</li> <li>▪ Offensive odours</li> <li>▪ Health risks</li> <li>▪ GHG</li> </ul>	<ul style="list-style-type: none"> <li>• Limit traffic speed and restrict movement of vehicles as is reasonable to minimize dust generation;</li> <li>• Field vehicles, trucks and any other machinery should be switched off when not in use;</li> <li>• Regular servicing of all trucks, service vehicles, and any other machinery should be carried out to ensure efficient combustion and minimisation of exhaust emissions;</li> <li>• Use low sulphur fuels if available and where suitable;</li> <li>• Employees working in dusty conditions must use appropriate PPE;</li> <li>• 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;</li> <li>• Installation and proper management of camp sanitation facilities.</li> <li>• 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;</li> <li>• 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. Volumes of hydrocarbons flared should be recorded; and</li> <li>• 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.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
<b>Desired Outcomes</b>	<b>Objective Indicators</b>	<b>Monitoring</b>	<b>Responsibility and Management</b>	<b>Risk with mitigation (High, Medium, Low)</b>
<ul style="list-style-type: none"> <li>▪ Minimal pollution from exhaust emissions</li> <li>▪ Minimal dust generation from traffic</li> <li>▪ No offensive odours</li> <li>▪ No health risks</li> </ul>	<ul style="list-style-type: none"> <li>▪ Number of equipment with low emissions</li> <li>▪ Use of low sulphur versus other fuels</li> <li>▪ Adherence to equipment maintenance schedule</li> <li>▪ Set speed limits are not exceeded (record exceedence incidents)</li> <li>▪ No offensive odours recorded</li> <li>▪ No violation of OHS requirements for dust impact mitigation (violations recorded).</li> </ul>	<ul style="list-style-type: none"> <li>▪ Malfunctioning equipment removed immediately from operations for repair</li> <li>▪ Compliance with use of low sulphur fuel (fuel supply tenders)</li> <li>▪ Speed limit violations based on speed-tracking devices in vehicles, monitored at base camp</li> <li>▪ Daily inspection of sanitary facilities and waste disposal points</li> <li>▪ Continuous</li> </ul>	<ul style="list-style-type: none"> <li>▪ The field operations supervisor will be responsible for the day-to-day monitoring and management of air quality issues in the field, while the camp supervisor will be responsible for monitoring the air quality at and around the campsite. The field operations supervisor and the camp supervisor will report to the Operations Manager on a weekly basis, and will immediately report on health risk incidents.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

#### 8.10.4 Surface and Groundwater Resources

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

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Conflict with neighbouring communities if water source is shared</li> <li>▪ Compaction of near-surface aquifers hence reducing yield</li> <li>▪ Downward draining of groundwater through exploratory well drilling</li> <li>▪ Liquid effluent discharges from sanitation systems at the campsite</li> <li>▪ Oil or chemical leaks from garage and storage areas, vehicles and machinery</li> <li>▪ Unorganized disposal of drilling waste and mud in a disposal facility</li> </ul>	<ul style="list-style-type: none"> <li>▪ The company should consider drilling its own water supply borehole and hand this over to the community once the drilling operation is completed.</li> <li>▪ It is recommended that an efficient water-use policy be adopted by the project proponent at the camp base and drilling site and other work areas (section 4.4.3)</li> <li>▪ An efficient sanitation system should be put in place in the base camp and drilling operation site to handle effluents (section.4.3.8)</li> <li>▪ Buffer zones of 300m will be maintained between cut lines and water sources such as wells and springs (sections 4.3.10, 4.4.3)</li> <li>▪ Ensure proper spill control and management at site</li> <li>▪ Proper engineering techniques during the drilling, cementing and casing of the exploratory wells</li> <li>▪ All chemical and fuel storage areas will have proper bunds so that contaminated run-off cannot meet the storm-water drainage system</li> <li>▪ Luggas should be crossed at road-crossings, where such crossings exist to avoid drainage contamination particularly during rainy seasons</li> <li>• 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.</li> <li>• The storm water system will be efficiently designed and maintained.</li> <li>• All chemical and fuel storage areas will have proper bunds so that contaminated run-off cannot meet the storm-water drainage system.</li> <li>• The company should use proper engineering techniques during the drilling, cementing and casing of the exploratory wells.</li> <li>• The company should ensure proper spill control and management at site.</li> <li>• Efforts will be made to reduce water requirement, and recycling will be practiced wherever possible.</li> <li>• 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.</li> <li>• Ensure that all vehicles and machinery operating in the field and at drilling operation sites do not have any oil leaks that could contaminate the soils.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with mitigation (High, Medium, or Low)
<ul style="list-style-type: none"> <li>▪ No conflict over water use with neighbouring</li> </ul>	<ul style="list-style-type: none"> <li>▪ TKBV has its own water</li> </ul>	<ul style="list-style-type: none"> <li>▪ Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>▪ The field operations supervisor will be responsible</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

<p>communities</p> <ul style="list-style-type: none"> <li>▪ No compaction of near surface aquifers</li> <li>▪ No unorganized disposal of drilling waste</li> <li>▪ No waste and mud in a disposal facility</li> <li>▪ No oil or chemical leaks from garage and storage areas, vehicles and machineries.</li> <li>▪ No downward draining of groundwater through drill holes</li> </ul>	<p>borehole or other independent water source</p> <ul style="list-style-type: none"> <li>▪ Identification of nearby surface and groundwater resources</li> <li>▪ No violation of buffer zone limits around groundwater sources</li> <li>▪ Water yields do not decrease</li> <li>▪ Inventory of drill well is maintained</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continuous, during drilling operation</li> <li>▪ Compliance with buffer zone requirements</li> <li>▪ Weekly monitoring of yields</li> <li>▪ Continuous, during line survey</li> <li>▪ Compliance with buffer zone requirements</li> <li>▪ Weekly monitoring of yields for a period of 4 weeks</li> </ul>	<p>for the day-to-day monitoring and management of surface and groundwater resources in the field, while the base camp supervisor will be responsible for water monitoring at and around the campsite. The field operations supervisor and the camp supervisor will report to the Operations Manager on a weekly basis, and will immediately report on incidents of concern.</p>	
---	--	---	--	--

### 8.10.5 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
<ul style="list-style-type: none"> <li>▪ Contamination of water supply source for the camp</li> <li>▪ Contamination of underlying aquifers</li> <li>▪ Contamination of surface water</li> </ul>	<ul style="list-style-type: none"> <li>• An efficient sanitation system should be put in place for camp workers to eliminate or minimise the levels potential water pollutants from domestic effluents (section 4.4.3);</li> <li>• Pits for containment and/or disposal of drill cuttings, spent drilling fluids, domestic and sanitary effluents should be sited by a competent and licenced contractor and based on consideration of the geological and soil characteristics of the area to avoid contamination of nearby surface and ground water systems;</li> <li>• All chemical and fuel storage areas should be bunded;</li> <li>• Ensure that all vehicles and machinery operating in the field (and in the campsite) do not have any oil leaks that could contaminate the soils (section 4.3.10);</li> <li>• The company should use proper engineering techniques during the drilling, cementing and casing of the exploratory well;</li> <li>• Fuelling will take place in a designated area;</li> <li>• An efficient sanitation system should be put in place in the campsite to handle effluents (section.4.3.7);</li> <li>• 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;</li> <li>• Ensure that all vehicles and machinery operating in the field and at drilling operation sites do not</li> </ul>

	<p>have any oil leaks;</p> <ul style="list-style-type: none"> <li>• Refuelling areas must be underlain with spill-proof hard-standing or bund, with spill kits readily available and operatives trained in their use;</li> <li>• All refuelling operations to be carefully overseen and managed;</li> <li>• Ensure that all drivers and technicians are familiar with drip-tray and spill-kit use through daily tool-box talks.</li> </ul>
--	--

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
<b>Desired Outcomes</b>	<b>Objective Indicators</b>	<b>Monitoring</b>	<b>Responsibility and Management</b>	<b>Risk with mitigation (High, Medium, Low)</b>
<ul style="list-style-type: none"> <li>▪ No contamination of water supply source for the camp</li> <li>▪ No contamination of underlying aquifers in the project area</li> </ul>	<ul style="list-style-type: none"> <li>▪ Camp water supply source is fit for human consumption</li> <li>▪ Camp water supply source is protected</li> <li>▪ Zero spillage of chemicals and hazardous material on soils that may lead to surface/groundwater pollution</li> <li>▪ Waste pits and landfills are professionally sited</li> <li>▪ Buffer zones are observed</li> </ul>	<ul style="list-style-type: none"> <li>▪ Physico-chemical and microbiological testing, weekly</li> <li>▪ Casing and cementing of borehole and wellhead area</li> <li>▪ Protocols for and conditions of oils and chemicals storage at the camp are adhered to</li> <li>▪ Professional recruited for the work</li> <li>▪ Compliance with buffer zone requirements</li> </ul>	<ul style="list-style-type: none"> <li>▪ The field operations supervisor will be responsible for the day-to-day monitoring and management of actions to protect water quality in the field, while the camp supervisor will be responsible for such actions at and around the campsite. The field operations supervisor and the camp supervisor will report to the Operations Manager on a weekly basis, and will immediately report on incidents of concern.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.6 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
<ul style="list-style-type: none"> <li>▪ Reduced vegetation cover</li> <li>▪ Disturbance of wildlife (physical presence and noise)</li> <li>▪ Introduced weeds and pests</li> </ul>	<ul style="list-style-type: none"> <li>▪ Avoid clearing/altering any land unless necessary, e.g. un-vegetated patches can be used for siting of camps and associated facilities; if unavoidable, use best practices that minimise disturbance of the land resources, flora and fauna;</li> <li>▪ In areas where vegetation clearing is unavoidable for campsite and drilling facility construction (estimated to be a coverage of not more than 3 Ha), the area should be levelled and restored where appropriate;</li> <li>▪ Ensure that equipment are in perfect working order and cause minimal or no noise/air pollution nuisance to fauna.</li> <li>▪ Hunting, fishing, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. All workers to be briefed regularly on this issue;</li> <li>▪ The risk of introduction of weed and pests species to the region via contaminated vehicles and equipment will be mitigated by the wash-down of all vehicles and ancillary equipment at a designated location prior to mobilisation of vehicles and equipment to the project site.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility Management and	Risk with mitigation (High, Medium, or Low)
<ul style="list-style-type: none"> <li>▪ Minimal cutting of vegetation for construction purposes</li> <li>▪ Minimal disturbance of wildlife</li> <li>▪ No weeds or pests introduced into the area</li> <li>▪ Minimal contamination of the environment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Construction of base, fly camp and derrick assembly installation where minimal or no vegetation clearance is required.</li> <li>▪ Number of wildlife encounters and actions taken recorded</li> <li>▪ All equipment (vehicles and vessels) are washed down and biofouling removed before being taken to the project area</li> <li>▪ 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</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continuous, during base camp, fly camp and derrick assembly preparation</li> <li>▪ Continuous, during well drilling</li> <li>▪ Inspection and certification</li> </ul>	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.7 Land Resources

The impact sources from the project operations will include: well pad, drilling rig, access roads, ancillary facilities, communication facilities (e.g. antennas), and power generation and transmission facilities.

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Man made structures may lower aesthetic value of landscape</li> <li>▪ Disturbance of animals and flora</li> </ul>	<ul style="list-style-type: none"> <li>▪ Refer to sections 8.10.1 ( Physiography and Geology), 8.10.2 (soils), 8.10.5 (Surface and ground water) and 8.1.6 (Terrestrial Environment).</li> </ul>

<i>Desired Outcomes, Objective Indicators and Monitoring</i>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with mitigation (High, Medium, or Low)
<ul style="list-style-type: none"> <li>▪ Animal encounters minimised</li> <li>▪ Pastoralist activities are only minimally disrupted</li> <li>▪ Other desired outcomes relate to the following sections: Soils (8.10.2), Terrestrial Environment (8.10.6)</li> </ul>	<ul style="list-style-type: none"> <li>▪ No animal encounters recorded</li> <li>▪ No complaints from pastoralists</li> <li>▪ Objective indicators for Soils and Terrestrial Environment are met</li> </ul>	<ul style="list-style-type: none"> <li>▪ Monitoring of animal presence along survey routes</li> <li>▪ Information outflow to the affected communities on seismic line survey schedules and exclusion time periods</li> <li>▪ Adhering to the use of existing routes and road network</li> <li>▪ Enforcing policy against hunting and gathering through training and direct supervision where applicable</li> </ul>	<ul style="list-style-type: none"> <li>▪ The field operation supervisors should ensure that hunting animals and gathering of indigenous roots/berries or other edible plant material while undertaking the project should be prohibited.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.8 Archaeological, Historical and Cultural Sites

The impact sources from the project operations will include: well pad, drilling rig, access roads, ancillary facilities, communication facilities (e.g. antennas), and power generation and transmission facilities.

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Compaction by heavy vehicles and machinery may damage or deface cultural sites</li> <li>▪ Digging and drilling?</li> </ul>	<ul style="list-style-type: none"> <li>• Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites during the exploration programme in order to prevent conflict with the community;</li> <li>• All project field workers must be informed, before commencement of operations, that any disturbance to, defacement of, or removal of historical, or sacred material will not be permitted.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with Mitigation (High, Medium or Low)
<ul style="list-style-type: none"> <li>▪ Negligible interference, if any, with historical and cultural sites</li> <li>▪ Desired Outcomes for Soils (section 8.10.2) apply</li> </ul>	<ul style="list-style-type: none"> <li>▪ No violations of buffer zone restrictions</li> <li>▪ The sites are flagged for avoidance</li> <li>▪ Objective indicators for section 8.10.2 are met</li> </ul>	<ul style="list-style-type: none"> <li>▪ Buffer zones are adhered to</li> <li>▪ Flagging is done and cleared once the work is completed</li> <li>▪ Cultural sites are not interfered with</li> </ul>	<ul style="list-style-type: none"> <li>▪ The field operations supervisor shall be responsible for ensuring that cultural sites are not disturbed, and that all the workers are aware of the locations of the site.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.9 Visual Aesthetics

The impact sources from the project operations will include drill rig and campsite design.

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Poor drill rig and campsite design does not blend in with the environmental</li> <li>▪ Vegetation cover removal lowers aesthetic value of landscape</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drill rig and campsite design should take into consideration the aesthetics of the selected area.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
<b>Desired Outcomes</b>	<b>Objective Indicators</b>	<b>Monitoring</b>	<b>Responsibility and Management</b>	<b>Risk with Mitigation (High, Medium or Low)</b>
<ul style="list-style-type: none"> <li>▪ Drill rig and campsite blends well with environment</li> <li>▪ Visual aesthetics maintained by minimising vegetation removal and proper design of access roads</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drill rig and campsite design is aesthetic</li> <li>▪ Residual impacts of access road and vegetation clearing minimized (sections 8.10.1, 8.10.2 and 8.10.6 apply)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Drill rig and camp constructed according to design</li> <li>▪ Physiography and Geology, Soils and Vegetation sections apply (sections 8.10.1, 8.10.2 and 8.10.6)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Maintenance of visual aesthetics will be the responsibility of the explorations manager. The camp site design and architecture should incorporate “green” principles and eco-friendly technologies</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.10 Noise

The impact sources from the project operations will include: generators, drilling and drill pipes, and support vehicles.

<b>Potential Impacts</b>	<b>Mitigation</b>
<ul style="list-style-type: none"> <li>▪ Disturbance to humans, animals and livestock</li> <li>▪ Disturbance to workers</li> <li>▪ Health risks</li> </ul>	<ul style="list-style-type: none"> <li>• 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 for all operations in accordance with the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations;</li> <li>• 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;</li> <li>• Workers should be sensitized on noise-related and other hazards likely to be encountered in such a work environment, and trained accordingly; and</li> <li>• Engage local leaders in sensitising the communities in the vicinity of the drilling area about the project and its possible noise impacts.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
<b>Desired Outcomes</b>	<b>Objective Indicators</b>	<b>Monitoring</b>	<b>Responsibility and Management</b>	<b>Risk with Mitigation (High, Medium or Low)</b>
<ul style="list-style-type: none"> <li>▪ Ambient noise levels maintained</li> </ul>	<ul style="list-style-type: none"> <li>▪ Equipment installed to monitor noise (e.g. dosimeter)</li> <li>▪ Regularly serviced and efficient vehicle engines</li> <li>▪ “Quiet” machinery e.g. generators, purchased</li> </ul>	<ul style="list-style-type: none"> <li>▪ Review of design parameters, as needed</li> <li>▪ Monitor installed equipment</li> <li>▪ Servicing work and schedules</li> <li>▪ Requirement embedded in tendering of equipment documents, inspect as needed</li> </ul>	<ul style="list-style-type: none"> <li>▪ The Drilling Superintendent will be responsible for ensuring the mitigation of noise</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.11 Solid and Liquid Wastes

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

<b>Potential Impacts</b>	<b>Mitigation</b>
<ul style="list-style-type: none"> <li>▪ Pollution of surface soils, waters and groundwaters</li> <li>▪ Offensive odours</li> <li>▪ Health risks</li> <li>▪ Litter</li> </ul>	<ul style="list-style-type: none"> <li>• Mitigations relating to section 7.4.5 apply, and in addition;</li> <li>• 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);</li> <li>• 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 national legislation, regulations, and international best practices in order to minimise or eliminate their potential environmental impacts;</li> <li>• 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;</li> <li>• A Hazardous Materials Management Plan (HMMP) will be developed for the project, 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;</li> <li>• The structural integrity of containment pits for drill cuttings, drilling fluids, mud pits and water storage</li> </ul>

	<p>reservoirs should be ensured – such pits should be appropriately banded;</p> <ul style="list-style-type: none"> <li>• 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 for dust suppression on access roads. Disposal of chemicals and motor oil should be documented, including quantities involved and disposal locations;</li> <li>• 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;</li> <li>• Hygienic sanitation and disposal of grey and blackwater will be covered in the waste management plan in order to protect the general health of the workers and the general public;</li> <li>• Ensure that solid waste is removed from site for recycling/disposal only by an authorised waste handler, ideally a handler licensed under the Waste Management Regulation, 2006;</li> <li>• Servicing of equipment should be carried out in a designated garage area which has regularly maintained oil drainage traps and readily available spill kits. Workers in this area will be regularly briefed on spill prevention;</li> <li>• Sound sanitation, solid and liquid waste management will be ensured to influence prevention of outbreak of diseases detrimental to the general health of the workers and the general public; and</li> <li>• The EHS officer shall consult with the local authorities in Maikona, Kargi and Marsabit to determine where and how the different types of wastes that will be generated during the project can be disposed of.</li> </ul>
--	--

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
<b>Desired Outcomes</b>	<b>Objective Indicators</b>	<b>Monitoring</b>	<b>Responsibility and Management</b>	<b>Risk with Mitigation (High, Medium or Low)</b>
<ul style="list-style-type: none"> <li>▪ No pollution of surface soils, water and groundwater</li> <li>▪ No offensive odours</li> <li>▪ No health risks</li> </ul>	<ul style="list-style-type: none"> <li>▪ No leakages of oils, chemicals or sewage and other domestic effluents reported</li> <li>▪ Sanitary systems are working and no breakdowns reported</li> <li>▪ Hazardous wastes (e.g. medical and chemical wastes) are properly disposed of</li> <li>▪ Appropriate use of personal protective equipment when and where mandatory</li> </ul>	<ul style="list-style-type: none"> <li>▪ Storage rooms are secure and accessed only by authorised personnel, daily</li> <li>▪ Work areas are secure and accessed only by authorised personnel, daily</li> <li>▪ Material storage containers checked for leaks daily</li> <li>▪ Daily checks on sanitary systems</li> <li>▪ Adherence to OHS policy and use of PPEs</li> </ul>	<ul style="list-style-type: none"> <li>▪ An EHS officer will be responsible for management of solid and liquid waste at the drilling rig and camp site.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.12 Social Characteristics

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

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Possible increase in crime rate</li> <li>▪ Possible increase in school drop-out by individuals searching for jobs</li> <li>▪ Erosion of culture and social values as a result of intermingling with workers</li> <li>▪ Conflict between community and immigrants</li> <li>▪ Increased pollution: waste and air</li> <li>▪ May interfere with grazing lands</li> </ul>	<ul style="list-style-type: none"> <li>• Displacement residents and loss of grazing land;</li> <li>• Potential interference with family structures if those employed would be separated from their families during the operations phase of the project;</li> <li>• Conflict over scarce resources due to influx thus security in the area will be compromised; and</li> <li>• There will be a new source of income which will substitute their pastoralist way of life.</li> </ul>

<i>Desired Outcomes, Objective Indicators and Monitoring</i>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with Mitigation (High, Medium or Low)
<ul style="list-style-type: none"> <li>▪ Decrease in crime rates and no school drop-outs</li> <li>▪ Preservation of cultural and social values</li> <li>▪ Protection of grazing lands and watering points</li> </ul>	<ul style="list-style-type: none"> <li>▪ No violations of Tullow CSR policy</li> <li>▪ No complaints from the locals on cultural or social values, concerns relating to the workers</li> <li>▪ Relates to Soils (8.10.2) and Surface and Groundwater Resources (8.10.4) sections</li> </ul>	<ul style="list-style-type: none"> <li>▪ Awareness of Tullow CSR policies by workforce</li> <li>▪ Grievance mechanism in place and implemented</li> <li>▪ Related monitoring aspects are being undertaken</li> </ul>	<ul style="list-style-type: none"> <li>▪ 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.</li> <li>▪ A liaison officer should be responsible for implementation of the grievance mechanism.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.13 Economic Characteristics

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

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Improved livelihood</li> <li>▪ Improved short-term business opportunities for the locals</li> <li>▪ Boost economy</li> <li>▪ Technological installation and advancement</li> </ul>	<ul style="list-style-type: none"> <li>• Liaise with local community leaders during the recruitment process;</li> <li>• A proportion of unskilled and semi-skilled manpower to be sourced locally;</li> <li>• Gender should be factored into the employment criteria; and</li> <li>• Sustained public awareness and sensitization about the proposed project should be continued throughout the project lifespan.</li> </ul>

<i>Desired Outcomes, Objective Indicators and Monitoring</i>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with Mitigation (High, Medium or Low)
<ul style="list-style-type: none"> <li>▪ Improved economy and living standards</li> </ul>	<ul style="list-style-type: none"> <li>▪ Number of locals recruited</li> <li>▪ Number and type of CSR projects that TKBV commits to</li> <li>▪ Establishment of recruitment and tender committees</li> </ul>	<ul style="list-style-type: none"> <li>▪ As needed</li> </ul>	<ul style="list-style-type: none"> <li>▪ The project management should ensure community involvement in the establishment of recruitment and committees to check on work influx, gender balance and potential conflict areas.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.14 Occupational Health and Safety

The impact sources from the project operations will include the drill rig and campsite.

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Injuries to workers, visitors and area residents arising from project operations</li> <li>▪ Fire hazard</li> <li>▪ Other health risks such as respiratory diseases due to dust</li> </ul>	<ul style="list-style-type: none"> <li>• All operations will be conducted in compliance with Tullow’s EHS policy, international best practices and Kenya Government requirements (as set out in the Occupational Health and Safety Act and the Public Health Act; see also sections 4.3.11 and 4.3.12 of this report);</li> <li>• All hazardous materials and equipment will be properly labelled and handled only by trained and certified personnel using appropriate and approved safety gear – the contractor shall ensure that the use of such materials and/or equipment is licenced by the relevant Authority, and that all necessary legislation and regulations (both national and international) are adhered to with respect to the import, export, handling and disposal of the materials or equipment;</li> <li>• 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 4.3.11);</li> <li>• Job-specific personal protective equipment to be provided to the workers, training should be given, and their use made mandatory in designated areas (section 4.3.9);</li> <li>• Environmental safety and health regulations and policies/plans must be adhered to (see sections 4.2.4 (Health Policy), 4.3.3 (Energy Act), 4.3.6 (Local Government Act), 4.3.7 (Physical Planning Act), 4.3.10 (Public Health Act), and 4.4 – NEMA Regulations);</li> <li>• A Camp Clinic is to be provided, manned by suitably qualified field medical staff, licenced as appropriate to operate in-country, equipped with equipment and medication as appropriate, including ambulance vehicle(s);</li> <li>• Adequate warning or cautionary signage will be posted as required;</li> <li>• All electrical equipment shall be properly installed earthed and regularly inspected and where practicable will comply with IEE 17<sup>th</sup> edition regulations; and</li> <li>• Only properly trained, licenced and authorised employees shall operate equipment or machinery or vehicles.</li> </ul>

<b>Desired Outcomes, Objective Indicators and Monitoring</b>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with Mitigation (High, Medium or Low)
<ul style="list-style-type: none"> <li>▪ Prevent workers and/or visitors from possible injuries/harm and health-related risks</li> </ul>	<ul style="list-style-type: none"> <li>▪ 100% use of personal protective equipment (PPE) when and where required</li> <li>▪ Caution signage placed visibly in required places</li> <li>▪ Training and drills on health and safety issues in the workplace, including fire-fighting</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continuous monitoring and recording of incidences under each work component section</li> </ul>	<ul style="list-style-type: none"> <li>▪ The project management should ensure all the protocols relating to environmental health and safety, and occupational health and safety policies are adhered to. Frequent training programs on first aid fire-drills and other related health issues should be a prerequisite.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

### 8.10.15 Security and Public Safety

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

Potential Impacts	Mitigation
<ul style="list-style-type: none"> <li>▪ Petty crimes</li> <li>▪ Improvement in security due to security enhancement for project activities</li> <li>▪ Acquisition of skills</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that all workers have staff uniform and badges and are accompanied by a local (tour guide) during operations so as to avoid going to forbidden areas that may bring about conflict;</li> <li>• Adequate security measures should be provided, like perimeter fencing and manning at the campsites during the day and at night;</li> <li>• The company should liaise with the Provincial Administration, the Kenya Police, Kenya Police Reservists and other agencies to provide adequate security during the exploratory drill operation.</li> </ul>

<i>Desired Outcomes, Objective Indicators and Monitoring</i>				
Desired Outcomes	Objective Indicators	Monitoring	Responsibility and Management	Risk with Mitigation (High, Medium or Low)
<ul style="list-style-type: none"> <li>▪ No security-related incidents</li> <li>▪ Adequate security for the workforce</li> </ul>	<ul style="list-style-type: none"> <li>▪ Number of security-related incidents recorded</li> </ul>	<ul style="list-style-type: none"> <li>▪ Continuous monitoring and recording of incidences</li> </ul>	<ul style="list-style-type: none"> <li>▪ The involvement of government agencies during the project operations may enhance long-term security initiatives from the concerned parties, hence improving the security situation in the area. Security issues should be the overall responsibility of the exploration manager, and should be delegated to the company security head.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Low</li> </ul>

## 8.11 OTHER GENERAL REQUIREMENTS AND TRAINING ISSUES

### 8.11.1 Occupational Health and Safety Plan

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

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

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

### 8.11.2 Vehicle Traffic Plan

The following guidelines will apply to vehicular traffic:

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

### 8.11.3 Hazardous Materials Management Plan

A Hazardous Materials Management Plan (HMMP) will be developed for the project that will identify potentially hazardous materials to be used and provide a system for monitoring them. Transportation, storage, use and ultimate disposal will be considered. Safety of the workers and the surrounding communities will be taken into account for all stages of materials handling during all project phases. The 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.

Hazardous materials and wastes require special handling and training procedures. All employees will be provided with basic training so that, at a minimum, they can: identify hazardous materials; know how to obtain appropriate information on special handling procedures required; know what precautions and protective equipment are required; know how to label and package hazardous materials and wastes; know where and how hazardous wastes are to be stored; and know how wastes are to be disposed of. Employees who are tasked with

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

#### **8.11.4 Spills Prevention and Response Plan**

Before construction of the project commences, a Spill Prevention and Response Plan (SPRP) will be developed for use by TKBV and contracted personnel in the event of a deleterious material spill. The objective of the spill response measures will be to ensure that where accidental spills occur, all available resources are used appropriately to minimize the extent and severity of effect on the environment. All spills occurring on the project site will be responded to in a way that will uphold the following priorities: protection of human life and health; protection of the environment; protection of property; and minimized disruption to operational activities. At all times, applicable regulations will be used to guide response and cleanup activities.

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

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

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

#### **8.11.5 Emergency Response Plan**

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

### **8.11.6 Environmental Awareness Plan**

On appointment, all contracting companies and employees will receive a copy of the EMP and will be trained in the relevant categories of the EMP that are outlined in sections 8.9 and 8.10 above. In addition, a detailed environmental awareness plan will be developed prior to commencement of the seismic survey activities. The plan will address the following items:

- Basic workforce environmental awareness;
- Sensitivity of the site
- Personnel environmental training needs; and
- Resources available for use in personnel environmental awareness training

Ongoing monitoring and auditing will also assist in continually improving the environmental awareness of the project team. TKBV will also target the community leaders and government administrators for awareness-building on the project components. These leaders and administrators would, thereafter, be able to explain the project components, the environmental issues, and mitigation measures that are being undertaken, to the community at large.

### **8.12 COST OF THE EMP AND TIMEFRAME FOR THE ACTIVITY**

It is estimated that the entire project will cost USD 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, one of the largest international oil and gas exploration companies with over 80 licences in more than 20 countries in Africa, Europe, South Asia and South America.

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 block area of 14747.57 km<sup>2</sup>, 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 acquired a majority shareholding in Block 10A (project area) and is now the operator of the block with Africa Oil Corporation and EAX (Afren) as its partners. In this regard, TKBV is proposing to undertake exploration drilling of an oil and natural gas well to a depth of 4,200 m in the project area.

Exploratory drilling is undertaken to establish the presence of hydrocarbons indicated by seismic survey and interpretation of such data. Exploratory drilling is a temporary and short duration activity taking between 3 to months under normal conditions. The drilling process is undertaken to determine where hydrocarbons are present and to measure the area and thickness of the oil and/or gas bearing reservoir or reservoirs; logging and coring wells to measure the permeability, porosity, and other properties of the geologic formation(s) encountered; completing construction of wells and site facilities deemed capable of producing commercially viable quantities of oil and/or gas; and or abandonment of wells deemed incapable of producing commercially viable quantities of oil and/or gas and restoration of the well site.

The EIA assessment approach included, with respect to the proposed exploratory oil and gas well drilling, the following:

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

The EIA covers the legislative and legal framework that, when properly implemented, will ensure environmental sustainability while allowing the project to proceed. It also provides the description of the current environmental and socio-economic situation against which the potential impacts of the proposed well can be assessed and future changes monitored and rectified. It presents an overview of the environmental aspects related to the well site and the surrounding areas in which the operations will take place, and which may bear the impacts of the proposed activities directly or indirectly.

The impacts and mitigation measures to be put in place to ensure that those impacts are minimised or eliminated where possible are discussed in Chapter 7. It can be concluded that the project is viable and will not adversely affect the environment or the local community if the EMP in Chapter 8 outlined in this document is strictly adhered to.

## 9.2 RECOMMENDATIONS

From the EIA report it can be concluded that the project will have only a minimal impact on the environment, and that measures will be put in place that will minimise any impacts that may occur. However, we would recommend that the EMP developed be strictly followed in order to ensure that such impacts do not occur. Some of the measures in Chapter 8 to be closely monitored include, but are not limited to, the following:

- Pre-survey possible access routes, and use the selected routes rather than accessing work sites through free-ranging driving across the open country;
- Minimize vegetation clearance as much as possible when clearing the area for well pad and campsite construction;
- An efficient sanitation system should be put in place for camp workers to eliminate or minimise the levels potential water pollutants from domestic effluents;
- Pits for containment and/or disposal of drill cuttings, spent drilling fluids, domestic and sanitary effluents should be sited and designed by a competent and licenced contractor and based on consideration of the geological and soil characteristics of the area to avoid soil contamination;
- 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;
- Regular servicing of all trucks, service vehicles, and any other machinery powered using fossil fuels to ensure efficient combustion and minimisation of exhaust emissions;
- A waste management plan 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;
- 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);
- Hunting, fishing, trapping and gathering of food resources by workers, when on and off duty should be strictly prohibited. All workers to be briefed regularly on this issue;
- The risk of introduction of weed and pests species to the region via contaminated vehicles and equipment will be mitigated by the wash-down of all vehicles and ancillary equipment at a designated location prior to mobilisation of vehicles and equipment to the project site.

- 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;
- A Hazardous Materials Management Plan (HMMP) will be developed for the project, 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;
- Consultations should be undertaken with local elders to help in identifying and avoiding any sensitive cultural sites during the exploration programme in order to prevent conflict with the community;
- Have an ongoing, continual, sensitization of the community on the project objectives, activities and scheduling, potential impacts; communication will be essential in carrying out the project activities;
- Environmental safety and health regulations and policies/plans must be adhered to;
- Adequate warning or cautionary signs will be posted as required;
- The company should liaise with the Provincial Administration, the Kenya Police, Kenya Police Reservists and other agencies to provide adequate security during the test drill operation; and
- Personal protective equipment to be provided to the workers and their use made mandatory in designated areas.

All in all it can be concluded that with the measures put in place in the EMP the project will have minimal impact on the environment.

## REFERENCES

- Bashat, H (2003). Managing Waste in Exploration and Production Activities of the Petroleum Industry. hc2/101/1191
- Dindi, E.W., 1994. Crustal structure of the Anza-graben from gravity and magnetic investigations. *Tectonophysics*, 236, 359-371.
- Dodson, N.G. 1985: Geology of the South Horr area. *Rep. Geol. Sur. Kenya*, No. 15, 53pp.
- Dodson R.G. 1991. Geology of the Barchuma-Kom Area. Report No. 93. Mines and Geological Department, Nairobi, Kenya. 39 pp.
- E&P Forum, (1993). Exploration and Production (E7P) Waste Management Guidelines. Report No. 2.58/196 September 1993.
- Exploration and Production (E&P): *Environmental Management in Oil and Gas Exploration and Production*. E&P Forum/ UNEP 1997. Report No. 2, 72/254.
- FAO-UNEP, 1977. Assessing Soil Degradation. FAO Soils Bulletin 34, FAO, Rome.
- FAO-UNESCO, 1997. Soil Map of the World; revised legend with corrections and updates, ISRIC, Wageningen, 1997.
- FAO, 1988. FAO/Unesco Soil Map of the world: Revised legend, with corrections and updates. World Soil Resources Report 60, FAO, Rome. Reprinted with updates as technical Paper 20, ISRIC, Wageningen, 1997.
- GESAMP (IMO/FAO/UNSERCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution) (1993). Impact of oil and related chemicals and wastes on the marine environment. GESAMP Reports and Studies 50: 180 pp.
- Glennie, K. W. 1970: Desert Sedimentary Environments. *Developments in Sedimentology*, 14.
- Government of Kenya, 1999. National Policy on Water Resources Management and Development, Sessional Paper No 1 of 1999, Government Printer, Nairobi.
- 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.
- Hughes, R.H. and Hughes, J.S., 1992. *A Directory of African Wetlands*. IUCN, UNEP, WCMC. 820 p.
- Hughes, F.M.R., 1987. Conflicting uses for forest resources in the Lower Tana River basin of Kenya. In: Anderson D, Grove R (eds) *Conservation in Africa: people, policies and practice*. Cambridge University Press, Cambridge, pp 211–228.
- Hurley, G and Ellis, J (2004). Environmental effects of exploratory drilling offshore Canada: environmental effects monitoring data and literature review – final report. The Canadian Environmental Assessment Agency, Regulatory Advisory Committee (RAC)
- IPAL. 1983: The hydrology of southern-West Marsabit District. *Kenya Tech. Rep.*, Vol. B-2, 359PP.
- IUCN Protected Areas Categories. Downloaded from [http://www.iucn.org/about/work/programmes/pa/pa\\_products/wcpa\\_categories/](http://www.iucn.org/about/work/programmes/pa/pa_products/wcpa_categories/) on 29<sup>th</sup> April 2011.
- Kenya National Bureau of Statistics, 2009. Kenya Population and Housing Census. Volume 1A.

- Kenya Soil Survey, 1987. Manual for soil survey and land evaluation, M24.
- Krhoda, G.O., 1989. Goundwater assessment in sedimentary basins of eastern Kenya,
- Landon, J.R. (ed), 1984. Booker Tropical Soil Manual. A Handbook for Soil Survey and Agricultural Land Evaluation in the Tropics and Subtropics.
- Lochner, P. 2005. *Guideline for Environmental Management Plans*. CSIR Report No ENV-S-C 2005-053 H. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.
- McCall, G. J. H., 1964. Geology of the Sekerr Area. Report No. 65, Ministry of Natural Resources Geological Survey of Kenya.
- MENRM., 1987: Geology of Marsabit area. *Rep. Mines and Geol. Dept., No. 108.* (Reconnaissance)
- Muturi, H. and Siambi, W.S, 1984: The Samburu- Marsabit geological mapping and mineral exploration project.
- Olago, D.O., 2001. Vegetation changes over palaeo-time scales in Africa. *Climate Research*, 17: 105-121.
- OCHA, 2008. Kenya Situation Report No. 2 – Floods and Landslides – November 10<sup>th</sup>, 2008. United Nations Office for the Coordination of Humanitarian Affairs.
- OSHA, 2009. Guide for Drilling Rigs. Directorate of Technical Support and Emergency Management, Salt Lake Technical Centre; Salt Lake City, UT.
- Republic of Kenya, 2002. Turkana District Development Plan, 2002-2008. Ministry of Finance and Planning. Government Printers.
- Survey of Kenya, 1977. *National Atlas of Kenya*. 3<sup>rd</sup> edition., Nairobi.
- Sombroek W.G, Braun H.M.H and B.J.A. van der Pow, 1982. Exploratory soil map and agro-climatic zone map of Kenya, scale:1:1,000,000. Exploratory soil report No. E1, Kenya Soil Survey, Nairobi
- Tena A. J, Romero, M. T, López Solis V.M, Fisher, M Ramos R. G (2007). Horizontal drilling with liner provides savings. Paper presented at the IADC/SPE Drilling Conference held in Amsterdam, Feb. 20.22, 2007. Defining Technology for Exploration, Drilling and Production. Vol. 228 No. 4
- Tilahun, S., Edwards, S. and Egziabher, T.B.G. (eds.), 1996. Important Bird Areas of Ethiopia. Published by Ethiopian Wildlife and Natural History Society. Semayata Press. Addis Ababa, Ethiopia.
- 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**

1. Minutes of the meetings
2. Analysis of soil samples
3. Copies of lab results
4. Certificates
5. Pin number
6. Other relevant documents

**MINUTES OF THE MEETING HELD AT MAIKONA SUB-LOCATION, MAIKONA LOCATION, CHALBI DISTRICT (MARSABIT NORTH DISTRICT) GPS 02.93N, 37.633E ON MONDAY 13<sup>th</sup> JUNE 2011.**

**Attendance**

Acting Chief..... Guyo Isako Elema  
EIA team.....Nicholas Aketch, Mercy Kihonge  
Community members

The meeting started at 2.40pm with a word of prayer.

The chief, Mr. Guyo gave the opening remarks and welcomed the EIA team and also presented the locals who attended the meeting. He said most of community members were attending a community event (*Sorio*) that was going on and therefore many of them were not able to turn up for the Baraza.

He welcomed Mr. Nicholas to introduce the team and explained the agenda of the meeting as follows:

- 1) To carry out an environmental audit of the previous activities and EIA for the next phase of the oil exploration project
- 2) To take community views on the project and forward their concerns to the proponent

**Community views**

- They said the company out-sourced labour from other areas and yet they had promised to employ people from Maikona.
- The community was not involved in the planning and the whole operation. The company carried out the work without consulting the selected committee in the community.
- They company employees were very harsh to the locals.
- The casuals (locals) were not given a rest day and were not allowed to go to the mosque/church for prayers; they felt the company didn't have respect for God.
- Trees were destroyed when laying the cables.
- The company drilled a water borehole for the community.
- They requested the company to provide them with a source of power: solar panel or windmill for pumping water to their homes since the borehole is far from their homesteads.
- The company initiated a secondary school sponsorship every year for those students who have excelled, and also the needy.
- The company offered assistance by taking a child to hospital in Wamba.
- The company employees respected the community culture and their women. There were no incidences of relationships with local girls or women.
- They want the company to help them establish a harmonious relationship between them and the Rendille by initiating and facilitating peace meetings so as to avoid further conflict.
- They want the company to enlighten them on the impacts of the projects before implementation.
- Those who were employed complained of too much work and minimal pay. They would also like to be informed of the qualifications required for the jobs.
- They wanted to know the length of the hole that will be drilled

- They also wanted to know when the project will commence

The EIA team responded to the issues raised by assuring the community that their views will be forwarded to the proponent and assured them their grazing area will not be affected. The team also said the youth will be offered employment opportunities once the next phase activities kick off just as was done in the previous phase. It was however indicated that the issue of employment will be further discussed with the contractor depending on the available job opportunities. The community was informed by the team that the project is likely to commence once the proponent has been issued with the NEMA license.

The chief made the concluding remarks by saying the development activities are welcomed in the area and they are ready to cooperate with the proponent as long as the community participation is considered. The meeting ended at 3.58pm with a word of prayer.

**MINUTES OF THE MEETING HELD WITH THE DO AT THE DO'S OFFICE IN MAIKONA DIVISION, CHALBI (MARSABIT NORTH) DISTRICT ON MONDAY 13<sup>th</sup> JUNE 2011**

**Attendance**

DO.....Mr. Martin Mureithi  
EIA team.....Nicholas Aketch, Mercy Kihonge

The meeting started at 12 p.m. The DO, Mr. Martin Mureithi, welcomed the E.I.A. team, followed by the introduction of the team. The DO was briefed on the background of the proposed project in the larger Chalbi District which involves Maikona.

Mr. Nicholas explained to the DO the E.I.A teams' mission in the district. He said that the proposed project was in its second stage, which requires an EA to be done for the previous stage (seismic survey) and that the community's views concerning the proposed project were very important. He also informed him that the report will be prepared and submitted to NEMA, which will require the DC, who is the chairman of the District Environment Committee, to give his/her comments concerning the proposed project before the proponent is given a license to operate in the area.

The DO assured the team that security was ok in the area and asked the team to report any incidence that may arise relating to security during our time in the area.

He said the company indeed had many benefits to the community such as:

- The company tracks were used in distribution of food and water to other areas without charging the community.
- He said the company paid for the community resources that they used, such as water and sand.
- He told us that at some point the locals started interfering with and cutting the cables installed, and disciplinary measures were taken by his office.

He said he was aware of the proposed project activities in the area and he was happy that we made the initiative to report our visit in area and assured us of his support where needed.

The meeting ended at 12.45 p.m. and he concluded by thanking the EIA team.

**MINUTES OF THE MEETING HELD ON TUESDAY 14<sup>th</sup> JUNE 2011 AT KALACHA SUB-LOCATION, KALACHA LOCATION, MAIKONA DIVISION, CHALBI DISTRICT (MARSABIT NORTH DISTRICT)**

**Attendance**

Chief .....Madaam Sabdio,  
Assistant Chief.....Mr. Mumo  
Councillor.....Mr. Diba Dambala  
EIA team.....Nicholas Aketch, Mercy Kihonge  
Community members

The meeting started at 2.25 pm with a word of prayer. The Councillor, Mr. Diba, made the opening remarks and welcomed everyone at the meeting.

The Assistant Chief said many people were not able to attend the meeting because there was a function going on (*Sorio*).

Mr. Nicholas gave a brief background of the proposed project activities and told them the main purpose for the meeting is to take the community views and comments on the proposed project, any environmental concerns relating to the just concluded seismic survey and the general views about the project.

**Community views**

- They said they did not benefit at all from the seismic survey as the company did not employ people from Kalacha, and that led to conflict between them and the Maikona people.
- In the initial meetings with the company, they said they would camp in Kalacha and employ 15-20 people from the area but they went to Maikona instead.
- They said the community members were not involved in the operation and the elders were not consulted on anything concerning the proposed project.
- They said the recruitment was not transparent and there was age gap in hiring casuals, men above 40 years old were not hired.

Responses were made by assuring the community that their views will be forwarded to the proponent for actions.

Closing remarks were made by the Councillor who said that the community members should be involved in the proposed project activities and be informed before its commencement. The meeting ended at 4:21 p.m.

## MINUTES OF THE MEETING HELD AT KARGI LOCATION, KARGI DIVISION, LOIYANGALANI DISTRICT ON FRIDAY 17<sup>th</sup> JUNE 2011.

### Attendance

Area Chief  
Area Councillor  
Social team.....Nicholas Aketch, Mercy Kihonge  
Community members

The meeting started at 11 a.m. The Chief introduced the EIA team and welcomed the team in Kargi and said they were happy to see us.

A brief background of the proposed project and its activities was given by Mr. Nicholas and the community assured that their grazing land and animals will not be interfered with. He explained to them that the main objective of the meeting is to assess if there would be any environmental impact, both negative and positive, related to the proposed project, and to take community views on social and economic issues relating to the proposed project.

The community gave a lot of views on the just concluded seismic survey operations by Africa Oil (the initial holder of the block) and wanted to know if Tullow Kenya B.V. is different from Africa Oil Kenya B.V.

### Community views

- The community said they had an MOU with the company during the seismic survey and they had proposed the following things though they were not fulfilled:
  1. Drill water borehole for the community
  2. Build a secondary school
  3. Build a hospital
  4. Give a scholarship to the best and most needy student
  5. Support the women's group in the area
  6. Set up a fly camp in Kargi
- They said they did not benefit at all from the project as a community
- The company repaired the airstrip at Kargi but this was because they were expecting their visitors
- They wanted to know if the environment will be affected and more so their grazing land and *manyattas*.
- There was no equal opportunity and transparency in hiring the casual workers.
- They wanted to be involved in the project activities
- The leaders want the company to communicate and work with them and also provide feedback on the outcome of the project.
- They want to have their own representative in the project works.
- They wanted to know if the project will take a large portion of their land.
- They said the Rendille community was oppressed and discriminated against in employment

- They want a map showing the sites of the proposed project
- One community member was happy to see the EIA team and said he believes that oil exploitation will bring many benefits to the community.

Responses to the views raised were addressed by Mr. Nicholas and he informed them that only a small piece of land will be occupied by the proposed project and the camp will be set on the project site.

He assured the community that their grievances will be forwarded to the proponent and they will get a feedback.

He also told them that they can access the EIA reports at the District Environment Office and give their comments.

The Councillor said firmly that unless the company fulfils their promises to the community mentioned in the MOU they will not allow any activities to be carried out in the area.

He added that the leaders and elders of the community should be consulted first before commencement of the proposed project.

The Chief gave the closing remarks by saying the community views must be respected, and want a feedback on the project progress.

The meeting ended at 2.34 p.m. with a word of prayer.

**MINUTES OF THE MEETING HELD WITH THE DISTRICT COMMISSIONER, MARSABIT NORTH (CHALBI) DISTRICT AT THE DC'S OFFICE ON FRIDAY 17<sup>th</sup> JUNE 2011**

**Present:**

DC Chalbi District  
EIA team

The meeting started at 2:10 p.m. Introduction of the EIA team was done by Mr. Nicholas, followed by a brief background of the proposed project. He said the aim of the meeting was to inform the DC of our presence in the area and also the objectives of the visit which were:

- I. To carry out environmental audit for the previous phase and EIA for the next phase.
- II. To take community views, comments and concerns on proposed project impacts.

He informed him that the EIA team had held community meetings in various areas covered in the Block Maikona and Kalacha.

The DC welcomed the team and thanked them for visiting the area and also taking time to pay a courtesy visit to his office.

He said he was new in the district but assured us of his cooperation where necessary. He was ready to work with the proponent in developing the area.

The meeting ended at 2.42 pm

## A: Soil Mapping unit's description and chemical data interpretation

The following Tables give the summarized field soil profile descriptions of the three mapping units viz: YV, Ps2+D1 and PI3 and the data obtained from soil sampling. The data was analysed at the National Soil Research Laboratories (NARL) of the Kenya Agricultural research Institute (KARI), Kabete. Both the field and laboratory data are used to finally classify a soil mapping unit. The lab data supports the field observations and the soils classify as *haplicSolonez* (mapping units YV and Ps2+D1) and *haplicSolonchak* (mapping unit PI3), according to FAO (1997), soil map of the world revised legend.

Table 1 (a): Soil unit description for Mapping Unit YV

<b>Profile Pit</b>	PP: KS-001	Kargi-South Horr (Sirius site)
<b>Way Point</b>		
<b>Parent material</b>	Alluvium (Quaternary volcanic rocks mainly -Basalts)	
<b>Physiography</b>	Piedmont plain	
<b>Drainage</b>	Moderately well drained	
<b>Vegetation/landuse</b>	Moderately dense pastoral shrubland with <i>Indigoferaspinosa</i> , <i>Commiphora Africana</i> and <i>Euphobiacuneata</i> .	
<b>Rock outcrops</b>	none	
<b>Depth</b>	deep	
<b>Soils general</b>	The unit consists of deep, brown, sandy clay loam soils. They have an ABC sequence of horizons with a clear to gradual boundaries that have a smooth to wavy topography. The soils are medium, angular blocky, and coarse prismatic structured, with moderate and strong grades respectively.	
<b>Colour (moist):</b> A- horizon B- horizon	brown brown	
<b>Structure</b> A-horizon  B-horizon	fine, strong grade granular and fine weak grade angular blocky  angular blocky, and coarse prismatic structured, with moderate and strong grades respectively	
<b>Consistency (dry, moist, wet)</b> A-horizon B-horizon	very hard when dry; friable to firm when moist; slightly sticky and none plastic when wet Hard when dry; firm when moist; slightly sticky and slightly plastic when wet	
<b>Texture</b> A-horizon B-horizon	Sandy Clay loam Sandy Clay loam	
<b>Diagnostic properties</b>	Natric B horizon	
<b>Soil classification</b>	HaplicSolonetz	

Table 1 (b): Soil unit description for Mapping Unit Ps2+D1)

<b>Profile Pit</b>	PP: KB-002	Kholl-South Horr (Beatrix site)
<b>Way Point</b>		
<b>Parent material</b>	Sheet wash deposits (undifferentiated basement system rocks)	
<b>Physiography</b>	Middle level sedimentary plain and dune complex	
<b>Drainage</b>	Moderately well drained	
<b>Vegetation/land use</b>	moderately pastoral shrubland with <i>Acacia reficiens</i> , <i>Indigoferaspinosa</i> , <i>hirpicum</i> spp and <i>Euphobiacuneata</i> .	
<b>Rock outcrops</b>	none	
<b>Depth</b>	deep	
<b>Soils general</b>	The unit consists of deep, brown, sandy clay loam soils. They have an ABC sequence of horizons with clear boundaries that have a smooth to wavy topography. The soils are coarse, prismatic structured, with a strong grade.	
<b>Colour (moist):</b> A- horizon B- horizon	Yellowish brown brown	
<b>Structure</b> A-horizon  B-horizon	fine, strong grade granular and fine weak grade angular blocky  coarse, prismatic structured, with a strong grade	
<b>Consistency (dry, moist, wet)</b> A-horizon B-horizon	Loose to slightly hard when dry; friable when moist; none sticky and none plastic when wet Hard when dry; firm when moist; slightly sticky and slightly plastic when wet	
<b>Texture</b> A-horizon B-horizon	Sand Sandy Clay loam	
<b>Diagnostic properties</b>	Natric B horizon	
<b>Soil classification</b>	Haplic Solonetz	

Table 1 (c): Soil unit description for Mapping Unit PI3)

<b>Profile Pit</b>	PP: KB-002 Basadekutumloni-Maikona (Paipai site)
<b>Way Point</b>	
<b>Parent material</b>	Sediments from various sources
<b>Physiography</b>	Lacustrine plain
<b>Drainage</b>	poorly drained
<b>Vegetation/land use</b>	nearly barren with sparse vegetation consisting of <i>Astrostripa</i> and <i>Spear grass</i> varieties
<b>Rock outcrops</b>	none
<b>Depth</b>	Moderately deep to deep
<b>Soils general</b>	The unit consists of moderately deep to deep, dull yellow orange, sandy clay soils. They have an ABC sequence of horizons with clear and gradual boundaries that have a smooth to wavy topography. The soils are coarse, prismatic and coarse platy with strong grades and medium granular with a moderate grade
<b>Colour (moist):</b> A- horizon C- horizon	Dull yellow orange Dull yellow orange
<b>Structure</b> A-horizon  B-horizon	fine, strong grade granular and medium, moderate grade angular blocky  coarse, prismatic and coarse platy with strong grades and medium granular with a moderate grade
<b>Consistency (dry, moist, wet)</b> A-horizon B-horizon	slightly hard when dry; friable when moist; slightly sticky and slightly plastic when wet Hard when dry; very friable when moist; sticky and slightly plastic when wet
<b>Texture</b> A-horizon B-horizon	Sandy Clay loam Sandy Clay
<b>Diagnostic properties</b>	Salic properties, Petrocalcic horizon
<b>Soil classification</b>	Haplic Solonchak

The following is the interpretation of the soil chemical data for the study area as depicted in Tables (2 a, b and c) below.

From the soil chemical data, the soil reaction of Mapping unit YV indicates a pH range of 8.3 to 8.8 (Table 2a). For classification purposes the pH is taken as 8.8 (Bu1 horizon) this is a strongly alkaline soil. The electrical conductivity indicates a soil that is slightly saline (2.30). However, the exchangeable sodium percentage gives a high value and is 23.8 in horizon Bu1. 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, rated as low value (Landon, 1984). For Bu1 horizon, the sum of the cations is 59.6% with sodium value at 3.1 me %, and calcium being the dominant cation at 52.3 me% (Table 2a)]. The ESP at 23.8 is greater than 15 making the soils strongly sodic. The soils classify as *haplicSolonetz*.

Table 2 (a) Soil chemical data for Mapping unit YV

Field	Kargi				
	SKS001	SKS002	SKS003	SKS004	SKS005
Sample designation	4115	4116	4117	4118	4119
Lab.No.2011	4115	4116	4117	4118	4119
Horizon	A	Bu1	Bu2	Bu3	C
Soil depth cm	0-11	11-23	23-52	52-92	92-140+
Soil pH-H <sub>2</sub> O(1:2.5)	8.8	8.8	8.3	8.8	8.2
Elect. Cond. mS/cm	2.68	2.30	2.29	1.07	0.06
Carbon%	0.03	0.03	0.02	0.03	0.06
Sand%	58	66	70	76	92
Silt%	8	2	0	4	2
Clay%	34	32	30	20	6
Texture Class	SCL	SCL	SCL	SCL	S
Cat. Exch. Cap. me%	13.6	12.8	13.6	8.8	6.4
Calcium me%	56.5	52.3	17.6	15.5	14.3
Magnesium me%	3.2	3.5	2.8	1.8	1.3
Potassium me%	0.40	0.78	0.42	0.32	0.20
Sodium me%	3.8	3.1	3.1	3.0	5.1
Summe%	63.8	59.6	23.9	20.6	20.9
Base%	100+	100+	100+	100+	100+
ESP	27.6	23.8	22.4	33.5	78.9

From the soil chemical data, the soil reaction of Mapping unit Ps2+D1 indicates a pH range of 8.3 to 10.1 (Table 2b). For classification purposes the pH is taken as 9.6 (Bu1 horizon) this is a very strongly alkaline soil. The electrical conductivity indicates a soil that is none saline ((0.64 mS/cm). However, the exchangeable sodium percentage gives a high value of 36.1 in horizon Bu1. 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 6.4 rated as low value (Landon, 1984). For Bu1 horizon, the sum of the cations is 91.9% % with sodium value at 3.8 me %, and calcium being the dominant cation at 86.0 me% (Table 2a)]. The ESP at 36.1 is greater than 15 making the soils strongly sodic. The soils classify as *haplicSolonetz*.

Table 2 (b) Soil chemical data for Mapping unit Ps2+D1

Field	Kholi					
Sample designation	SKB001	SKB002	SKB003	SKB004	SKB005	SKB006
Lab.No.2011	4120	4121	4122	4123	4124	4125
Horizon	A	AB	Bu1	Bu2	Bu3	C
Soil depth cm	0-14	14-34	34-51	51-74	74-103	103-118+
Soil pH-H <sub>2</sub> O(1:2.5)	8.3	8.7	9.6	10.0	10.1	10.1
Elect. Cond. mS/cm	0.06	0.07	0.64	0.84	1.04	1.21
Carbon%	0.31	0.16	0.20	0.03	0.13	0.07
Sand%	90	90	60	64	62	62
Silt%	2	2	10	8	10	10
Clay%	8	8	30	28	28	28
Texture Class	S	S	SCL	SCL	SCL	SCL
Cat. Exch. Cap. me%	6.4	7.2	10.4	14.8	16.8	17.2
Calcium me%	32.4	33.5	86.0	79.2	78.9	45.9
Magnesium me%	1.1	1.1	1.9	1.9	0.9	1.3
Potassium me%	0.58	0.36	0.20	0.46	0.46	0.64
Sodium me%	1.7	2.4	3.8	5.4	6.4	6.9
Summe%	35.8	37.3	91.9	86.9	86.7	54.7
Base%	100+	100+	100+	100+	100+	100+
ESP	26.6	32.6	36.1	36.1	37.8	39.8

From the soil chemical data, the soil reaction of Mapping unit PI3 indicates a pH range of 10.3 to 10.5 (Table 2c). For classification purposes the pH is taken as 10.5 (B horizon) this is a very strongly alkaline soil. The electrical conductivity indicates a soil that is moderately saline (11.00 mS/cm). The exchangeable sodium percentage gives a high value of 40.3 in B horizon. 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 12.8 rated as low (Landon, 1984). For B horizon, the sum of the cations is 42.1 % with sodium value at 8.1 me %, and calcium being the dominant cation at 32.8 me% (Table 2c)]. The ESP at 40.3 is greater than 15 while ECe value is greater than 4 mS/cm making the soils moderately saline and excessively sodic. The soils classify as *haplic Solonchak*.

Table 2 (c) Soil chemical data for Mapping unit PI3

Field	Maikona			
Sample designation	SKP001	SKP002	SKP003	SKP004
Lab.No.2011	4126	4127	4128	4129
Horizon	A	B	C1	C2
Soil depth cm	0-10	10-25	25-61	61-80
Soil pH-H <sub>2</sub> O(1:2.5)	10.3	10.5	10.5	10.5
Elect. Cond. mS/cm	2.08	11.00	13.10	14.70
Carbon%	0.23	0.25	0.15	0.14
Sand%	56	60	68	58
Silt%	10	2	4	4
Clay%	34	38	28	38
Texture Class	SCL	SC	SCL	SC
Cat. Exch. Cap. me%	12.8	20.0	16.0	21.6
Calcium me%	27.2	32.8	22.5	17.9
Magnesium me%	1.0	0.5	0.3	0.3
Potassium me%	0.52	0.78	0.34	0.48
Sodium me%	7.9	8.1	8.3	8.5
Summe%	36.6	42.1	31.4	27.2
Base%	100+	100+	100+	100+
ESP	61.3	40.3	51.6	39.1

## Soil Fertility status of the study sites

Soil fertility status of the study area indicates similar soil fertility conditions. The soils are very alkaline for plants' growth. Nitrogen, phosphorus and zinc are deficient. Very high values of electrical conductivity and sodium in Mapping unit PI3 [SKP – 005 (Table 3)] suggest the possibility of saline-sodic condition confirmed by results in Table 2c. The soil alkalinity may be reduced by applying 400 kg/acre of elemental sulphur. The addition of sulphur is usually accompanied by irrigation to get water into the soil and, with good drainage, to carry off the excess and to remove unwanted products of the reaction between the sulphur and the soil. Further, to augment soil phosphorous, should trees be desired to be grown, apply 100 gm/ tree of diammonium phosphate (DAP) and 50 gm/ tree of ammonium sulphate (AS) at the beginning of rains. The fertilizer quantity should be split and applied one or two weeks after the onset of the rains. Manure should be applied one bucket of 20 kg per tree per year. To correct zinc deficiency spray growing trees with a foliar feed, like bayfolan with zinc. Table 3 below gives the soil fertility status of the study area.

Table 3 Soil Fertility status of the three study sites

Field	Soil Analytical Data					
	YV (SKS-006)		Ps2+D1 (SKB-007)		PI3 (SKP-005)	
Lab.No/2011	4130		4131		4132	
Soildepthcm	0-20		0-20		0-20	
Fertilityresults	value	class	value	class	value	class
SoilpH	8.96	strong alkaline	9.40	extreme alkaline	9.84	extreme alkaline
TotalNitrogen%	0.04	low	0.03	low	0.02	low
Org.Carbon%	0.07	low	0.06	low	0.07	low
Phosphorusppm	5.6	low	3.2	low	6.1	low
Potassiumme%	0.62	adequate	0.52	adequate	0.30	adequate
Calciumme%	7.0	adequate	7.9	adequate	22.7	high
Magnesiumme%	3.42	high	2.87	adequate	3.28	adequate
Manganese%	0.43	adequate	0.31	adequate	0.29	adequate
Copperppm	1.39	adequate	1.42	adequate	1.28	adequate
Ironppm	25.8	adequate	31.8	adequate	10.8	adequate
Zincppm	2.05	low	2.33	low	2.62	low
Sodiumme%	0.73	adequate	0.85	adequate	28.0	high
Elect.Cond.mS/cm	0.07	adequate	0.10	adequate	9.84	high

### B: Infiltration Rate measurements for the Soils of the Study area (Mapping Unit YV, Ps2+D1 and PI3)

Infiltration rates of the soils were obtained using the double ring infiltrometer equipment. The double ring infiltrometer is a way of measuring saturated hydraulic conductivity of the surface layer, and consists of an inner and outer ring inserted into the ground. Each ring is supplied with a constant head of water either manually or from mariotte bottles. Hydraulic conductivity can be estimated for the soil when the water flow rate in the inner ring is at a steady state. Water is directed onto a known surface area as provided by the inner ring where the actual measurements take place. The rate of infiltration is determined by the amount of water that infiltrates into the soils per surface area, per unit of time. Infiltration can be measured by either a single or double ring infiltrometer. Double rings are preferred because the outer ring, acting as a buffer water source, assists in reducing the error that may result from lateral flow in the soil.

The basic infiltration of different soils can be classified using table 4 below, developed by Landon (1984) for irrigation purposes. This is also suitable for appropriate planning of land/soil discharge of waste water and drilling mud required by the proponent.

**Table 4: Infiltration categories**

Class	Infiltration categories	Basic Infiltration rate (cm/hr)
1	Very slow (non-irrigable)	< 0.1
2	Slow	0.1-0.5
3	Moderately slow	0.5-2.0
4	Moderate	2.0-6.0
5	Moderately rapid	6.0-12.5
6	Rapid	12.5-25.0
7	Very rapid} (overhead methods preferred)	>25.0

Source: Landon, 1984.

From the graph of the SIRIUS site, infiltration rate is highest at the early stages of the experiment. Though in the very beginning water percolated slowly into the soil before breaking the sealed top layer, and then thereafter, the rate increased. The topsoil soil texture [(SCL) Table 2a] and the structure [(granular and angular blocky) Table 1a] parameters, checked against the soil matrix pore distribution, ascertains adequate macro-pores that permit water to pass through. After the initial stages, the water intake slows as the soil structure changes to prismatic soil colloids connotative of a compact B horizon. Here the macro-pores are compromised and water percolates more slowly. A steady state is then realised at the 205<sup>th</sup> minute representing a cumulated time of 29.25 hours, indicated by the light blue arrow (figure 1a) and Table 5a below. From Table 5a, the basic infiltration rate is 1.365 cm/hr which is rated as moderately slow (Table 4). This means that the surface water discharge in the normal drilling operations would also be moderately slow.

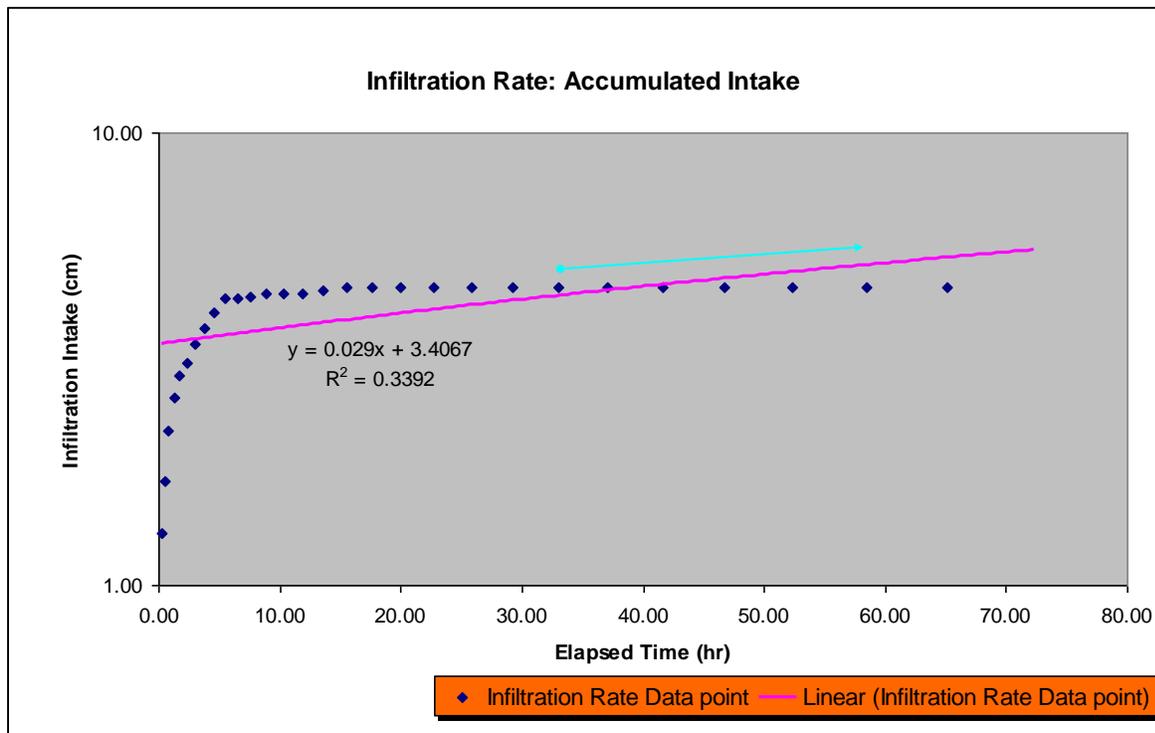


Figure 1 (a): Infiltration rate curve for SIRIUS site (Mapping unit YV)

Table 5a below gives the field infiltration measurements for Sirius site (Mapping unit YV) using a double ring infiltrometer equipment.

**Table 5a Infiltration measurements for Sirius site (Mapping Unit YV)**

Sirius Site Infiltration measurements (Wet Run)								
Time (min)	Time (hr)	Cumulative Time (hr)	Initial Reading	Infiltration (cm)	Cumulative Infiltration (cm)	Infiltration Rate (cm/hr)	h'/t' (cm/min)	h'/t' (cm/hr)
5	0.08	0.08	31.8	0	0.00	0.00		
10	0.17	0.25	32.2	0.4	0.40	2.40	0.08	4.8
15	0.25	0.50	33.1	0.9	1.30	3.60	0.13	7.8
20	0.33	0.83	33.5	0.4	1.70	1.20	0.113333333	6.8
25	0.42	1.25	34	0.5	2.20	1.20	0.11	6.6
30	0.50	1.75	34.4	0.4	2.60	0.80	0.104	6.24
35	0.58	2.33	34.7	0.3	2.90	0.51	0.096666667	5.8
40	0.67	3.00	34.9	0.2	3.10	0.30	0.088571429	5.314286
45	0.75	3.75	35.2	0.3	3.40	0.40	0.085	5.1
50	0.83	4.58	35.5	0.3	3.70	0.36	0.082222222	4.933333
55	0.92	5.50	35.8	0.3	4.00	0.33	0.08	4.8
60	1.00	6.50	36.1	0.3	4.30	0.30	0.078181818	4.690909
65	1.08	7.58	36.1	0	4.30	0.00	0.071666667	4.3
75	1.25	8.83	36.15	0.05	4.35	0.04	0.062142857	3.728571
85	1.42	10.25	36.2	0.05	4.40	0.04	0.055	3.3
95	1.58	11.83	36.2	0	4.40	0.00	0.048888889	2.933333
105	1.75	13.58	36.2	0	4.40	0.00	0.044	2.64
115	1.92	15.50	36.3	0.1	4.50	0.05	0.040909091	2.454545
125	2.08	17.58	36.35	0.05	4.55	0.02	0.037916667	2.275
145	2.42	20.00	36.35	0	4.55	0.00	0.0325	1.95
165	2.75	22.75	36.35	0	4.55	0.00	0.0284375	1.70625
185	3.08	25.83	36.35	0	4.55	0.00	0.025277778	1.516667
205	3.42	29.25	36.35	0	4.55	0.00	0.02275	1.365
225	3.75	33.00	36.35	0	4.55	0.00	0.020681818	1.240909
245	4.08	37.08	36.35	0	4.55	0.00	0.018958333	1.1375
275	4.58	41.67	36.35	0	4.55	0.00	0.016851852	1.011111
305	5.08	46.75	36.35	0	4.55	0.00	0.015166667	0.91
335	5.58	52.33	36.35	0	4.55	0.00	0.013787879	0.827273
365	6.08	58.42	36.35	0	4.55	0.00	0.012638889	0.758333
400	6.67	65.08	36.35	0	4.55	0.00	0.011518987	0.691139
430	7.17	72.25	36.35	0	4.55	0.00	0.010705882	0.642353

h'= change in height

t'= change in time

Basic infiltration rate =h'/t'

From the graph of the BELATRIX site, infiltration rate is highest at the early stages of the experiment. The water percolated fast into the soil before slowing. The topsoil soil texture [(S) Table 2b] and the structure [(granular and angular blocky) Table 1b] parameters, checked against the soil matrix pore distribution, ascertains abundant macro-pores that permit water to pass through. After the initial stages, the water intake slows as the soil structure changes to prismatic soil colloids connotative of a compact B horizon. Here the macro-pores are compromised and water percolates more slowly. A steady state is then realised at the 300th minute representing a cumulated time of 24.4 hours, indicated by the light blue arrow (figure 1 b) and Table 5b below. From Table 5b, the basic infiltration rate is 1.10 cm/hr which is rated as moderately slow (Table 4). This means that the surface water discharge in the normal drilling operations would also be moderately slow.

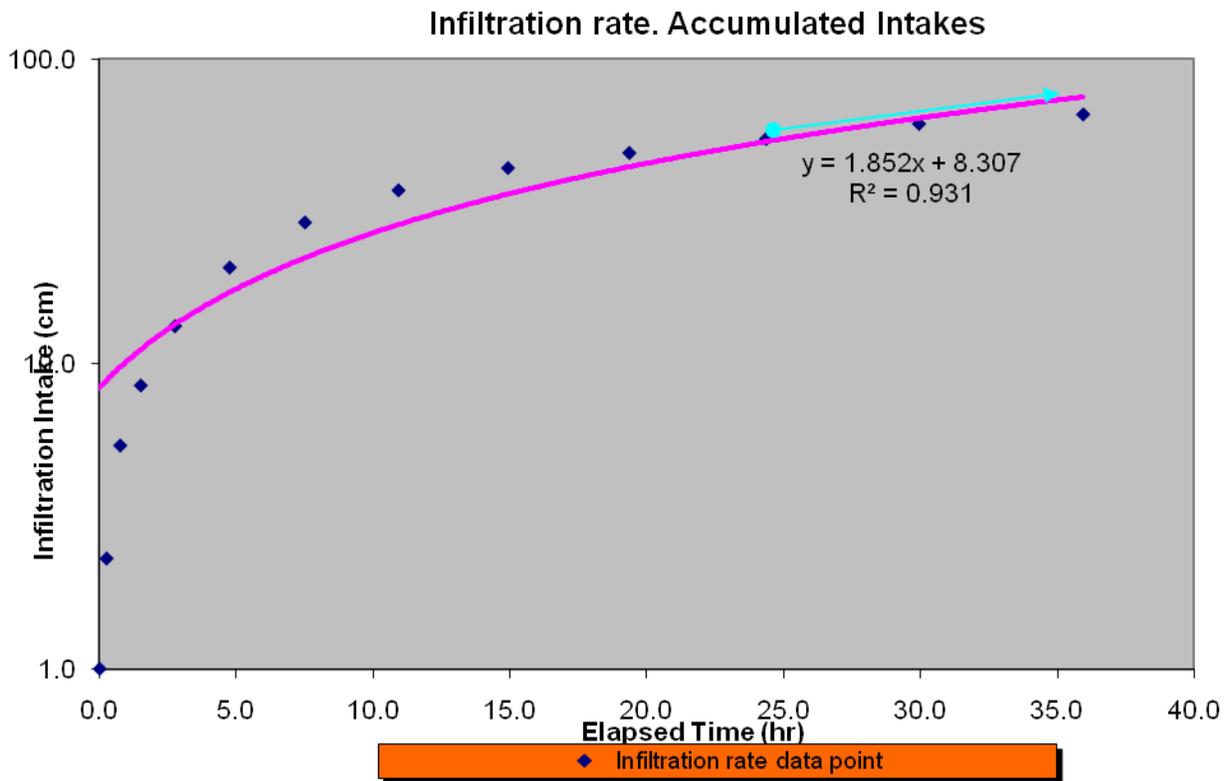


Figure 1 (b): Infiltration rate curve for Belatrix site (Mapping unit Ps2+D1)

Table 5b below gives the field infiltration measurements for Belatrix site (Mapping unit Ps+D1) using a double ring infiltrometer equipment.

Table 5b Infiltration measurements for Belatrix site (Mapping Unit Ps2+D1)

Beatrix Site Infiltration measurements (Wet Run)								
Time (t min)	Time (hr)	Cumulative Time (hr)	Initial Reading	Infiltration	Cumulative Infiltration	Infiltration Rate (cm/hr)	h/ t' (cm/min)	h/t' (cm/hr)
0.0		0.0	8.4	0.0	<b>0.0</b>			
15.0	0.3	0.3	10.7	2.3	<b>2.3</b>	7.67	0.23	13.80
30.0	0.5	0.8	13.8	3.1	<b>5.4</b>	6.20	0.22	12.96
45.0	0.8	1.5	16.9	3.1	<b>8.5</b>	3.88	0.21	12.75
75.0	1.3	2.8	21.7	4.8	<b>13.3</b>	3.69	0.19	11.40
120.0	2.0	4.8	29.1	7.4	<b>20.7</b>	3.70	0.18	10.80
165.0	2.8	7.5	37.5	8.4	<b>29.1</b>	3.00	0.18	10.91
205.0	3.4	10.9	45.5	8.0	<b>37.1</b>	2.35	0.19	11.13
240.0	4.0	14.9	52.3	6.8	<b>43.9</b>	1.70	0.19	11.21
266.0	4.4	19.4	57.6	5.3	<b>49.2</b>	1.21	0.19	11.31
300.0	5.0	24.4	63.1	5.5	<b>54.7</b>	1.10	0.19	11.13
335.0	5.6	29.9	69.7	6.6	<b>61.3</b>	1.10	0.19	11.15
360.0	6.0	35.9	74.2	4.5	<b>65.8</b>	0.75	0.19	11.12

h'= change in height  
t'= change in time

From the graph of the PAIPAI site, infiltration rate is very slow at the early stages of the experiment. This is because of the surface salt puffs (crusts) that seal the soil (Table 1c). Further, soil texture in B horizon [(SC), Table 2c] has a clay increment and a prismatic and platy structure that impedes macro-poresdistribution. Again, the underlying *Caliche* horizon provides an almost impermeable layer. However, this is overcome after the 45<sup>th</sup> minute since the caliche layer is not indurate. Thereafter, soil texture changes to SCL (Table 2c) and the rate increases. A steady state is then realised at the 180<sup>th</sup> minute representing a cumulated time of 11.8 hours, indicated by the light blue arrow (figure 1c) and Table 5c below. From Table 5c, the basic infiltration rate is 0.1 cm/hr which is rated as slow (Table 4). This means that the surface water discharge in the normal drilling operations would also be slow.

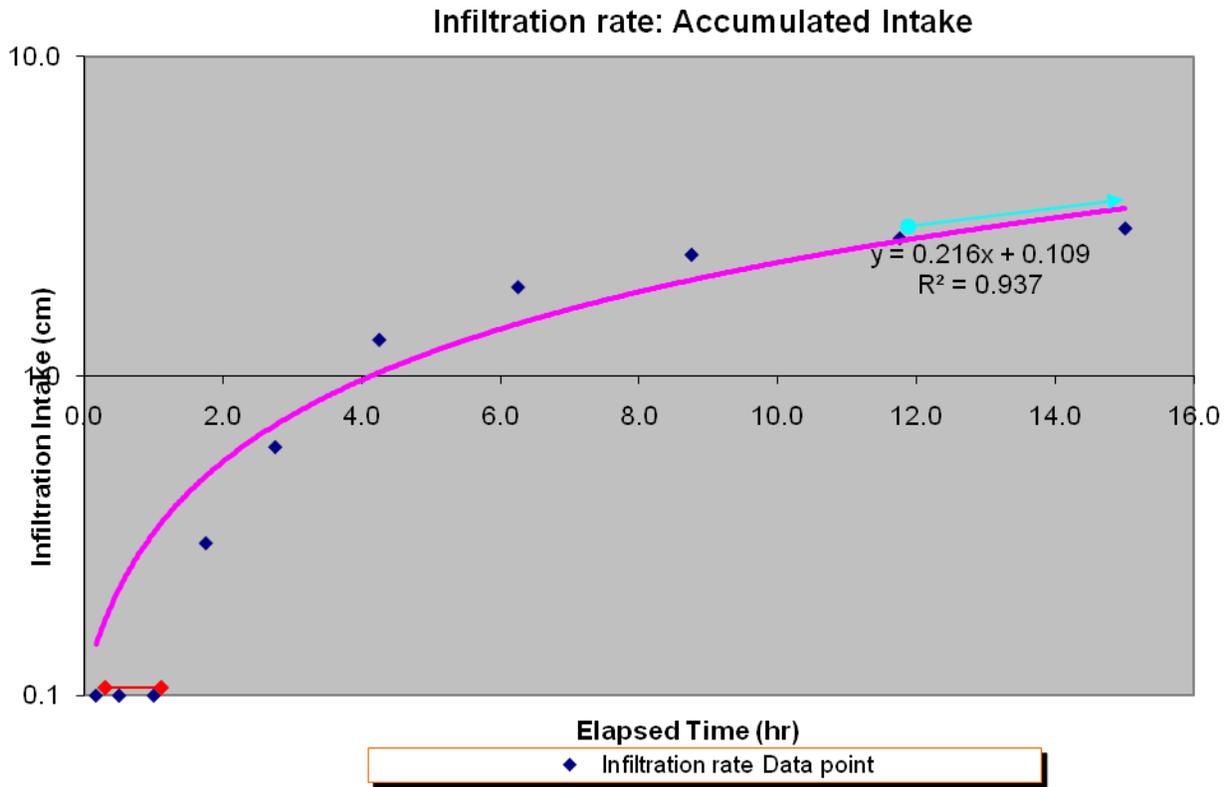


Figure 1 (c): Infiltration rate curve for Paipai site (Mapping unit PI3)

Table 5c below gives the field infiltration measurements for Paipai site (Mapping unit PI3) using a double ring infiltrometer equipment.

Table 5c Infiltration measurements for Paipai site (Mapping Unit PI3)

Paipai Site Infiltration measurements (Wet Run)								
Time (min)	Time (hr)	Cumulative Time (hr)	Depth cm (b4 filling)	Infiltration (cm)	Cumulative Infiltration (cm)	Infiltration Rate (cm/hr)	h'/t' (cm/min)	h'/t' (cm/hr)
0	0	0.0	8.1	0	0.0	0.0		
10	0.2	0.2	8.2	0.1	0.1	0.5		
20	0.3	0.5	8.2	0.0	0.1	0.0	0	0
30	0.5	1.0	8.2	0.0	0.1	0.0	0	0
45	0.8	1.8	8.4	0.2	0.3	0.3	0.005	0.3
60	1.0	2.8	8.7	0.3	0.6	0.3	0.009	0.545
90	1.5	4.3	9.4	0.7	1.3	0.5	0.014	0.847
120	2.0	6.3	10.0	0.6	1.9	0.3	0.015	0.939
150	2.5	8.8	10.5	0.5	2.4	0.2	0.015	0.951
180	3.0	11.8	10.8	0.3	2.7	0.1	0.014	0.891
190	3.2	15.0	11.0	0.2	2.9	0.1	0.015	0.908

h' = change

in height

t' = change in

time

Basic infiltration rate = h'/t'

### C: Soil water retention measurements

The bulk density results indicate compact soils in all sites. However the Paipai soils are slightly less compact than the other sites due to high salt content (Table 6) below. Checking the moisture retention characteristics of B horizon marked in the table in brackets i.e., (B), in all sites reveals the following. The surface soils at Sirius and Beatrix have almost the same retention characteristics due to the sandy texture. However Paipai site has more water retained at saturation. This is due to the texture class (SCL) and the salt that is hygroscopic causing salt puffs or crusts. The loss of water at higher pressures for Sirius and Beatrix sites has a similar trend the textural class being sandy clay loam, however Sirius site soils retain slightly more water at 10.1% compared to Beatrix (7.5%) at permanent wilting point pressure (15 bars). This could be due to the slightly higher clay content value 30% (Bu2) for Sirius site compared to 28% (Bu2) for Beatrix site (Tables 2 a and 2b) respectively. Paipai site retains more water at higher pressures than the other two sites since the soils have a higher clay content i.e, 38% (B) Table 2 c. This corroborates earlier evidence of the drainage characteristics of these soils. The first two sites soils being moderately well drained while Paipai site soils being poorly drained

**Table 6: Soil moisture retention measurements for the study area**

Area	Sample Description	Depth (cm)	Lab. No.	%Moisture is in weight by weight basis (W/W)			Bulk density (g/cm <sup>3</sup> )
				Saturation	Field Capacity	PWP	
				pF 0	pF 2.3	pF 4.2	
<b>Kargi South Horr PP:KS-001</b>	SKS-001	11-16.5	4115	17.8	13.1	8.2	1.6
	SKS-002(B)	23-28.5	4116	18.4	12.6	10.1	1.7
	SKS-003	92-97.5	4117	26.9	15.7	5.0	1.5
<b>Kholl Kargi South Horr PP:KB-002</b>	SKS-004	9-14.5	4118	22.1	4.6	1.9	1.6
	SKS-005(B)	32-37.5	4119	19.9	11.4	7.5	1.6
	SKB-001	63-68.5	4120	22.7	16.2	7.4	1.6
<b>MaikonaChal bi PP:KP-003</b>	SKB-002	2-7.5	4121	32.0	23.9	18.4	1.4
	SKB-003(B)	28-33.5	4122	31.2	23.9	13.4	1.4
	SKB-004	80-85.5	4123	32.9	27.1	15.0	1.4



Application Reference No. PR/5272

Registration No: 0003729

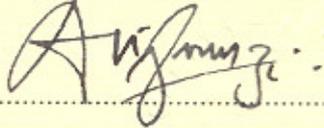
For official use

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT  
ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Project Report/Environmental Impact Assessment Study Report received from  
.....LUNDIN KENYA B.V..... (Name  
of individual/firm)..... P.O. BOX 63298-00619, NAIROBI..... (Address)  
submitted to the National Environment Management Authority in accordance with the Environmental Impact  
Assessment & Audit Regulations regarding ..PROPOSED OIL AND GAS EXPLORATION.....  
.....  
(title of project) whose objective is to carry on ..EXPLORATION OF OIL AND GAS FOR A.....  
.....PERIOD OF FOUR (4) YEARS.....  
.....  
..... (briefly describe purpose) located  
at ..BLOCK 10A, MARSABIT DISTRICT.....  
..... (locality and district)  
has been reviewed and a licence is hereby issued for implementation of the project, subject to attached  
conditions.

Dated this.....26TH.....day...JUNE..... of 20.09..

Signature..........

(SEAL)

*Director General*

*The National Environment Management Authority*

CONDITIONS OF LICENCE

1. This licence is valid for a period of 24 MONTHS... (time within which the project should commence) from the date hereof.
2. The Director-General shall be notified of any transfer/variation/surrender of this licence.

3. The seismic lines, where possible, should be made in such a way as to avoid natural drainage lines and road crossings. Existing access ways should be considered for usage as much as possible.
4. The seismic crew should separate grey and black water which should be fed to evaporation pits. These should then be treated and filled at the end of the survey and camp occupation.
5. Consultation with local leaders and elders should be done prior to cutting of any trees or clearing of vegetation and in selection of final transect lines that may interfere with the identified community and natural heritage sites.
6. Any hazardous and toxic waste materials should be disposed off in accordance with national and internationally accepted standards.
7. During seismic operations the company should consider minimal fencing off of the area of operation in order to allow free movement of livestock and the pastoralists.
8. The vibroseis shot points should be located as far as possible from Kalacha terrace  
where basalts are loosely deposited so as to minimize the risk of landslides in the form of rock fall, rock slides and slumping.
9. The proponent should continually undertake public sensitization programmes before and during the survey exercise.
10. The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.
11. The proponent shall collaborate with the EIA Expert(s) and the contractor(s) to ensure that proposed mitigation measures are adhered to during the construction phase and where necessary appropriate mending-up activities undertaken and a report of the same submitted to NEMA. Emphasis must be given to control of dust, noise, vibrations and occupational hazards.
10. The proponent shall comply with the relevant principal laws, by-laws and guidelines issued for development of such a project within the jurisdiction of Marsabit County Council, Energy Regulatory Commission, Ministry of Energy, Mines and Geology Department and other relevant Authorities.
12. The proponent shall ensure that during the construction phase, the operations adhere to Occupational Safety and Health Act, No. 15 of 2007.
13. The proponent shall ensure that records on conditions of licences/approval and project monitoring and evaluation shall be kept on the project site for inspection by NEMA's Environmental Inspectors.
14. The proponent shall submit an Environmental Audit Report in the first year of occupation/operation/commissioning to confirm the efficacy and adequacy of the Environmental Management Plan.
15. The proponent shall have a decommissioning plan at the end of the exercise to ensure that all disused equipment and other wastes are disposed according to Environmental Management and Coordination (EMCA) Regulations.
16. The proponent shall comply with NEMA's improvement orders throughout the project circle.

Application Reference No. PR/5272

Certificate No: 000083

For official use



THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT  
CERTIFICATE OF TRANSFER OF ENVIRONMENTAL IMPACT  
ASSESSMENT LICENCE

This is to certify that the Environmental Impact Assessment Licence No. 0003729  
Issued on 26/06/2009 (date) to LUNDIN KENYA B.V.  
(name of previous holder) of P. O. BOX 63298-00619, NAIROBI  
(address)  
regarding PROPOSED OIL AND GAS EXPLORATION of project)  
whose objective is to EXPLORATION OF OIL AND  
GAS FOR A PERIOD OF FOUR (4) YEARS  
(briefly describe purpose) located at BLOCK 10A, MARSABIT DISTRICT  
(locality and district) has been transferred to TULLOW KENYA B.V.  
(name of new holder) of P. O. BOX 63298-00619, NAIROBI  
(address)  
with effect from 7<sup>TH</sup> OCTOBER 2011 (date of transfer) in accordance with the  
provisions of the Act.

Dated this OCTOBER day 25 of 2011

Signature

(SEAL)

*TW* Director General

The National Environment Management Authority

Important notes.

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



Application Reference No. PR/8941

Registration No: 0009576

For official use

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT  
ENVIRONMENTAL IMPACT ASSESSMENT LICENCE

This is to certify that the Project Report/Environmental Impact Assessment Study Report received from  
TULLOW KENYA B.V. (Name  
of individual/firm) P.O. BOX 63298-00619, NAIROBI (Address)  
submitted to the National Environment Management Authority in accordance with the Environmental Impact  
Assessment & Audit Regulations regarding PROPOSED EXPLORATORY OIL AND NATURAL  
GAS WELL DRILLING PROGRAMME IN BLOCK 10A  
(title of project) whose objective is to carry on EXPLORATION OF OIL AND NATURAL GAS  
BY WELL DRILLING IN BLOCK 10A, TO IMPROVE ACCESS TO AFFORDABLE  
ENERGY SERVICES AND PROMOTE DEVELOPMENT OF INDIGENOUS ENERGY RESOURCES  
(briefly describe purpose) located  
at PARTS OF MARSABIT NORTH (CHALBI) AND LOYANGALANI DISTRICTS  
(locality and district)  
has been reviewed and a licence is hereby issued for implementation of the project, subject to attached  
conditions.

Dated this 21ST day OCT of 2011

Signature

(SEAL)

for Director General  
The National Environment Management Authority

CONDITIONS OF LICENCE

1. This licence is valid for a period of 24 MONTHS (time within which the project should commence) from the date hereof.
2. The Director-General shall be notified of any transfer/variation/surrender of this licence.

P. T. O.

## **1.0 General Conditions**

- 1.1 This project is for the proposed exploratory oil and natural gas well drilling programme on Block 10A : Parts of Marsabit North (Chalbi) and Loyangalani Districts.
- 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.

## **2.0 Drilling Conditions**

- 2.1 The proponent shall put up a project signboard as per the Ministry of Public Works standards showing the NEMA EIA license number among other details.
- 2.2 The proponent shall obtain clearance from the Ministry of Energy before commencement of the exploration works.
- 2.3 The proponent shall ensure that all excavated material and debris is collected, re-used and where need be, disposed off as per the Environmental Management and Coordination (Waste Management) Regulations of 2006.
- 2.4 The proponent shall obtain clearance from the Department of Mines and Geology before commencement of the project.
- 2.5 The proponent shall ensure that the exploratory wells are covered and the land is well reclaimed before moving to new grounds.
- 2.6 The proponent shall ensure strict adherence to the provisions of Environmental Management and Coordination (Noise and Excessive Vibrations Pollution Control) Regulations of 2009.
- 2.7 The proponent shall ensure strict adherence to the Occupational Safety and Health Act (OSHA), 2007.

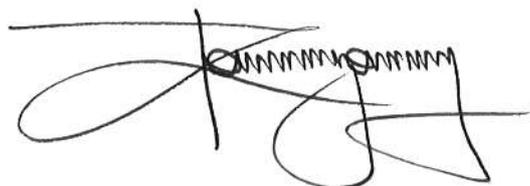
- 2.8 The proponent shall ensure that exploration workers are provided with adequate personal protection equipment (PPE), sanitary facilities as well as adequate training.
- 2.9 The proponent shall ensure strict adherence to the Environmental Management Plan developed throughout the project cycle.
- 2.10 The proponent shall ensure that the development adheres to any specifications issued for development of such a project within the jurisdiction of County Councils of Marsabit North and County Council of Loyangalani, with emphasis on approved land use for the area.

### **3.0 Operational Conditions**

- 3.1 The proponent shall ensure corporate social responsibility by hiring and utilizing local resources as much as possible.
- 3.2 The proponent shall ensure that adequate and appropriate emergency response plans are designed and implemented during the survey.
- 3.3 The proponent shall ensure that all waste water is disposed as per the standards set out in the Environmental Management and Coordination (Water Quality) Regulations of 2006.
- 3.4 The proponent shall ensure that appropriate and functional efficient air pollution control mechanisms are installed in the facility to control all air emissions.
- 3.5 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.
- 3.6 The proponent shall ensure that all solid waste is handled in accordance with the Environmental Management and Coordination (Waste Management) Regulations of 2006.
- 3.7 The proponent shall ensure that all workers are well protected and trained as per the Occupational Safety and Health Act (OSHA) of 2007.
- 3.8 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 Councils of Marsabit and Loyangalani, Ministry of Energy, Energy Regulatory Commission, Mines and Geology Department, Ministry of State for Development of Northern Kenya and Other Arid Lands, Kenya Wildlife Service, Water Resources Management Authority and relevant Local Authorities.
- 3.9 The proponent shall ensure that environmental protection facilities or measures to prevent pollution and ecological deterioration such as re-vegetation, proper waste mechanisms are designed, constructed and employed simultaneously with the proposed project.

### **4.0 Notification Conditions**

- 4.1 The proponent shall seek written approval from the Authority for any operational changes under this license.
- 4.2 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.
- 4.3 The proponent shall keep records of all pollution incidences and notify the Authority within 24 hours.

A handwritten signature in black ink, consisting of a large, stylized initial 'A' followed by a series of loops and a horizontal line across the top.

4.4 The proponent shall notify the Authority in writing of its intent to decommission the facility **one (1) month** in advance.

**5.0 Decommissioning Conditions**

5.1 The proponent shall ensure that a decommissioning plan is submitted to the Authority for approval at least one (1) month 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.